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Examining Relations Between Parental Feedback Types and Preschool-Aged Children's Academic Skills

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Abstract

Prior research has shown associations between parent and teacher feedback and school-aged children's academic outcomes. Specifically, studies have demonstrated that positive feedback (i.e., praise and/or affirmation) is beneficial for children's academic outcomes, while corrective feedback exhibits more mixed associations with children's academic outcomes. Little is known about the relations between parental feedback and younger children's academic skills. The present study examines the frequency of positive and corrective types of feedback provided by parents of 4-year-old children during semi-structured interactions, as well as how these feedback types relate to children's concurrent math and language skills and their change in math skills over a one-year period. Parent-child dyads (n=91) were observed interacting with a picture book, grocery store set, and magnet board puzzle for 5 to 10 minutes each, after which they completed math and language assessments. Parental affirmation was positively and corrective feedback was negatively associated with children's concurrent math outcomes, but only corrective feedback was uniquely negatively associated with children's math outcomes when controlling for affirmations. Parental praise was individually and uniquely positively associated with children's expressive vocabulary and change in math outcomes from age 4 to age 5. This study suggests that the relations between parental feedback and young children's academic outcomes depend on the type of feedback and the outcome of interest (i.e., math vs language), which can inform how parents may want to provide feedback to facilitate learning.

Keywords: affirmation, corrective feedback, praise, early math abilities, parent-child interactions, preschool-aged children

1. Introduction

Children enter kindergarten with substantial individual differences in their knowledge of fundamental math concepts, which impact their ability to learn more advanced material, succeed academically, and later excel in the workforce (Duncan et al., 2007). One factor explaining differences in children's math skills is the verbal input children receive from their parents in the home environment. Prior work has shown that parental feedback is related to children's future academic performance (Buriel, 1983; Gunderson, Sorhagen et al., 2018; Kamins & Dweck, 1999; Reigel, 2008). However, this work focused primarily on school-aged children. Thus, it is important to examine how the feedback parents provide in the home environment may impact younger children's foundational academic skills prior to formal schooling. This knowledge can help guide the development of interventions aimed at enhancing early learning in the home environment, particularly in STEM domains, which lays the foundation for subsequent growth and development so the next generation can positively contribute to their chosen fields and society.

1.1 Role of Positive Feedback on Child Outcomes

One form of parental input that has been shown to influence children's academic performance is praise (Gunderson et al., 2013). As noted by Henderlong and Lepper (2002), praise is positively associated with various

outcomes for school-aged children, including self-perceptions of ability, interest in and motivation for completing the praised task, and the development of academic skills. Potential mediating variables for these relations include self-efficacy, perceived competence and autonomy, and positive self-perceptions. Bąk and Leśniak (2020) found that praise following failure resulted in increased self-perceptions of intelligence and affect for high school students.

Beneficial effects of praise have also been observed for younger children. Overall, parental praise was found to positively predict the learning goals of children in first through eighth grade (Gunderson, Donnellan et al., 2018). In particular, many positive effects have been demonstrated for process praise, a type of praise that commends the child's effort or strategies in one specific episode. This includes children adopting a learning goal orientation, focusing on mastering new material to improve their skills, seeking challenges, and exhibiting enhanced achievement motivation, persistence, positive affect, and performance in the face of difficulty (Dweck & Leggett, 1988; Nicholls, 1984). Gunderson, Sorhagen, and colleagues (2018) demonstrated that parental process praise bestowed upon children at 1 to 3 years in the home environment positively predicted their math and reading achievement at 9 to 10 years, with children's growth mindsets at 7 to 8 years as a mediator. The relations remained significant when overall parent talk, SES, child gender, and academic achievement at 7 to 8 years were controlled for, which suggests that parental process praise results in the improvement of children's academic abilities over time.

In contrast, a type of praise that commends the child's abilities based on their performance known as person praise has repeatedly been shown to have many negative effects, particularly for children with low self-esteem (Brummelman et al., 2016). After receiving person praise, children may interpret their performance as indicative of ability and develop ability attributions for successes and failures, increasing their vulnerability to a helpless response to failure and performance goal orientation (Diener & Dweck, 1978; Elliott & Dweck, 1988; Kamins & Dweck, 1999). Pomerantz and Kempner (2013) found that academically relevant parental person praise in response to 10-year-old children's academic success predicted children's fixed mindsets. However, Gunderson and colleagues (2013) did not find a significant relation between parental person praise bestowed in non-academic contexts and 7- to 8-year-old children's adoption of a fixed mindset, which suggests that person praise may be more salient and impactful at a later age and/or in more academically relevant settings.

Children have demonstrated susceptibility to the implications of person praise versus process praise as early as kindergarten. Children ages five to six who received consistent process praise exhibited greater self-assessments, persistence, motivation, and positive affect following failure compared to those who received consistent person praise, which are all characteristic of a growth mindset (Kamins & Dweck, 1999). Cimpian and colleagues (2007) showed that the difference in connotation between the two praise types can even impact achievement motivation and response to failure in preschoolers. Despite a significant body of research on parental praise, research has yet to examine how parental praise in the home impacts young children's academic outcomes prior to formal schooling. Therefore, this was examined in the current study.

In addition to praise, past work has shown that other more generalized forms of positive parental feedback such as affirmations are linked with children's academic achievement. Unlike praise, which conveys positive affect and emphasizes the child's behavior or abilities, affirmation (e.g., "that's correct" or "yeah") conveys the correctness or comprehension of the child's response (Reigel, 2008). Prior research showed that teacher affirmation following correct responses was significantly related to standardized test scores of fourth- and fifth-grade minority students (Buriel, 1983). However, teacher affirmation may be contingent upon student academic achievement since high achievers received more affirmation. A study with ESL students found similar results: increased teacher positive feedback, including affirmation and praise, was associated with improved performance on informal classroom assessments, posttest performance, and motivation to pursue a higher level of learning (Reigel, 2008). Similarly, Morris and Zentall (2014) demonstrated that verbal ambiguous praise, similar to affirmation in this study, bestowed upon kindergarteners was equally or more motivating than verbal process praise. In addition, Buriel and Reigel (1983; 2008) observed a higher frequency of affirmation relative to praise, indicating that affirmation may be a more salient form of reinforcement received by students. These studies suggest that many forms of positive feedback, including praise and affirmation, can impact children's academic outcomes (see also Berner et al., 2022), so it is important to examine how parental affirmation in the home impacts young children's academic skills prior to formal schooling.

Notably, prior research varies on the types of utterances that are considered affirmation. Gunderson and colleagues (2013) defined affirmation as a sub-category of other praise, including utterances that affirm the child's response and occur in a praise context, like "you're right" and "you did it," while excluding more objective utterances that occur in a non-praise context and could be perceived as simple commentary on the

child's response, like "yes" or "you are buttoning it." In contrast, Reigel (2008) defined affirmation as distinct from praise and consisting of more objective utterances like "yeah" and "okay." These varied definitions of affirmation were considered and incorporated when defining affirmation in the current study.

1.2 Role of Corrective Feedback on Child Outcomes

In addition to positive feedback, it has been demonstrated that corrective feedback is associated with children's response to setbacks and thus their future performance (Kamins & Dweck, 1999). On the one hand, some motivation theories argue corrective feedback is more effective for motivating goal pursuit than positive feedback because corrective feedback in response to an individual's lack of success can suggest more effort is needed for goal attainment and thus encourage goal pursuit, while positive feedback can suggest partial goal attainment and result in reduced effort toward goal attainment (Fishbach et al., 2010). Corrective feedback can draw the learner's attention to errors in their performance and prompt modifications to their previous utterances or behaviors, providing a learning opportunity and positively impacting their academic development (McDonough, 2005).

