Connections between Pre-Service Teachers' Professional Noticing and Perceptions of Race and/or Gender

Professional noticing of children's mathematical thinking (PN), as a conceptualization of responsive teaching practice, is the subject of much focus within the mathematics education research community (Sherin, Jacobs, & Philipp, 2011; Schack, Fisher, & Wilhelm, 2017; Thomas, et al., 2017). Within this burgeoning area of scholarship, there is an emerging focus on PN as it relates to equity issues in the teaching and learning of mathematics (Hand, 2012; Thomas, et al., 2017; van Es, Hand, & Mercado, 2017). Louie (2018), for example, examined teacher noticing intended to "manage dominant ideologies that position students – especially students from non-dominant communities – as mathematically deficient rather than as sense makers. . ." (p. 55). This study builds upon this growing literature base to examine emergence of bias within preservice teachers' enactment of PN. While considerable research has been conducted on teachers' (inservice and preservice) noticing of children's mathematical thinking (Sherin et al., 2011; Schack, Fisher, & Wilhelm, 2017), there is only an emerging understanding of how individual bias filters through and mediates such noticing activity. For this study, we draw upon Jacobs, Lamb, and Philipp's (2010) construction of professional noticing to include the interrelated component skills of attending, interpreting, and deciding, along with Gutiérrez's (2002, 2008) conceptions of equity to include more critical mathematics and asset-based perspectives. Our goal was to examine such biases within the component skills of PN and the extent to which they may be influenced by perceptions of race and gender. The research question was: *How and to what extent does bias emerge within pre-service teachers professional noticing of children of differing perceived races and genders?*

Conceptual Framework

Professional Noticing

While there have been varying depictions of PN regarding its nature and focus (Sherin, Jacobs, & Philipp, 2011; Thomas, et al., 2017), there is considerable consensus around perspectives that describe the practice as an assemblage of interrelated component skills. Sherin et al. (2011) characterized such noticing as consisting of two processes, "attending to particular events in an instructional setting [and] making sense of events in an instructional setting" (p. 5). Jacobs et al. (2010) conceived of PN as comprised of similar, related components referred to in their work as attending and interpreting; however, they also posited the presence of a third component, deciding. It is this three-component perspective in which we frame this study. *Attending* involves observing verbal and nonverbal cues that a student displays as they are using (or describing) the strategies they have used to solve mathematical problems. *Interpreting* refers to the leveraging of information (gained while attending) to make some determination regarding the student's mathematical understanding. *Deciding* refers to the pedagogical thought and activity that stems from one's interpretation. While primarily focused on children's mathematical thinking, we note that PN is inescapably a human endeavor. Thus, "teachers see the classroom through different lenses depending on their experiences, educational philosophies, cultural backgrounds . . .these experiences and lenses affect the teacher's noticing" (Jacobs et al., p. 171). As such, PN is presumably burdened with biases of the practitioner, and inquiries into the emergence of such biases are warranted.

Like most skills in any profession, professional noticing requires professional learning and practice. Jacobs et al. (2010) evaluated the professional noticing skills of in-service teachers (ISTs) in K-3; whereas the team of Schack et al. (2013) focused on the skills of pre-service elementary teachers (PSETs). Jacobs et al.'s (2010) approach to teaching the skills of professional noticing centered around sustained professional development for ISTs. Schack et al. (2013) designed the Noticing Numeracy Now (N3) curriculum aimed at teaching pre-service elementary teachers the skills of professional noticing. These studies concluded that the professional noticing skills of both ISTs and PSETs can be improved through learning and practice.

Jacobs et al.'s (2010) model of professional development categorizes ISTs by their level of previous experience with the concept of PN. The categories were: (1) Initial participants who were current teachers that had not engaged in any prior professional noticing learning and practice, (2) advanced participants who were current teachers with at least two years of experience using the professional noticing model, and (3) emerging teacher leaders who were current teachers with four or more years of professional noticing development and were engaged in leadership activities to help their peers develop their skill set. The study by Jacobs et al. (2010) revealed an apparent link between teaching experience and increased level of expertise in the skills of attending and interpreting; however, it found that sustained professional development appeared to be the key factor for increased expertise in the skill of deciding. Further, in their examination of inservice teachers' conceptualizations and purported enactment of PN, Thomas et al. (2020) found that teachers in different contexts (i.e. special education, regular education, mathematics intervention) differed in their understanding of professional noticing and its aims as a practice.