On the other hand, there are also motivation theories that posit positive feedback may be more effective because it increases people's confidence in their ability to pursue goals, resulting in increased expectancy of successful goal attainment, while corrective feedback undermines people's confidence and outcome expectancy (Fishbach et al., 2010). According to cognitive evaluation theory, corrective feedback results in reduced self-evaluations of competence and intrinsic motivation, fostering a fixed mindset (Gunderson, Donnellan et al., 2018). For instance, greater teacher corrective feedback in the academic domain was negatively correlated with fourth- and fifth-grade students' standardized test scores (Buriel, 1983), and greater parental corrective feedback predicted maladaptive perfectionist outcomes in high school students that were associated with a performance-avoidance goal orientation (Madjar et al., 2015). However, research has yet to examine whether parental corrective feedback in the home is positively or negatively associated with young children's academic outcomes prior to formal schooling.

Children develop the ability to utilize corrective feedback between the ages of 5 and 9 years (Schachter, 1991). Despite this development, children between the ages of 4 and 9 years often do not respond to corrective feedback and instead hold on to their original incorrect hypotheses, which could lead to more corrective feedback on the same subject. Nguyen and Lwin (2014) found that 3- and 4-year-old English-speaking Singaporean children did not adjust their behavior after parental corrective feedback 67% of the time during dyadic interactions. These studies suggest that on average children do not acquire the ability to uptake and internalize corrective feedback in a way that leads to a change in their response until formal schooling begins. The present study aimed to examine whether corrective feedback is associated with academic abilities at an earlier age, i.e., prior to formal schooling.

In addition, it is important to examine the relative impact of parental positive feedback and corrective feedback in the home environment on the same children's academic outcomes. For example, Dorrington and van Nieuwerburgh (2015) reported that 10- to 11-year-old English children were more likely to accept and respond positively to corrective feedback when it was preceded by positive feedback, indicating their greater relative receptiveness to positive feedback. Similarly, Berkeljon and Raijmakers (2007) found that for Dutch children as young as 4 years old, corrective feedback had lesser impact on their neural networks, which model discrimination learning processes, compared to the neural networks of adults. This suggests that at the age of 4 years old, children may be able to comprehend and learn from positive feedback but not corrective feedback. In the present study, we compared whether positive and corrective feedback are each uniquely associated with children's math and language skills.

1.3 The Current Study

Prior research has examined how parental praise, affirmation, and/or corrective feedback relate to older children's general academic outcomes. However, research has yet to focus on how parental praise, affirmation, and corrective feedback in the home environment impact children's academic abilities before they enter formal schooling. Unlike many other studies, we used observational methods to measure the frequency of parental feedback that children were exposed to in the home environment and tested children's math and language skills. This study addressed three specific research questions (RQ):

RQ1) What is the frequency of parental praise, affirmation in a non-praise context, and corrective feedback directed at 4-year-old children across three semi-structured observational tasks?

RQ2) How are parental praise, affirmation in a non-praise context, and corrective feedback each individually related to children's math and language skills concurrently and to their change in math performance over a one-year period?

RQ3) Are parental praise, affirmation in a non-praise context, and/or corrective feedback *unique predictors* of children's math and language skills concurrently and/or their change in math performance over a one-year period?

2. Method

2.1 Participants

The data for this study came from the Parents Promoting Early Learning study conducted at the University of Pittsburgh. The overarching goal of this study is to understand how parents help their young children learn and develop through everyday home learning activities. Initially, 128 participants were recruited to take part in this study when children were 4 years old. To be eligible to participate, children had to be fluent in English and typically developing (i.e., without any diagnosis of a developmental or intellectual disorder such as autism or Down syndrome). Dyads were invited for a follow-up about a year later when children were 5 years old. However, 37 participants had missing data when it came to key variables for the current study and were therefore excluded from the study. Thus, the final sample for the current study consisted of 91 four-year-old children (*M* child age at the time of the first wave of data collection=4.41 years, *SD*=0.30 years, 49.45% male, 50.55% female) and one of their primary caregivers (95.45% mothers, 4.55% fathers) from the greater Pittsburgh, Pennsylvania area. The average delay between the first and second wave of data collection was 1.07 years (*SD*=0.12 years). Based on available caregiver self-reports, 84% identified as White Non-Hispanic, 9% identified as Black, 3% identified as Asian, 2% identified as Hispanic/Latino, and the last 2% identified as Other/Multiracial. On average, caregivers were highly educated, with the majority possessing at least a Bachelor's degree (82.23%) and the remainder having obtained a limited college education that was insufficient to earn a degree (6.67%), an Associate's degree (3.33%), a high school diploma (4.44%), or training from a vocational/technical program (3.33%). Parents' average annual reported household income was $109,816.90 (*SD*=$69,921.24, median=$100,000, range=$5,000-$350,000). In compliance with the local Institutional Review Board, all caregivers provided written informed consent to participate prior to engaging in any research-related activities.

2.2 Measures

2.2.1 Semi-Structured Interactions

To obtain an estimate of how much parental feedback each child received, researchers video-recorded parent-child dyads as they engaged in three different semi-structured tasks designed to stimulate a broad range of conversations between the parent and child. We chose this approach over parents' self-report measures of the feedback they bestow upon their children during home activities because self-report measures have been shown to inaccurately represent actual parent feedback (Swenson et al., 2016). Thus, semi-structured tasks that resemble potential day-to-day activities for the dyads were utilized instead. A total of 90 dyads completed these tasks in the home, while one dyad completed the tasks in the lab.

The first task involved sharing a picture book created by the research team that did not contain any text but still provided opportunities for math-related talk about counting, calculation, and spatial relations. The second task involved a magnet board puzzle consisting of magnetized shapes and a picture prompt. The third task involved a grocery store set consisting of a cash register and plastic food items. For all tasks, parents were encouraged to play with their child as they normally would with the respective toy, and for the magnet task parents and children were given additional instruction to use the magnetized shapes to construct a giraffe as depicted in the picture prompt. Dyads spent around 5 to 10 minutes on each task, during which the researchers left the room to facilitate naturalistic play.

2.2.2 Transcription

Videos from the semi-structured observations were transcribed verbatim at the utterance level by trained research assistants using Datavyu, an open-source behavioral coding software (Datavyu Team, 2014). An utterance was defined as a unit of speech separated by grammatical closure, intonation contour, or prolonged pausing at the end of a complete thought or sentence (Gunderson, Sorhagen et al., 2018; Rowe et al., 2004). All transcripts were checked by a second trained research assistant from the lab for reliability. All transcripts were coded for instances of praise, affirmation, and corrective feedback. See below for detailed descriptions and appendix for examples of each parental feedback category.

2.2.3 Coding Scheme for Positive Feedback

Praise referred to any utterance that provided positive feedback or reinforcement in response to the child's verbalizations, actions, and/or product of their actions and contained an explicit or implicit positive valence (Gunderson et al., 2013; Reigel, 2008). Consistent with the coding scheme developed by Gunderson and colleagues (2013), praise was further broken down into three different categories: (1) Person praise consisted of utterances that implied the child possessed a fixed, positive quality. This included utterances that provided a label for the child without the use of a verb (e.g., "good boy") or described the child using a copular verb (e.g., "you're so smart"). (2) Process praise consisted of utterances that emphasized the child's decisions, effort, actions, or strategies with respect to the task (e.g., "good job"). (3) All other praise responses that did not fall into these two categories were considered other praise. This included praise that expressed a general positive valence but lacked explicitness about whether the target of the praise was the child's personal traits or process (e.g., "very good"), praise that emphasized the product or outcome of the child's actions (e.g., "nice puzzle"), and affirmation in a praise context, which was initially coded separately from other praise and was later combined with other praise for data analysis. A script was used to search the checked transcripts for a specified set of words commonly found in praise utterances (good, job, high, five, there, we, go, totally, wow, had, right, here, very, looks, great, nice, cool, give, up, awesome, got, did, own, yourself, perfect, amazing, beautiful, impress, excel, wonderful, ace, like, love, smart, idea, found, girl, boy, correct, yay). Then, each selected utterance was assessed to determine if praise had occurred, since the script often selected utterances that included search terms but were not instances of praise, and if so which category of praise. Each utterance was coded with only one praise category. Also, the checked transcripts were manually searched to see if the script missed any instances of praise.

Affirmation referred to any utterance that confirmed and therefore conveyed the correctness or comprehension of the child's verbalizations, actions, and/or product of their actions (Reigel, 2008). Based on the aforementioned coding scheme by Gunderson and colleagues (2013), affirmation was further broken down into two different categories: (1) Affirmation in a praise context consisted of utterances that affirmed the child's response with an implicit statement of positive valence (e.g., "you got it"), and was therefore considered a sub-category of other praise. (2) Affirmation in a non-praise context consisted of all other affirmation responses that were more objective (e.g., "yeah"). This included exactly repeating the child's verbalizations or describing the child's actions that were in response to a parental prompt or question. A script was used to search the checked transcripts for a specified set of words commonly found in affirmation utterances (yes, yea, okay, right, correct, true). Then, each selected utterance was assessed to determine if affirmation had occurred, since the script often selected utterances that included search terms but were not instances of affirmation such as the parent saying "yes" in response to the child's yes/no question (Reigel, 2008), and if so which category of affirmation. The checked transcripts were also manually searched to see if the script missed any instances of affirmation.

2.2.4 Coding Scheme for Corrective Feedback

Corrective feedback referred to any utterance that conveyed a negative evaluation of the child's incorrect verbalizations, actions, and/or product of their actions and contained an explicit correction or an implicit negative valence (Kamins & Dweck, 1999). Corrective feedback was further broken down into the same three categories as praise: (1) Person corrective feedback consisted of utterances that implied the child possessed a fixed, negative quality. This included utterances that described the child using a copular verb (e.g., "you're not very good at this"). (2) Process corrective feedback consisted of utterances that emphasized the child's decisions (e.g., regarding shape selection or placement in the magnet puzzle task) or the child's effort, actions, or strategies with respect to the task. This included utterances that contained an action verb (e.g., "keep turning"), referred to the child's physical manipulation of objects (e.g., the placement of a shape in the puzzle task), or referred to the child's use of a mental process (e.g., performing arithmetic in the book task). (3) All other corrective feedback responses that did not fall into the other two categories due to lack of explicitness about whether the target of the corrective feedback was the child's personal traits or process but nevertheless prompted the child to think about their mistake and/or how to rectify their mistake were considered other corrective feedback. This included feedback that critiqued the product of a child's action (e.g., "that doesn't look right"), critiqued the child's actions or product of their actions with an implicit statement of negative valence (e.g., "not quite"), or disagreed with the child's verbalizations often by adding "no" or "not" to the child's response. The checked transcripts were manually searched for corrective feedback utterances and each corrective feedback utterance was coded according to which category of corrective feedback had occurred. Each utterance was coded with only one corrective feedback category.

Lastly, 10% of all videos were double-coded and kappa coefficients were calculated to determine the degree of agreement between coders in identifying praise, affirmation, and corrective feedback out of total utterances. Coders were highly reliable in identifying instances of praise (percent agreement [PA]=.99, κ=.94), person praise (κ=.92), process praise (κ=.92), and other praise (including affirmation in a praise context, κ=.93). Also, coders were in high agreement for identifying occurrences of affirmation in a non-praise context (PA=.99, κ=.87). Finally, coders were highly reliable in coding instances of corrective feedback (PA=.99, κ=.89), process corrective feedback (κ=.90), and other corrective feedback (κ=.79). Person corrective feedback did not occur in this sample.

2.2.5 Child Math Assessment

Children's math competency was assessed using the Applied Problems subtest of the Woodcock-Johnson Tests of Achievement III, a standardized math test that evaluates children's ability to analyze and solve math problems (Woodcock et al., 2001). The problems become progressively more difficult, with initial items requiring the application of basic number concepts, such as counting (e.g., "How many ducks are in the pond?"), and later items requiring arithmetic (e.g., "If I took away three crayons, how many crayons would I have left?") and knowledge of units, such as currency, temperature, and time (e.g., "Point to the quarter."). Standardized scores were calculated based on the child's age at the time of assessment. Past work has demonstrated high test-retest reliability for this scale in the norming sample ($r(89)=.93$) and concurrent validity with other math assessments (Woodcock et al., 2001).

This test was utilized for the 4-year-old and 5-year-old waves of data collection. At the 4-year-old time point, the assessment was administered to each child during one in-person testing session in conjunction with other assessments of children's math skills that tap into children's number knowledge. The session took place in a quiet room at the child's home immediately after the observational tasks on the same day or at the child's preschool or daycare on a later day. All assessments were administered in the same order by one of five trained graduate students or full-time research staff. At the 5-year-old time point, the assessment was administered to the same children via Zoom due to the COVID-19 pandemic.

2.2.6 Child Language Assessment

Children's language competency was assessed using the Developmental Vocabulary Assessment for Parents (DVAP), an expressive vocabulary assessment in which parents are asked to report which words they have heard their 2- to 7-year-old children say from a list of 212 words taken from the Peabody Picture Vocabulary Test (PPVT-4) (Dunn & Dunn, 2007; Libertus et al., 2015). The PPVT-4 is a widely used experimenter-administered test of receptive vocabulary that serves as a direct measure of children's language abilities in which the experimenter asks children to point to the image that best corresponds to a spoken word out of an array of images (Dunn & Dunn, 2007). The DVAP was utilized in lieu of a child assessment because the DVAP is highly correlated with the PPVT-4, indicating caregiver reports are a reliable measure of children's vocabulary size in early childhood. Past work has demonstrated the concurrent and predictive validity of this assessment (Libertus et al., 2015). This measure was used for the 4-year-old wave of data collection and was administered to parents as part of an online Qualtrics Parent Questionnaire. This measure was omitted from the 5-year-old wave of data collection due to researcher error.

2.3 Analytic Plan

2.3.1 RQ1: Frequency of Parental Feedback

Descriptive statistics were examined for the three sub-types of parental praise, parental affirmation in a non-praise context, and three sub-types of parental corrective feedback collapsed across the three semi-structured tasks. All three tasks offered parents the opportunity to provide their children with verbal feedback, so collapsing across tasks allowed for a more comprehensive and representative measure of parent-child interactions in the home learning environment.

2.3.2 RQ2: Relations between Each Type of Parental Feedback and Child Outcomes

Separate linear regression models were utilized to examine the relations between each type of parental feedback and children's concurrent math and language performance, as well as their longitudinal change in math performance. To determine whether any observed relations between parent feedback and children's math outcomes were domain-specific or reflective of general academic abilities, all models predicting 4-year-old children's concurrent performance on the math assessment were followed up with parallel models predicting 4-year-old children's concurrent language skills.

All regression models included two covariates: parents' overall amount of talk and child age. Parents who converse more with their children have more opportunities to bestow praise, affirmation, and/or corrective feedback (Gunderson, Sorhagen et al., 2018). To control for children's overall language exposure, the total number of parent utterances for each video was calculated and summed across all three tasks. Moreover, since child age has been found to relate to parental feedback and children's ability to respond to it (Uscianowski et al., 2020; Henderlong Corpus & Lepper, 2007), we included the child's age at the time of the semi-structured observations as a control.

2.3.3 RQ3: Relations Between All Types of Parental Feedback and Child Outcomes

All categories of parental feedback were examined in the same linear regression models to determine whether they differentially related to children's concurrent performance on the math assessment, as well as their longitudinal change in performance on the assessment over a one-year period. For all models predicting 4-year-old children's concurrent math outcomes, similar regression models were estimated to examine the role of parental feedback for 4-year-old children's concurrent language outcomes. All regression models included the same two covariates of parents' total number of utterances and child age.