Schack et al.'s (2013) Noticing Numeracy Now (N3) curriculum model was, in part, motivated by the findings of Grossman et al. (2009) where teacher preparation courses were more focused and centered around lesson and unit planning activities rather than on the "interactive or reflective aspects of in the moment teaching" (Schack et al., 2013, p. 381). The

N3 model followed the "pedagogies of practice framework" (Grossman et al., 2009) which involve the use of videos (representations of practice) which facilitate the practice of professional noticing to reflect on instruction (decomposition of practice) and then role playing "what if situations" (approximations of practice). Schack et al.'s (2013) findings concluded that professional noticing skills are teachable to PSETs and that pedagogies of practice are a viable option for developing those skills and that study has served as a model for subsequent study of PN. For example, Fisher et al. (2019) relied upon this framing and measurement approach in their study on preservice elementary teachers' noticing in the context of children's early algebraic reasoning.

Noticing *Within* and *Among* Instances of Student Mathematical Thinking

Stockero, Leatham, Van Zoest, and Peterson (2017) introduced the concept of noticing within and among instances of student mathematical thinking. Noticing within an instance is when a teacher is "asked to analyze specific instances of students' mathematical thinking based on what they are presented" (Stockero et al., 2017, p. 469). Noticing within occurs when a teacher is asked to focus on specific characteristics of one student's mathematical understanding. Questions such as "what strategy did student A use to solve the problem?" or "what does this say about student A's level of mathematical understanding?" are characteristic of noticing within an instance of student mathematical thinking. Noticing among instances is more generalized and offers the teacher the opportunity to choose which instance on which to focus their attention. Questions are more general such as, "what did you notice?" rather than asking the teacher to focus in on one specific instance. Stockero et al. (2017) further state that neither method is better or worse than the other and that both can be employed in the classroom.

Equity and Deficit Perspectives

Equity is the process of creating fairness in a classroom, which is different from equality (Gutiérrez, 2002). Most dictionaries define equity as creating a fair situation, while equality is sameness for all. An environment that creates sameness for all assumes that if students are given standardized resources, teachers, curriculum, and setting, then all students are able to excel to high levels and all have the potential to achieve the same level of success. According to Gutiérrez (2002), there are two main issues with teaching for equality. Teaching and learning, as a practical matter, occur in contexts where resources, social identities, biases, and other pieces of the context affect learning in unpredictable ways. Secondly, requiring all students to reach for the same goal may not lead them to their desired field or future.

Aligning with the first issue of teaching for equality rather than equity, the expectations and perspectives that teachers have formed about teaching and the impact it has on their students allow them to understand all of the factors that contribute to successes and setbacks in their classroom (Erickson, 2011). Not only do the expectations and perspectives teachers have impact how they view their classroom as a whole, but overall these things impact how they specifically attend and interpret in PN situations (van Es et al., 2017). Being conscious of these expectations and perspectives, and specifically how they impact noticing is vitally important for teachers with respect to instruction within diverse classrooms. Culture permeates every aspect of life by its very definition; thus, it has some impact on how students think about mathematics. In our work, we view culture as dynamic experiences, knowledges, and beliefs that are constantly being negotiated by individuals rather than a set of static characteristics associated with a group (DiME, 2007; Ladson-Billings, 2014).