3. Results

3.1 RQ1: Frequency of Parental Praise, Affirmation, and Corrective Feedback

Substantial variability was observed in the frequency of parents' feedback when interacting with their children. Parents produced between 45 and 256 total feedback utterances across the three tasks. Table 1 displays descriptive statistics of parental feedback frequency across all types and summed across tasks. Across all types of parental feedback, parents provided affirmation in a non-praise context with the greatest frequency, and bestowed corrective feedback with a greater frequency compared to praise. Across praise sub-types, parents provided other praise with the greatest frequency while there was an extremely low frequency of person praise. Across corrective feedback sub-types, parents provided the greatest frequency of process corrective feedback, while there was an extremely low frequency of person corrective feedback. Thus, praise and corrective feedback were collapsed across all three respective sub-types (person, process, and other) for subsequent analyses.

Table 1. Descriptive Statistics of Parental Feedback Types Summed Across Three Semi-Structured Interactions

Feedback type (*n=91*)	*M* (SD)	Range
Praise	24.45 (13.41)	3-58
Person praise	.69 (1.28)	0-7
Process praise	5.15 (4.00)	0-15
Other praise	18.60 (11.17)	2-51
Affirmation in a non-praise context	81.41 (32.44)	20-195
Corrective feedback	35.11 (19.42)	2-102
Person corrective feedback	.05 (.27)	0-2
Process corrective feedback	22.22 (13.31)	2-67
Other corrective feedback	12.84 (8.33)	0-37
Total feedback	140.97 (48.48)	45-256

3.2 RQ2A: Relations Between Each Type of Parental Feedback and 4-Year-Old Children's Concurrent Math and Language Skills

Children's average Woodcock-Johnson Applied Problems subtest raw score was 15.30 (SD=3.98) at the 4-year-old time point, while the average score on the DVAP at the 4-year-old time point was 108.54 out of 212 words (SD=26.75). See Appendix for descriptive statistics of child outcomes and covariates.

Table 2 displays correlations between parental feedback types, child outcomes, and covariates. Among the different types of parental feedback, the two categories of positive parental feedback were significantly positively correlated while neither one of them was significantly correlated with corrective feedback. Parental praise was significantly positively correlated with children's DVAP scores, while parental corrective feedback was significantly negatively correlated with children's Woodcock-Johnson Applied Problem subtest scores at both time points.

Table 2. Correlations Between Parental Feedback Types, Child Outcomes, and Covariates

Measure	1	2	3	4	5	6	7
1. Praise							
2. Affirmation in a non-praise context	.48***						
3. Corrective feedback	.20	.17					
4. WJ Applied Problems subtest score at time 1	.06	.10	-.35***				
5. DVAP score at time 1	.26*	.17	-.10	.47***			
6. WJ Applied Problems subtest score at time 2	.17	.10	-.26*	.74***	.47***		
7. Total parental utterances	.57***	.69***	.54***	-.13	.12	-.09	
8. Child age	.02	-.02	.01	.33**	.16	.32**	.05

^p<.06, *p<.05, **p<.01, ***p<.001

Regression models examining the associations between each type of parental feedback and child outcomes are shown in Table 3 and Table 4. As can be seen in Model 1 in Table 3, *parental praise* was not a significant predictor of children's concurrent math skills. In contrast, Model 5 in Table 4 showed that the frequency of parental praise was a significant predictor of children's expressive vocabulary. One standard deviation increase in the frequency of parental praise was associated with a .29 standard deviation increase in children's expressive vocabulary.

Table 3. Regression Analyses Predicting 4-Year-Old Children's Woodcock-Johnson Applied Problems Subtest Scores From Parental Praise, Affirmation in a Non-Praise Context, and Corrective Feedback

Variable (n=91)	Model 1		Model 2		Model 3		Model 4	
	B (β)	*SE*	B (β)	*SE*	B (β)	*SE*	B (β)	*SE*
Parental feedback								
Praise	.06	.04					.03	.03
	(.20)						(.11)	
Affirmation in a non-praise context			.05**	.02			.03	.02
			(.39)				(.26)	
Corrective feedback					-.08**	.02	-.06*	.02
					(-.39)		(-.30)	
Child age	4.57**	1.32	4.82***	1.28	4.50**	1.25	4.69***	1.24
	(.34)		(.36)		(.34)		(.35)	
Total parental utterances	-.01*	.00	-.02**	.00	.00	.00	-.01	.01
	(-.25)		(-.41)		(.06)		(-.23)	
R^2/adjusted R^2	.16/.13		.21/.18		.24/.21		.28/.24	
F for R^2	5.45**		7.74***		9.04***		6.60***	

^p<.06, *p<.05, **p<.01, ***p<.001

Table 4. Regression Analyses Predicting 4-Year-Old Children's Developmental Vocabulary Assessment for Parents Scores From Parental Praise, Affirmation in a Non-Praise Context, and Corrective Feedback

Variable (*n=91*)	Model 5		Model 6		Model 7		Model 8	
	B (*β*)	*SE*	B (*β*)	*SE*	B (*β*)	*SE*	B (*β*)	*SE*
Parental feedback								
Praise	.58*	.25					.50*	.25
	(.29)						(.25)	
Affirmation in a non-praise context			.15	.12			.06	.12
			(.18)				(.08)	
Corrective feedback					-.31	.17	-.22	.18
					(-.22)		(-.16)	
Child age	14.00	9.19	14.68	9.40	13.63	9.29	14.14	9.19
	(.16)		(.16)		(.15)		(.16)	
Total parental utterances	-.01	.03	-.00	.04	.06	.03	-.00	.05
	(-.06)		(-.02)		(.23)		(-.00)	
R^2/adjusted R^2	.09/.06		.05/.02		.07/.04		.12/.07	
F for R^2	2.99*		1.66		2.25		2.30^	

^p<.06, *p<.05, **p<.01, ***p<.001

As can be seen in Model 2 in Table 3, *parental affirmation in a non-praise context* was a significant predictor of children's concurrent math skills. One standard deviation increase in the frequency of parental affirmation was associated with a .39 standard deviation increase in children's math skills. In contrast, parental affirmation in a non-praise context was not significantly related to children's expressive vocabulary (Model 6, Table 4).

As can be seen in Model 3 in Table 3, *parental corrective feedback* was a significant predictor of children's concurrent math skills. One standard deviation increase in the frequency of parental corrective feedback was associated with a .39 standard deviation decrease in children's math skills. In contrast, parental corrective feedback was not significantly related to children's expressive vocabulary (Model 7, Table 4).

3.3 RQ2B: Relations Between Each Type of Parental Feedback and the Change in Children's Math Skills Between 4 and 5 Years of Age

Children's average Woodcock-Johnson Applied Problems subtest raw score increased from the 4-year-old time point (M=15.30; SD=3.98) to the 5-year-old time point (M=17.30; SD=5.96). Regression models examining the relations between each type of parental feedback and change in children's math skills are shown in Table 5. Frequency of parental praise was significantly related to children's growth in math skills after controlling for parents' total utterances and child age (Model 9). One standard deviation increase in the frequency of parental praise was associated with a .28 standard deviation increase in children's growth in math skills. In contrast, the frequencies of parental affirmation and corrective feedback did not significantly relate to the change in children's math skills.

Table 5. Regression Analyses Predicting the Change in Children's Woodcock-Johnson Applied Problems Subtest Scores Between 4 and 5 Years of Age From Parental Praise, Affirmation in a Non-Praise Context, and Corrective Feedback

Variable (*n=91*)	Model 9		Model 10		Model 11		Model 12	
	B (*β*)	*SE*	B (*β*)	*SE*	B (*β*)	*SE*	B (*β*)	*SE*
Parental feedback								
Praise	.08*	.04					.08*	.04
	(.28)						(.27)	
Affirmation in a non-praise context			.02	.02			.01	.02
			(.12)				(.08)	
Corrective feedback					-.01	.03	-.00	.03
					(-.06)		(-.00)	
Child age	1.92	1.41	1.98	1.45	1.89	1.45	1.97	1.43
	(.14)		(.15)		(.14)		(.14)	
Total parental utterances	-.01	.00	-.00	.01	.00	.00	-.01	.01
	(-.16)		(-.09)		(.03)		(-.21)	
R^2/adjusted R^2	.07/.04		.03/-.01		.02/-.01		.07/.02	
F for R^2	2.22		.81		.66		1.36	

^*p*<.06, **p*<.05, ***p*<.01, ****p*<.001

3.4 RQ3A: Relations Between All Types of Parental Feedback and 4-Year-Old Children's Concurrent Math and Language Skills

We also examined which types of parental feedback were unique predictors of children's math and language skills. As can be seen in Model 4 in Table 3, parental corrective feedback was uniquely associated with children's concurrent math skills. One standard deviation increase in the frequency of parental corrective feedback was associated with a .30 standard deviation decrease in children's math skills, even when accounting for parental praise and parental affirmation. In contrast, parental praise uniquely explained significant variance in children's expressive vocabulary (Model 8, Table 4). One standard deviation increase in the frequency of parental praise was associated with a .25 standard deviation increase in children's expressive vocabulary, even when controlling for parental affirmation and parental corrective feedback.

3.5 RQ3B: Relation Between All Types of Parental Feedback and the Change in Children's Math Skills Between 4 and 5 Years of Age

Finally, we examined which types of parental feedback were unique predictors of children's change in math skills. As can be seen in Model 12 in Table 5, the frequency of parental praise was the only unique predictor of children's growth in math skills. One standard deviation increase in the frequency of parental praise was associated with a .27 standard deviation increase in children's growth in math skills between 4 and 5 years of age, even when controlling for parental affirmation and parental corrective feedback.

4. Discussion

The present study explored the variability in parent feedback during three semi-structured dyadic interactions in the home environment and the relations between different types of parent feedback (praise, affirmation, and corrective feedback) and children's math and language skills prior to entering formal schooling. Overall, there was considerable variability in the frequency and type of parents' feedback during the semi-structured interactions. Importantly, parental affirmation in a non-praise context and parental corrective feedback were significantly related to children's concurrent math abilities and parental praise was significantly related to children's concurrent language abilities as well as the difference in children's math abilities over a one-year period. These findings highlight the importance of considering the valence of parental feedback, as positive and corrective feedback related differentially to children's concurrent math and language abilities as well as their growth in math abilities over a one-year span.

4.1 Variability in the Occurrence of Parental Feedback

Consistent with past findings (Gunderson et al., 2013; Swenson et al., 2016), the sample demonstrated considerable individual variability in the frequency of all types of parental feedback. Among the different categories of parental feedback, parents utilized affirmation in a non-praise context the most often. This is consistent with several studies showing that affirmation was the most common form of positive feedback given by teachers and classmates in a classroom environment, while praise was rarely used (Buriel, 1983; Reigel, 2008). Both corrective feedback and praise are more detailed and stronger forms of feedback than affirmation in a non-praise context, which is a more simple and generalized form of feedback regarding the correctness or appropriateness of behavior (Brophy, 1981).

4.2 Relations Between Parental Praise and Child Outcomes

Although the different sub-groups of parent feedback (e.g., different sub-types of parent praise) were examined descriptively, due to the low frequency of certain sub-groups they were summed such that only the three main groups of parental feedback (i.e., praise, affirmation, and corrective feedback) were used in the regression analyses. Parental praise was positively related to children's expressive vocabulary and the change in children's math abilities after controlling for child age and total parental utterances, as well as uniquely related to these same measures after additionally controlling for the other two types of parent feedback. This indicates that parents' positive feedback was not simply the opposite of corrective feedback such that children who provided more correct responses to parental prompts received more positive feedback and proportionally less corrective feedback. Instead, parental praise was predictive of children's expressive vocabulary and change in math abilities above and beyond parental affirmation and parental corrective feedback. This suggests that there may be reasons why parents provide praise besides in response to their children's performance, such as using praise to motivate or engage their children during an activity or parents' inherent tendency to bestow praise on their children.

These findings are consistent with two studies that showed teacher praise was related to enhanced academic performance for upper elementary school children (Harris et al., 1986; Van Houten et al., 1975) and that experimentally manipulated occurrence of praise yielded greater improvements in 5- to 7-year-old children's math performance than general affirmations (Berner et al., 2022). However, this contrasts with the findings of Gunderson, Sorhagen, and colleagues (2018) showing that other praise, which made up the greatest proportion of total praise in their sample, was not significantly related to children's performance in math and reading comprehension measures years later.

A potential explanation for the findings related to children's expressive vocabulary is that parents often bestowed praise after children provided verbal responses to their prompts such that children with superior expressive vocabulary may have been better equipped to answer parents' prompts and therefore may have received praise more often. Alternatively, the observed dyadic interactions may have been an accurate reflection of parents' inherent tendency to praise their children and the frequency of parental praise may have impacted children's mindsets, which may have influenced how they approached learning opportunities and challenges and responded to setbacks, which in turn may have impacted their math and language skill development. Gunderson, Sorhagen, and colleagues (2018) found support for this mechanism by showing that parental process praise bestowed upon children between the ages of 1 and 3 years during naturalistic dyadic interactions indirectly predicted children's future academic achievement in math and reading comprehension measures 7 years later.

However, it may take time for parental input to influence child outcomes, as children may not reflect on praise and their mindsets may not be fully developed at the young age of four, so praise may not yet shape child mindsets and therefore child outcomes (Brummelman & Thomaes, 2017). In support of this idea, Blackwell and colleagues (2007) found that the relations between adolescents' motivational frameworks and longitudinal academic measures grew stronger over time as adolescents encountered more learning opportunities and challenges. This supports the finding in this sample that parental praise was significantly related to children's change in math abilities from age four to five but not their concurrent math abilities at age four.

Another possible explanation for the divergent relations between parental praise and children's concurrent math abilities versus children's change in math abilities is that as children learn everyday mathematics prior to entering formal schooling at around age five (Ginsburg et al., 2008), they may need more encouragement to complete tasks involving math, so parents may make a more concerted effort to praise younger children's responses in a way that overstates their actual performance with the aim of improving their math abilities (Reigel, 2008). Even though praise is a form of positive feedback, Lee and colleagues (2017) found that children were sensitive to the accuracy of parental praise: parental praise that was perceived by children as forced or not

accurately reflecting their performance was predictive of decreased academic outcomes compared to parental praise accurately reflecting their performance. As a result of excessive praise, children may hold inflated views of their own abilities and set high expectations for future performance such that they experience increased pressure and concern about meeting those expectations, leading them to avoid future learning opportunities and execute self-handicapping strategies. This is characteristic of a fixed mindset (Mueller & Dweck, 1998), which has been shown to lead to decreased performance (Smiley & Dweck, 1994). This may explain why parental praise was not positively related to 4-year-old children's concurrent math outcomes. However, a negative relation was not observed either.

A possible interpretation of the nonsignificant results regarding children's concurrent math skills and the significant results regarding children's expressive vocabulary is that prior research showed that many parents report spending less time teaching math at home compared to language, think of math as less of a personal strength compared to language, and view reading skills as more important than math skills (Cannon & Ginsburg, 2008). Parents may think it is not their responsibility to teach math and that children should learn math during formal schooling, so parents may not do many math activities with their children and may not adjust their verbal input to children's math skills to help them build those skills. In contrast, language is inherent in communication, and a lot of informal learning activities parents do with their children are reading activities. Parents may adjust their feedback based on how their children verbally respond to their general questions or prompts. Children who have better expressive vocabulary are likely better able to keep up with and respond to the parental language input, and thus could receive more parental feedback.

4.3 Relations Between Parental Corrective Feedback and Child Outcomes

Corrective feedback was negatively related to children's concurrent math abilities after controlling for child age and total parental utterances, as well as uniquely related to this same measure after additionally controlling for the other two types of parent feedback. This indicates that parents' corrective feedback was not simply the opposite of positive feedback such that children who provided fewer correct responses to parental prompts received more corrective feedback and proportionally less positive feedback. Instead, parental corrective feedback was predictive of children's concurrent math abilities above and beyond parental praise and parental affirmation. This suggests that there may be reasons why parents provide corrective feedback besides in response to their children's performance, such as parents thinking it is particularly important to correct a certain type of behavior.