Dominant mathematics is defined as standardized mathematics (Gutiérrez, 2002), the type of math that appears on standardized testing. Critical mathematics first looks at a student's culture and identity, and then builds upon their unique experience to allow them to be successful (Gutiérrez, 2002). Dominant math aligns with society and encourages assimilation, which might negatively impact students whose culture and thinking does not align with what is typical in the society around them, while critical mathematics challenges societal norms and encourages individual growth with intentions of improving society as a whole. This is vital to recognize for equity, because in order for teaching to be considered fair, students from non-dominant cultures should be encouraged to use the creative aspects of their culture to think critically in mathematics. Similar to this idea proposed by Gutiérrez, projects like Funds of Knowledge (Civil, 2007; Moll, Amanti, Neff, & Gonzalez, 1999) and Cognitively Guided Instruction (Carpenter, Fennema, Leof, Franke, Levi, & Empson, 1999) propose teaching structures that allow all students to participate in learning mathematics and use their unique skill sets. Ultimately, culture can be viewed as a positive and powerful learning tool in the classroom, but it can also be viewed negatively. Culture can be misused in a negative way when teachers misinterpret a student's mathematical ability based upon the student's ethnicity, race, class, sex, beliefs and creeds, and/or their ability to speak the dominant language of the class (Gutiérrez, 2002). Similarly, equity may be compromised when dominant mathematics is perceived by students as the only Discourse of value. In this instance, Discourse refers to classroom actions and interactions via the language, tools, and technologies (Gee, 2002).

Consequently, such distinctions tend to draw focus upon achievement gaps; moreover, achievement gap research tends to focus on gaps between particular groups (Gutiérrez, 2008). By focusing on a gap that develops between students based on their societal identities there is the temptation to develop a deficit-based view of particular students. For example, much of the conversation on achievement gaps hold middle-class White students as the standard and norm for which other groups must reach. This perception then creates a rhetoric around closing achievement gaps where Black and Latino students have deficiencies and often blames the students rather than examining larger systematic issues.

Deficit-based perspective "holds that poor schooling performance is rooted in students' alleged cognitive and motivational deficit." (Valencia, 1997, p. 9). Deficit thinking attributes no blame to the institution but sees failure as the students' fault. Additionally, deficit thinking does not attribute failure to a lack of effort, but rather attributes failure based upon students' physical or cognitive qualities. Deficit-based perspective aligns with the focus on achievement gaps, which in turn encourages teachers to focus on what students are missing or not able to do rather than what they are able to accomplish (Gutiérrez, 2008). In contrast, an asset-based perspective is defined to be that which focuses on students' strengths and potential. According to Missingham (2013), an asset-based perspective focuses primarily upon what students know and are able to do, while also acknowledges that students may not be experts in their field and may need support to reach their fullest potential. By taking an asset-based perspective, students are taught in a way that prepares them to reach their greatest potential. In contrast, a negative consequence of deficit-based thinking is that often, it creates "negative narratives about students of color and working-class students." (Gutiérrez, 2008, p. 359) simply because they are not of the dominant culture. Thus, teachers' perceptions of students' cultures and whether those perceptions are asset-based or deficit-based is critically important to the practice of PN.

Intersection of Professional Noticing and Equity

Given that concern for equity must be inextricable from mathematics education (Confrey, 2010), there is emerging interest in connecting and studying aspects of equity in conjunction with PN (Schack, Fisher, & Wilhelm, 2017). For example, both Kalinec-Craig (2017) and Hand

(2012) have examined student positioning (and, by extension, power) in the context of PN. Specifically, Hand's construction of *taking up space* does not simply "comprise [students] participation in classroom mathematical practices, but rather is about being able to contribute to the classroom community that is aligned with who one sees herself as becoming" and the extent to which teachers' in-the-moment decision-making enlarge or constrain such contributions through manifestations of culturally dominant ideologies status (p. 237). Such connections are consistent with portrayals of PN as contested and political space (Lefstein & Snell, 2011; Louie, 2018). Regarding the pedagogical activity that might productively influence such spaces, van Es et al. (2017) posited a number of practices (i.e., make norms explicit for doing mathematics, support students in developing mathematical identities) and associated foci for PN that they describe as *noticing for equity*. While not all of the teachers in the study noticed the same things or in the same way, "each of these teachers had particular strengths for promoting equity that can be leveraged and used as opportunities for teacher learning" (p. 267). Delving deeper into the interactions of PN and culture, Louie (2018) examined how mathematical proficiency, activity and race influenced one teacher's coding for *smartness.* Note, coding, in this context, refers to the process of transforming observed phenomena into objects of knowledge that provoke discourse (Goodwin, 1994). On the topic of coding and race, Louie writes,

> [The Teacher] was aware that society positioned most of her students as 'bad at math'. She described how this motivated her to prove society wrong . . . but this goal did not make the coding of intelligence, motivation, and merit as White – and the absence of these traits as Black and Brown – simply disappear. Labels like 'lazy' and cultural narratives about people of color who 'feel entitled because they are in poverty' were readily available to [The Teacher] when she perceived problems with her students' work

> habits and skills, and she sometimes reasoned about her work in these terms . . . That is, dominant discourses about race and mathematics coded [The Teacher's] students – Latinx, African American, Filipinx boys and girls, in ways that made it harder to see them as mathematically smart (p.23).