A potential explanation for the findings on the relation between parental corrective feedback and children's concurrent math abilities is that 4-year-old children with lower math skills are less equipped to answer parents' math-related prompts such that they are more likely to answer them incorrectly or inappropriately and thus parents may provide more corrections. In addition, parents may use more math prompts with children who have lower math skills to help them build a stronger foundation of math concepts and they may often answer incorrectly due to their lower math skills, resulting in them receiving more of this type of feedback. Alternatively, parents in the sample may have tended to give similar amounts of corrective feedback to their children, but children with lower math skills may have spent more time on the same prompts and thus may have received more of the same repeated feedback.

In addition, although corrective feedback was significantly related to children's concurrent math skills, it was not significantly related to children's concurrent expressive vocabulary after controlling for child age and total parental utterances. A potential explanation for this finding is that parents may think it is more important to correct children's math responses than their language responses in the home environment prior to entering formal schooling. In addition, math responses have a greater degree of objective correctness than language responses such that children's responses to math-related prompts lend themselves to a greater amount of corrective feedback.

Interestingly, parental corrective feedback was uniquely related to children's concurrent math outcomes while parental praise was uniquely related to the change in children's math outcomes. One potential explanation is that corrective feedback prompts children to immediately compare their current incorrect response with other alternatives to reach the correct response. Therefore, corrective feedback may be more reflective of children's concurrent skills and parents' perception of the need to improve those skills. Children learn everyday mathematics prior to entering formal schooling at around age five (Ginsburg et al., 2008), and once they enter formal schooling math concepts build upon each other such that children will continue to struggle with different math concepts as they age, prompting parents to bestow corrective feedback to ensure their children develop a strong foundation for mathematics. In contrast, praise prompts children to remember their current response so

they can repeat it in the future. Thus, praise may be more necessary for long-term change and as such relates to the growth in children's math abilities from age four to five.

The opposite directions of the associations between praise and corrective feedback and child outcomes may reflect the different functions of praise and corrective feedback in the home learning environment. Parents often bestow praise upon children to provide motivation while completing tasks. Henderlong and Lepper (2002) noted the utility of praise for boosting children's motivation and perceived competence, particularly when it is perceived as sincere, attributes their performance to causes within their control, provides attainable expectations, and promotes their autonomy. Following praise, the child is not required to make any adjustments to their response and instead knows to repeat the praised action or verbalization in future tasks, thereby strengthening their development of academic skills and allowing the dyad to move on to another aspect of the task.

In contrast, parents often provide their children with corrective feedback to scaffold their children's learning and acquisition of concepts. Scaffolding consists of parental elicitations that are contingent on the child's performance and facilitate the child answering the parent's questions and prompts, thereby fostering the development of problem-solving abilities and autonomy, particularly in goal-directed activities such as the magnet task (Mermelshtine, 2017). After children receive corrective feedback, they must realize that their original conception of the topic was incorrect and work to correct their actions or verbalizations, which means they must exert more effort in response to corrective feedback compared to praise. Otherwise, they will have an inaccurate academic foundation that will hinder them from advancing and learning progressively more difficult material. Also, children with inferior math skills may receive more corrective feedback regarding the same few concepts due to repeatedly struggling with responding to parental prompts as well as responding appropriately to parents' prior corrective feedback.

4.4 Relations Between Parental Affirmation and Child Outcomes

Affirmation in a non-praise context was positively related to children's concurrent math outcomes, but not expressive vocabulary. This finding is consistent with several studies that exhibited how teacher affirmation and positive feedback in general were significantly related to enhanced academic achievement of students (Buriel, 1983; Reigel, 2008). However, once the other two types of parental feedback were controlled for, this relation was no longer significant, suggesting that affirmation in a non-praise context did not contribute unique variance to explaining children's math skills after accounting for the other parental feedback types. This is in contrast with a study by Morris and Zentall (2014) showing that utterances labelled as verbal ambiguous praise, which were defined as affirmation in this study, bestowed upon kindergarteners were as motivating or more motivating than process praise. In addition, affirmation in a non-praise context was not significantly related to children's change in math outcomes after controlling for child age and total parental utterances in this sample. These two findings suggest that although the frequency of affirmation was greater than praise in these studies, children did not perceive all forms of positive feedback similarly such that any form of positive feedback resulted in improved academic outcomes, as suggested by Reigel (2008). Thus, affirmation may not be the most salient form of reinforcement for young children developing foundational math skills prior to formal schooling.

4.5 Strengths, Limitations, and Future Directions

One strength for the current study is that potentially confounding parent and child factors were controlled for in the regression models. Controlling for the total number of parental utterances during the semi-structured interactions allowed for the separation of the amount of parental talk, which is an established source of variation in children's math and language outcomes (Cristofaro & Tamis-LeMonda, 2011), from the frequency of parental feedback types in predicting children's math and language skills. In addition, controlling for child age isolated the effect of age on parental feedback and child outcomes, as older children may receive more parental feedback as a result of their higher level of expertise (Uscianowski et al., 2020) and they may have higher math and language abilities.

Although the inclusion of these covariates helped isolate the relations between the types of parental feedback and children's academic abilities, several variables such as children's general intelligence and other parent characteristics were omitted due to the small sample size or were not measured during data collection. For example, prior research showed that the more parents valued math skills, the more they engaged in math-related activities with their young children to prepare them for formal schooling (Musun-Miller & Blevins-Knabe, 1998). Additionally, parents with a higher subjective math ability engaged in more number talk with their 5- and 6-year-old children (Elliott et al., 2017). These and other factors are likely important predictors of children's math and language skills explaining why the effect sizes of parental feedback in the current study are rather

modest. Thus, future work should collect data on additional characteristics of the dyads to examine whether the relations between parental feedback types and child outcomes differ after accounting for other characteristics.

Another strength of the current study is the use of semi-structured observations in the home environment, as these observations revealed how the parents and children in this sample play and interact with each other, as well as how often the parents provided feedback during tasks that resemble potential day-to-day activities the dyads could engage in outside of the data collection. Prior work examining the impact of parental feedback on child outcomes has tended to utilize self-report measures (Lee et al., 2017; Madjar et al., 2015; Pomerantz & Kempner, 2013) or experimental measures (Cimpian et al., 2007; Kamins & Dweck, 1999; Zentall & Morris, 2010). In contrast, in this sample parents were instructed to engage with their children as they normally would without informing them of what the researchers would be looking for during the interactions, as this likely would have impacted the amount and types of feedback they provided. This is a more reliable and valid measure than self-report data, which can easily be biased and thus can inaccurately represent parental feedback (Swenson et al., 2016).

Although the three semi-structured observational tasks were selected to provide parent-child dyads with opportunities to engage in math-talk and scaffolding, which lend themselves to parental feedback, and to represent tasks the dyads could engage in together outside of the data collection, the tasks were brief (5-10 minutes each) and all have some degree of structure and may not actually reflect the day-to-day interactions of the dyads. They may represent how parents and children interact under ideal situations (i.e., if they had access to the provided materials for a certain period of uninterrupted time with limited distractions) as opposed to how they naturally interact in their home environments. Future work should examine dyadic interactions in more naturalistic settings that are not as structured, such as measuring the feedback parents spontaneously bestow upon their children in the home environment (Gunderson et al., 2013), to increase the ecological validity of the results.

A notable limitation of this study is that we only included verbal feedback and that certain categories of parental feedback occurred at a low frequency, particularly person praise and person corrective feedback, which required that the three sub-types of praise and corrective feedback be collapsed into single measures of total praise and total corrective feedback. This prevented the examination of the relations between different sub-types of praise and corrective feedback and child outcomes, which would have been a novel research aim for corrective feedback and would have allowed for comparisons with prior literature regarding the impact of the different sub-types of praise (Cimpian et al., 2007; Gunderson, Sorhagen, et al., 2018; Kamins & Dweck, 1999). Increasing the number of opportunities for parents to provide feedback in future work could allow for the observation of a greater frequency of these sub-types of parental feedback, which could reveal relations that were not observed in this sample.