Given the role that cultural narratives play in the manner in which teachers appropriate children's mathematical activity as objects for consideration and reflection, we aim to examine emergence of biases within PN. Indeed, the idea that emphasizing equity concerns within the practice of PN is appropriate and worthy of examination.

Methodology

Survey Design

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 PN measure used by Schack et al. (2013) in their study of PSETs' PN capabilities. Specifically, rather than using a video-recording as the anchor for PN enactment, we substituted a transcription of the video recording (see Figure 1). We note that this survey does not encapsulate the essence of PN in situ, but rather serves as an approximation of practice (Grossman et al., 2009) which allow "novices to engage in practices that are more or less proximal to the practices of the profession" (p. 2058). As such, researchers seeking to measure PN have approximated the practice via videos, vignettes, and other artifacts (Schack, Fisher, & Wilhelm, 2017; Sherin, Jacobs, & Philipp, 2011).

<Figure 1>

Similar to Schack et al. (2013), PSTs were asked to respond to three prompts– each aligned with a particular component skill of PN.

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*).
3. Pretend that you are [Student Name]'s teacher. What problems or questions might you pose next? Provide a rationale for your answer (*deciding*).

Additionally, PSTs were prompted to provide some basic demographic data (i.e., gender, race, age, home-state) as well as their familiarity with PN.

The affordance of using a transcript rather than a video recording was that it allowed us to easily modify the perceived gender and race of the student in question. As such, we generated transcripts featuring the names of four different students with the aim of each student eliciting different perceptions of gender and/or race. The transcript case names were *Margaret* (perceived white female) (See Figure 1)*, William* (perceived white male)*, Shaquan* (perceived African-American male)*,* and *Miguel* (perceived Latino male). We acknowledge that this study assumes that participants perceived the intended race solely based on names, which has limitations. *Note, these transcripts and subsequent prompts were identical to that in Figure 1 except for the name of the student.* The survey was designed to randomly select and display one case for each PSET completing the survey while also ensuring that the cases were (relatively) equally apportioned across the four possible cases. 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.

We note the fundamental limitation of reliance upon respondent perceptions of names (e.g., Margaret=white female; Shaquan=African American male, etc.). However, Gaddis (2017) found that, for many names (but not all), respondents' perception of individual race matched typical birth-name assignations by race. For example, Margaret (presented with no last name) is typically perceived as white and children named Margaret are typically (>50%) born to white mothers. As such, "the research base clearly shows that race can be signaled through names and that using names as a signal of race can successfully capture some version of racial discrimination" (Gaddis, p. 470). Gaddis is careful to note, though, that perception strength varies somewhat across a range of names. Nevertheless, there is a significant literature base which suggests that individual names may trigger unconscious biases in professional decision-making processes (see Bertrand & Mullainathan, 2004; Hanson, Hawley & Martin, 2016 for examples).

Participants

The electronic survey was fielded among PSTs in the United States who were in various stages of their respective teacher education programs at their institutions of higher learning. To increase the probability of PST response rates, we leveraged professional connections to mathematics teacher educators as the mechanism for fielding this survey. We sent the survey (along with some brief recruitment text) to 30 teacher educators across 17 states, and these individuals were asked to forward the instrument to PSTs in their mathematics and/or mathematics methods courses. The survey had 214 total respondents; however, 63 of the respondents only answered demographic questions and then exited the survey without completing the remainder of the questions focused on responding to the transcript. The incomplete surveys were manually discarded during evaluation of the data which left a total of 151 completed responses. Among the 151 participants, the largest gender/ethnic demographic was 18-24-year-old white females. While we are unable to argue that our sample is representative of PSTs in the United States, we do note that this demographic composition is quite typical, broadly speaking, of PSTs in this geographic area (Loewus, 2017).

Analysis of PN Skills

Each response was scored for quality of responses using the same flow-process tool (AMSE, 1947) developed for the PN study upon which this inquiry is based (Schack et al., 2013; Schack et al., 2015). The flow-process tool featured a series of yes/no choice-points for raters regarding the perceived quality of the three components of PN. In order to ensure there was no bias within the raters regarding the child's perceived race or gender, data were blinded and combined into one list per component. Each component (attending, interpreting, deciding) were scored with individual scoring tools by two raters. Based on the previous studies (Schack et al., 2013; Schack et al., 2015), benchmarks were established for the ranked responses for each component resulting in four ranks for attending (Score 1-4), three ranks for interpreting (Score 1-3), and three ranks for deciding (Score 1-3). The attending component warranted an additional rank as the researchers agreed that there were mathematical actions beyond the key components of the mathematical activity that merited an additional rank. After scoring, the raters combined data and negotiated any discrepancies in scoring. This resulted in interrater reliability above 70% for each pair of raters. See table 1 for examples of each rank within the components of PN.

<Table 1>

Analysis of Asset/Deficit in PN

The participant responses to the three questions were evaluated using a different flow-process tool (AMSE, 1947). Rather than score for the quality of the response as in the previous study, the scoring tool for this part of the study scored the presence or absence of asset-oriented or deficit-oriented language describing the child. Each response was ultimately ascribed one of four different codes – asset, deficit, both [asset and deficit], and neutral. Note, neutral responses contained no asset/deficit-oriented descriptions of the child. Two raters used the flow process tool to calibrate with sample data, from a previous data set, until a 95% interrater reliability was achieved. The data from the current study were blinded and scored independently by the two raters. Per previous studies of PN, rating discrepancies were resolved via discussion (Jacobs et al., 2010; Krupa, Huey, Lessieg, Casey, & Monson, 2017). See Table 2 for examples of each response type with the asset and deficits noted in bold.

<Table 2>

Findings

Quality of PN Responses Analyzed by Perceived Races and Genders

Scores were compared by case (i.e., Margaret, Shaquan, William, Miguel) and component skill (i.e., attending, interpreting, deciding). Descriptive statistics of each are provided in Table 3. In the component of attending, the largest discrepancy was between Shaquan ($m = 2.13$) and William ($m = 1.92$). For interpreting, the results were similar as the largest discrepancy was again between Shaquan ($m = 1.37$) and William ($m = 1.47$), however the roles were reversed as William had the highest interpreting score. The final component, deciding, resulted in Miguel and William with the lowest averages ($m = 1.47$) and Shaquan with the highest average ($m = 1.75$). When the sum of the three components were compared, William remained the lowest ($m = 4.86$) and Shaquan the highest ($m = 5.25$).

<Table 3>

In order to determine if statistically significant differences occurred when comparing the different cases in each component, Wilcoxon signed ranks tests were used to analyze the scores. Although William and Shaquan received the highest and lowest scores in each component, none of the comparisons were statistically significant. See Table 4 for the results of those tests.

<Table 4>

Asset and Deficit among PN Components Analyzed by Perceived Races and Genders

We examined frequencies per component skill (i.e., attending, interpreting, deciding) rather than by case (i.e., Margaret, Shaquan, William, Miguel) to make some determination regarding the overall presence or absence of bias within participants' enactment of PN. See Table 5 for the percentage of each response type per PN component skill.

<Table 5>

Interestingly, we note that participants provided attending and deciding responses that were predominately neutral in nature while participants' interpreting responses were much more varied with respect to biased descriptions of the child's mathematics in a given case. We conducted a chi-square test of the attending ($\chi^2(3)=307.68$, $p<.001$), interpreting ($\chi^2(3)=14.54$, $p=.002$), and deciding ($\chi^2(3)=391.49$, $p<.001$) components and determined that each distribution of rating categories was statistically significant. Given this outsized emergence of bias (i.e., non-neutral responses) within the interpreting component of PN, we disaggregated these responses per case (see Table 6).

<Table 6>

Examining participants' responses across perceived race reveals a relatively balanced expression of bias among asset, deficit, and both response types. While participants were slightly more likely to offer an asset-laden response to describe Shaquan's mathematical thinking and a deficit-laden response to describe William's mathematical thinking, we did not detect a disproportionate amount of a particular rating type. We note that, for all four cases, fewer participants offered neutral responses when interpreting the child's mathematical thinking. Much more often, participants interjected some form of bias into their interpretations.