Finally, as noted in the method section, the analytic sample for this study may not be generalizable to the broader population, as it was geographically restricted, and parents were fairly highly educated. Future work should include data from a larger and more diverse range of families.

5. Conclusion

Parental feedback has the potential to support children's math and language development in various ways. Parents' praise when their children were 4 years old was found to be individually and uniquely associated with children's concurrent expressive vocabulary and change in math skills from age four to five, parents' affirmation was found to be associated with children's concurrent math skills, and parents' corrective feedback was found to be individually and uniquely associated with children's concurrent math skills, above and beyond the total number of parental utterances and child age. The results of this study provide insight into the contribution of parental feedback to children's academic outcomes in the home environment prior to formal schooling, expanding upon a body of prior work that primarily consists of research on the impact of parental and teacher feedback on school-aged children's academic achievement. This work has broader implications for the development and dissemination of interventions that can be implemented in preschool or community settings to aid parents in providing academically beneficial learning opportunities for their children. These interventions may contribute to the development of children's math and language skills before they enter formal schooling through fostering advantageous behaviors during learning opportunities, including a motivation to learn and a growth mindset.

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References

Bąk, O., & Leśniak, M. M. (2020). Can praise undo the unfavourable effects of earlier failures? *Educational Psychology, 40*(10), 1287-1305. https://doi.org/10.1080/01443410.2020.1778642

Berkeljon, A., & Raijmakers, M. E. J. (2007). An ART neural network model of discrimination learning. In *Proceedings of the IEEE Sixth International Conference on Development and Learning* (pp. 169-174). London: IEEE. https://doi.org/10.1109/DEVLRN.2007.4354035

Berner, V.-D., Seitz-Stein, K., Segerer, R., Oesterlen, E., & Niklas, F. (2022). 'Good' or 'well calculated'? Effects of feedback on performance and self-concept of 5- to 7-year-old children in math. *Educational Psychology, 42*(3), 296-315. https://doi.org/10.1080/01443410.2021.2001790

Blackwell, L. S., Trzesniewski, K. H., & Dweck, C. S. (2007). Implicit theories of intelligence predict achievement across an adolescent transition: A longitudinal study and an intervention. *Child Development, 78*(1), 246-263. https://doi.org/10.1111/j.1467-8624.2007.00995.x

Brophy, J. (1981). Teacher praise: A functional analysis. *Review of Educational Research, 51*(1), 5-32. https://doi.org/10.3102/00346543051001005

Brummelman, E., & Thomaes, S. (2017). How children construct views of themselves: A social-developmental perspective. *Child Development, 88*(6), 1763-1773. https://doi.org/10.1111/cdev.12961

Brummelman, E., Crocker, J., & Bushman, B. J. (2016). The praise paradox: When and why praise backfires in children with low self-esteem. *Child Development Perspectives, 10*(2), 111-115. https://doi.org/10.1111/cdep.12171

Buriel, R. (1983). Teacher-student interactions and their relationship to student achievement: A comparison of Mexican-American and Anglo-American children. *Journal of Educational Psychology, 75*(6), 889-897. https://doi.org/10.1037/0022-0663.75.6.889

Cannon, J., & Ginsburg, H. P. (2008). "Doing the math": Maternal beliefs about early mathematics versus language learning. *Early Education and Development, 19*(2), 238-260. https://doi.org/10.1080/10409280801963913

Cimpian, A., Arce, H. M. C., Markman, E. M., & Dweck, C. S. (2007). Subtle linguistic cues affect children's motivation. *Psychological Science, 18*(4), 314-316. https://doi.org/10.1111/j.1467-9280.2007.01896.x

Cristofaro, T. N., & Tamis-LeMonda, C. S. (2011). Mother-child conversations at 36 months and at pre-kindergarten: Relations to children's school readiness. *Journal of Early Childhood Literacy, 12*(1), 68-97. https://doi.org/10.1177/1468798411416879

Datavyu Team. (2014). *Datavyu: A video coding tool (Version 1.3.7).* Databrary Project, New York University. Retrieved from https://datavyu.org

Diener, C. I., & Dweck, C. S. (1978). An analysis of learned helplessness: Continuous changes in performance, strategy, and achievement cognitions following failure. *Journal of Personality and Social Psychology, 36*(5), 451-462. https://doi.org/10.1037/0022-3514.36.5.451

Dorrington, L., & van Nieuwerburgh, C. (2015). The development of peer coaching skills in primary school children: An exploration of how children respond to feedback. *International Journal of Information and Education Technology, 5*(1), 50-54. https://doi.org/10.7763/IJIET.2015.V5.475

Duncan, G. J., Dowsett, C. J., Claessens, A., Magnuson, K., Huston, A. C., Klebanov, P., Pagani, L. S., Feinstein, L., Engel, M., Brooks-Gunn, J., Sexton, H., Duckworth, K., & Japel, C. (2007). School readiness and later achievement. *Developmental Psychology, 43*(6), 1428-1446. https://doi.org/10.1037/0012-1649.43.6.1428

Dunn, L. M., & Dunn, D. M. (2007). *Peabody Picture Vocabulary Test-Fourth Edition.* San Antonio, TX: Pearson. https://doi.org/10.1037/t15144-000

Dweck, C. S., & Leggett, E. L. (1988). A social-cognitive approach to motivation and personality. *Psychological Review, 95*(2), 256-273. https://doi.org/10.1037/0033-295X.95.2.256

Elliott, E. S., & Dweck, C. S. (1988). Goals: An approach to motivation and achievement. *Journal of Personality and Social Psychology, 54*(1), 5-12. https://doi.org/10.1037/0022-3514.54.1.5

Elliott, L., Braham, E. J., & Libertus, M. E. (2017). Understanding sources of individual variability in parents' number talk with young children. *Journal of Experimental Child Psychology, 159*, 1-15. https://doi.org/10.1016/j.jecp.2017.01.011

Fishbach, A., Eyal, T., & Finkelstein, S. R. (2010). How positive and negative feedback motivate goal pursuit. *Social and Personality Psychology Compass, 4*(8), 517-530. https://doi.org/10.1111/j.1751-9004.2010.00285.x

Ginsburg, H. P., Lee, J. S., & Boyd, J. S. (2008). Mathematics education for young children: What it is and how to promote it. *Social Policy Report, 22*(1), 1-24. https://doi.org/10.1002/j.2379-3988.2008.tb00054.x

Gunderson, E. A., Donnellan, M. B., Robins, R. W., & Trzesniewski, K. H. (2018). The specificity of parenting effects: Differential relations of parent praise and criticism to children's theories of intelligence and learning goals. *Journal of Experimental Child Psychology, 173*, 116-135. https://doi.org/10.1016/j.jecp.2018.03.015

Gunderson, E. A., Gripshover, S. J., Romero, C., Dweck, C. S., Goldin-Meadow, S., & Levine, S. C. (2013). Parent praise to 1- to 3-year-olds predicts children's motivational frameworks 5 years later. *Child Development, 84*(5), 1526-1541. https://doi.org/10.1111/cdev.12064

Gunderson, E. A., Sorhagen, N. S., Gripshover, S. J., Dweck, C. S., Goldin-Meadow, S., & Levine, S. C. (2018). Parent praise to toddlers predicts fourth grade academic achievement via children's incremental mindsets. *Developmental Psychology, 54*(3), 397-409. https://doi.org/10.1037/dev0000444

Harris, M. J., Rosenthal, R., & Snodgrass, S. E. (1986). The effects of teacher expectations, gender, and behavior on pupil academic performance and self-concept. *The Journal of Educational Research, 79*(3), 173-179. https://doi.org/10.1080/00220671.1986.10885672

Henderlong, C., J., & Lepper, M. R. (2007). The effects of person versus performance praise on children's motivation: Gender and age as moderating factors. *Educational Psychology, 27*(4), 487-508. https://doi.org/10.1080/01443410601159852