Discussion and Conclusion

The purpose of this study was to examine potential bias by PSTs within the component skills of PN and across perceived gender and race of children. With respect to the PSTs' PN performance, we found no significant difference in such performance across differing perceived gender and ethnicities which is in contrast to previous research in which ethnicity and gender were found to differ (Gutiérrez, 2008; Gutiérrez, 2002). Ideally, we would not want to see a difference in performance since the dialogue in each case was identical and the only difference was the perceived ethnicity and gender of the child in the scenario; however, there are still implications to be discussed from those findings. Recall that the selected instrument privileges detail and specificity with respect to the component processes of PN. For example, one's attending score elevates with the offering of additional salient (and accurate) details regarding the child's mathematical activity. Thus, it is conceivable that PSTs may subconsciously exhibit different levels of investment in their attending in connection with the perceived race or gender of the child. That we observed no such differences suggest that PN, as a practice, may mediate implicit bias in some manner. The original development of PN was a focus on *children's mathematical thinking* (Jacobs et al., 2010), thus perhaps the PSTs are holding to the focus on mathematical thinking instead of the child's name meaning the PN process is mitigating the chances for bias. That is, focusing solely upon aspects of the students' mathematical thinking and how this thinking would influence one's instructional decision-making may counteract biases which manifest in other professional contexts dependent upon name-centric inferences such as resume screening/hiring and apartment rental decisions (Bertrand & Mullainathan, 2004; Hanson et al., 2016). For example, "African American sounding names (such as Lakisha Washington or Jamal Jones)" prompted 50% fewer employer callbacks than "white sounding names (such as Emily Walsh or Greg Baker) when randomly assigned to fictitious resumes" (Bertrand & Mullainathan, 2004, p.992). From this, one might expect that varying the student names in the professional noticing cases might result in more pronounced manifestations of bias than what we observed in this study.

From the extant literature, one would anticipate elevated levels of deficit-oriented responses for Shaquan and elevated levels of asset-oriented responses for William within the interpreting component. In fact, though, the portion of asset-oriented responses (from the total response set) for Shaquan is 10% greater than that of William's (41% asset-Shaquan vs. 31% asset-William). One possible explanation for this may relate to the notion of *bias inversion* (Thomas et al., 2020) where survey participants lower expectations for Shaquan while elevate expectations for William thus resulting in counterintuitive manifestations of asset/deficit-oriented responses.

Conversely, it is also plausible that PN does not mediate implicit bias, rather the varied student names embedded in the cases (i.e., Shaquan, Miguel, William, Margaret) simply did not meet some necessary threshold for the manifestation of implicit bias with respect to proximal measurement of PN. This could mean that it is possible that our instrumentation was not precise enough to detect any manifestations of bias. In a similar study, Thomas et al. (in press) not only used the varied student names, but they also added photos of children of the perceived race and gender of each name. The results of that study revealed that by adding the photo, the implicit bias was significant in some of the areas of PN across some cases. For example, the greatest difference was between the deciding scores of Shaquan and William and also between the deciding scores of William and Margaret. This may indicate that the aforementioned threshold could be a visual representation of gender and ethnicity; however, we still argue that additional work in this area would generate further understanding of the relationships between bias and the quality of PN performance.

Turning to expressions of asset and deficit perspectives embedded within PN enactment, we found that the attending and deciding components of PN are predominately neutral in nature while the interpreting component was predominately non-neutral (see Table 5). This is somewhat intuitive as the interpreting component skill represents the cognitive space where individuals *reason with and reshape* their observations (gained during the attending component) according to their knowledge (Thomas, et al., 2017), attitudes and beliefs (Fisher et al., 2014), and culture/race/ethnicity (Kalinec-Craig, 2017). Within the interpreting component, across perceived race and gender (see Table 6), the percentages indicate a more asset-based approach for Shaquan and a seemingly more deficit-based approach for William. However, it is only a slight difference indicating a relative balance of such bias with respect to asset, deficit, and interpretations that feature both asset and deficit perspectives. This slight difference could be attributed to the difference of the names of the children in the scenarios or the varied PN skills of the PSETs participating in the study. This relative balance runs counter to existing findings regarding such bias driven by gender and/or ethnicity/race of students (Gutiérrez, 2008). Thus, it is plausible that PN, as a practice, serves as a mitigating pedagogical space with respect to gendered or ethnically-driven manifestations of bias. A deeper question with respect to PN, is when and how bias should manifest within productive practice.