Henderlong, J., & Lepper, M. R. (2002). The effects of praise on children's intrinsic motivation: A review and synthesis. *Psychological Bulletin, 128*(5), 774-795. https://doi.org/10.1037/0033-2909.128.5.774

Kamins, M. L., & Dweck, C. S. (1999). Person versus process praise and criticism: Implications for contingent self-worth and coping. *Developmental Psychology, 35*(3), 835-847. https://doi.org/10.1037/0012-1649.35.3.835

Lee, H. I., Kim, Y. H., Kesebir, P., & Han, D. E. (2017). Understanding when parental praise leads to optimal child outcomes: Role of perceived praise accuracy. *Social Psychological and Personality Science, 8*(6), 679-688. https://doi.org/10.1177/1948550616683020

Libertus, M. E., Odic, D., Feigenson, L., & Halberda, J. (2015). A Developmental Vocabulary Assessment for Parents (DVAP): Validating parental report of vocabulary size in 2- to 7-year-old children. *Journal of Cognition and Development, 16*(3), 442-454. https://doi.org/10.1080/15248372.2013.835312

Madjar, N., Voltsis, M., & Weinstock, M. P. (2015). The roles of perceived parental expectation and criticism in adolescents' multidimensional perfectionism and achievement goals. *Educational Psychology, 35*(6), 765-778. https://doi.org/10.1080/01443410.2013.864756

McDonough, K. (2005). Identifying the impact of negative feedback and learners' responses on ESL question development. *Studies in Second Language Acquisition, 27*(1), 79-103. https://doi.org/10.1017/S0272263105050047

Mermelshtine, R. (2017). Parent-child learning interactions: A review of the literature on scaffolding. *British Journal of Educational Psychology, 87*(2), 241-254. https://doi.org/10.1111/bjep.12147

Morris, B. J., & Zentall, S. R. (2014). High fives motivate: The effects of gestural and ambiguous verbal praise on motivation. *Frontiers in Psychology, 5*. https://doi.org/10.3389/fpsyg.2014.00928

Mueller, C. M., & Dweck, C. S. (1998). Praise for intelligence can undermine children's motivation and performance. *Journal of Personality and Social Psychology, 75*(1), 33-52. https://doi.org/10.1037/0022-3514.75.1.33

Musun-Miller, L., & Blevins-Knabe, B. (1998). Adults' beliefs about children and mathematics: How important is it and how do children learn about it? *Early Development and Parenting, 7*(4), 191-202. https://doi.org/10.1002/(SICI)1099-0917(199812)7:4<191::AID-EDP181>3.0.CO;2-I

Nguyen, M. T. T., & Lwin, M. S. (2014). Effects of parents' corrective feedback on the pragmatic performance of L1 English-speaking Singaporean children. *The Asian Journal of Applied Linguistics, 1*(2), 129-148. Retrieved from https://caes.hku.hk/ajal/index.php/ajal/article/view/48

Nicholls, J. G. (1984). Achievement motivation: Conceptions of ability, subjective experience, task choice, and performance. *Psychological Review, 91*(3), 328-346. https://doi.org/10.1037/0033-295X.91.3.328

Pomerantz, E. M., & Kempner, S. G. (2013). Mothers' daily person and process praise: Implications for children's theory of intelligence and motivation. *Developmental Psychology, 49*(11), 2040-2046. https://doi.org/10.1037/a0031840

Reigel, D. (2008). Positive feedback in pairwork and its association with ESL course level promotion. *TESOL Quarterly, 42*(1), 79-98. https://doi.org/10.1002/j.1545-7249.2008.tb00208.x

Rowe, M. L., Coker, D., & Pan, B. A. (2004). A comparison of fathers' and mothers' talk to toddlers in low-income families. *Social Development, 13*(2), 278-291. https://doi.org/10.1111/j.1467-9507.2004.000267.x

Schachter, J. (1991). Corrective feedback in historical perspective. *Second Language Research, 7*(2), 89-102. https://doi.org/10.1177/026765839100700202

Smiley, P. A., & Dweck, C. S. (1994). Individual differences in achievement goals among young children. *Child Development, 65*(6), 1723-1743. https://doi.org/10.1111/j.1467-8624.1994.tb00845.x

Swenson, S., Ho, G. W. K., Budhathoki, C., Belcher, H. M. E., Tucker, S., Miller, K., & Gross, D. (2016). Parents' use of praise and criticism in a sample of young children seeking mental health services. *Journal of Pediatric Health Care, 30*(1), 49-56. https://doi.org/10.1016/j.pedhc.2015.09.010

Uscianowski, C., Almeda, M. V., & Ginsburg, H. P. (2020). Differences in the complexity of math and literacy questions parents pose during storybook reading. *Early Childhood Research Quarterly, 50*, 40-50. https://doi.org/10.1016/j.ecresq.2018.07.003

Van Houten, R., Hill, S., & Parsons, M. (1975). An analysis of a performance feedback system: The effects of timing and feedback, public posting, and praise upon academic performance and peer interaction. *Journal of Applied Behavior Analysis, 8*(4), 449-457. https://doi.org/10.1901/jaba.1975.8-449

Woodcock, R. W., McGrew, K. S., & Mather, N. (2001). *Woodcock-Johnson III Tests of Achievement.* Itasca, IL: Riverside Publishing.

Zentall, S. R., & Morris, B. J. (2010). "Good job, you're so smart": The effects of inconsistency of praise type on young children's motivation. *Journal of Experimental Child Psychology, 107*(2), 155-163. https://doi.org/10.1016/j.jecp.2010.04.015

Appendix

Supplementary Tables

Table A1. Positive Feedback Categories

Positive feedback category	Examples
Person praise	"Good girl"*
	"You're so smart"*
	"You're so nice"
	"You're so good at this"*
Process praise	"Good job / good idea"*
	"That's a great spot you picked"
	"Great placement"*
	"You tried really hard"*
	"I like how you put that shape there"*
Other praise	"Very good"*
	"Perfect"
	"Nice"
	"Wow / yay"*
	"It looks great"
	"That's a nice puzzle"*
Affirmation in a praise context (sub-category of other praise)	"That's right / you're right"*
	"Correct"*
	"That is it"*
	"You did it / you got it / you found it"*
	"There you go / there we go"*
	"You really did turn that thing on"*
	"I can't believe you made that"*
Affirmation in a non-praise context	"Yes / yeah"
	"Mmhm / uhhuh"
	"Okay / kay / alright"
	"Okay go ahead"
	"Thank you"

*Examples taken from Gunderson et al. (2013). All other examples are from semi-structured observations in the present study.

Table A2. Corrective Feedback Categories

Corrective feedback category	Examples
Person corrective feedback	"I'm very disappointed in you"*
	"You're not very good at this"
	"You need to be more careful"
Process corrective feedback	"Maybe you could think of another way to do it"*
	"That's not the right way to do it"
	"Keep trying / keep turning / keep going"
	"I think we need to turn it a different way"
	"I don't think you picked the right spot"
	"That shape doesn't go there"
	"Let's start over"
Other corrective feedback	"No"
	"Close / almost / not quite"
	"That doesn't look right"
	"That doesn't match the puzzle picture"
	"Well let's look at the picture"
	"That's not a table silly"

*Examples taken from Kamins & Dweck (1999). All other examples are from semi-structured observations in the present study.

Table A3. Descriptive Statistics of Child Outcomes and Covariates

Variable (*n=91*)	Dependent measure	*M* (SD)	Range
Woodcock-Johnson Applied Problems subtest			
Time 1	Total number of correct trials	15.30 (3.98)	1-26
	Standardized score	116.32 (11.32)	71-147
Time 2	Total number of correct trials	17.30 (5.96)	5-49
	Standardized score	104.87 (17.43)	55-151
Developmental Vocabulary Assessment for Parents Time 1	Number of words indicated out of 212	108.54 (26.75)	29-173
Child age	Years	4.41 (.30)	4.00-4.96
Total parent utterances in all tasks	Number of utterances	400.70 (108.34)	141.00-664.00