Limitations of this study include the lack of diversity among the PSTs participating and the variance of PN knowledge and background of those PSTs, but there is much ground still to cover. This lack of diversity does not allow deeper investigations among gender, race, and college year of the participants, therefore, the focus of this study remained PSTs as a group. While a preponderance of deficit-laden interpretations is arguably counterproductive, what might we make of interpretations that are solely asset-oriented? Would asset-driven interpretations be more likely to capitalize upon students' prior knowledge? Missingham (2013) argues that an asset-based perspective prepares children to reach their greatest potential but might an interpretation that features both asset and deficit perspectives be the most grounded and actionable interpretation? How might manifestations of bias relate to overall performance of PN? These and similar questions will guide our path as we delve more deeply into our data.

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PROBLEM CONTEXT A Teacher and a 1st grade (6-year-old) female student named Margaret are working together on a math problem involving seashells and small, plastic counting-bears. The teacher is posing problem situations where each bear wishes to 'hold' one seashell. Below is the scripted exchange around one problem situation.	
Teacher	"How about this one, so now I've got seven . . .you've got seven little bears, right? But now I have too many shells. I have eleven shells." The teacher shows the eleven shells then covers them with his hand. "How many shells am I going to have left over?"
Margaret	Margaret briefly holds up seven fingers and glances at them. "You've got eleven?" Margaret puts her fingers down and counts each of the seven bears, beginning at one, by touching each bear and whispering a counting sequence. "one, two, three, four, five, six, seven." While keeping her finger on the seventh bear, Margaret raises four fingers on her other hand while whispering, "eight, nine, ten, eleven". Margaret glances at her hand and says, "Four! There is gonna be four shells left over."
Teacher	"Interesting, Margaret . . . I was watching you work on that, but I am curious why it has to be four. Can you tell me more about your thinking?"
Margaret	Looks at her hand with four fingers raised. "Well, it's gonna be four because that's how many is left over. I don't know how else to say it."

Figure 1. Case 1-Margaret Transcription

Table 1. Example scores for quality of PN components

Rank	Attending	Interpreting	Deciding
1	[He/She] counted up to how many shells there were after she ran out of bears.	[He/She] understands how to solve a problem but [he/she] cannot explain his reasoning behind his method.	I would ask if there was another way [he/she] could solve it, hoping [he/she] would start with the 11 and then count down by 7 from there.
2	[He/She] used [his/her] fingers. After [he/she] realized he didn't have enough fingers he found another way.	[He/She] understands that you match the quantities one-to-one, and then the leftover of the bigger number is the remainder.	Can you draw it out? I would ask this to make sure that [he/she] is getting the one-to-one idea.
3	[He/She] counted up. Once [he/she] had counted all of the bears, [he/she] began using his fingers to represent the shells that were left over.	[He/She] begins [his/her] counting from one and requires physical objects to represent each number. This tells me that [he/she] likely doesn't yet have the skills to visualize the problem in [his/her] head.	I would possibly pose a question where [he/she] cannot start with the beginning number like 7 on her fingers. This would show if [he/she] is still able to add on.
4	[He/She] understood there were seven bears and eleven seashells. [He/She] listened to the question. When [he/she] went to solve, [he/she] counted each bear then used her fingers to stand in for the missing bears. When [he/she] looked at her fingers, [he/she] saw there were four left so [he/she] understood there would be four sea shells without bears.		

Table 2. Example responses for asset/deficit in PN components

	Attending	Interpreting	Deciding
Asset	The **student understood** there were seven bears and eleven shells **they listened to the question**. When they went to solve, they counted each bear then used her fingers to stand in for the missing bears. When they looked at her fingers, they saw there were four left so they understood there would be four shells without bears.	The **student understands** the one to one ratio, as well as counting on.	I would give the student a problem involving either multiplication or division, **assuming that [the student] already mastered** addition word problems. This is the next step in learning math after addition and subtraction. [The student] also will not use redundant counting and will be forced to try other strategies to solve the problem.
Deficit	[The student] worked it out **but did not know** how to explain it.	**She doesn't know** how to subtract in her head yet. When students first learn addition and subtraction, they usually will use their fingers or objects to visually see the problem.	If I were the student's teacher I was [sic] pose the problem that **he doesn't know how to complete addition or subtraction without using his fingers.** Also, I would add onto his basic mathematic skills by having him add/subtract higher numbers.
Both [asset & deficit]	**The student could not complete the problem** from a conceptual understanding. [The student] had to use fingers and turn to simple counting. **I believe that the student understood the problem**, but [the student] **is not fluent in doing addition and subtraction in his head**. Thus, causing [the student] to use physical means to map out addition and subtraction."	**[The student] understands** counting **but not counting up** from a specific number. [The student] has to count all numbers.	I would ask [the student] another question like this but with different numbers, and ask [the student] to explain [her/his] thinking aloud and talk about each step they takes to solve the problem. This way, I can follow [her/his] mindset as they goes [sic] through the problem. **The student is able to answer** the question correctly **but can't explain how** they did it so going through the next alike problem with [the student] will help me to understand how they solves [sic] it and help explain [the student's] thinking in words back to her.
Neutral	[The student] counted all of his bears accounting for the seven, and then counted up to 11 to find	[The student] saw the problem as not subtracting 7 from 11	I may ask [the student] harder problems to find or I may ask [the student] to go into further detail.

	out how many shells would be left without a bear to hold them.	but adding 4 to 7 to get 11.

Table 3. Descriptive Statistics by Case and Component

		Margaret		Miguel		Shaquan		William	
	Range	m	SD	m	SD	m	SD	m	SD
Attending	1-4	2.05	1.06	2.04	0.98	2.13	1.04	1.92	0.84
Interpreting	1-3	1.39	0.68	1.40	0.72	1.37	0.66	1.47	0.81
Deciding	1-3	1.68	0.70	1.47	0.59	1.75	0.76	1.47	0.56
Total	3-10	5.13	1.53	4.91	1.47	5.25	1.98	4.86	1.33

Table 4. Wilcoxon Signed Ranks Test by Case and Component

		Miguel	Shaquan	William
Margaret	Attending	$Z = -.069$ $p = .945$	$Z = -.296$ $p = .767$	$Z = -.695$ $p = .487$
	Interpreting	$Z = -.147$ $p = .883$	$Z = -.134$ $p = .894$	$Z = -.480$ $p = .631$
	Deciding	$Z = -.1.189$ $p = .058$	$Z = -.390$ $p = .696$	$Z = -1.338$ $p = .181$
	Sum	$Z = -1.016$ $p = .310$	$Z = -.354$ $p = .724$	$Z = -.868$ $p = .385$
Miguel	Attending		$Z = -.413$ $p = .679$	$Z = -.527$ $p = .598$
	Interpreting		$Z = -.162$ $p = .871$	$Z = -.484$ $p = .628$
	Deciding		$Z = -1.801$ $p = .072$	$Z = -.426$ $p = .670$
	Sum		$Z = -.823$ $p = .411$	$Z = -.031$ $p = .975$
Shaquan	Attending			$Z = -1.389$ $p = .165$
	Interpreting			$Z = -.397$ $p = .691$
	Deciding			$Z = -1.568$ $p = .117$
	Sum			$Z = -1.293$ $p = .196$

Table 5. Expressions of Bias within PN per Component Skill (n=151)

Category	Attending	Interpreting	Deciding
Asset	6%	31%	1%
Deficit	5%	27%	3%
Both	2%	30%	1%
Neutral	87%	12%	95%

Table 6. Expression of Bias within Interpreting Component Skill per Case

	Margaret perceived White Female n=38	Shaquan perceived African-American Male n=32	Miguel perceived Latino Male n=45	William perceived White Male n=36
Asset	26%	41%	29%	31%
Deficit	24%	19%	24%	39%
Both	39%	31%	29%	22%
Neutral	11%	9%	18%	8%