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Vocal overimitation in preschool-age children

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ABSTRACT

Overimitation—copying incorrect, idiosyncratic, or causally irrelevant actions—has been linked to our species' long history with artifacts whose functions are often opaque. It is an open question, however, whether children overimitate outside the artifact domain. We explored this question by presenting preschool-age children (3- to 5-year-olds, $N = 120$) with an elicited imitation task that included high- and low-frequency disyllabic nouns (e.g., 'pizza) and nonwords (e.g., 'chizza), all of which had a stressed first syllable. However, during testing, half of the stimuli were incorrectly pronounced by stressing the second syllable (e.g., pi'zza). More than half of the children copied the model's incorrect pronunciation of high-frequency familiar words, consistent with overimitation. This pattern of response persisted even after children had themselves correctly named the familiar words prior to the start of testing, confirming that children purposefully altered the pronunciation of known words to match the incorrect pronunciations used by a model. These results demonstrate that overimitation is not restricted to the artifact domain and might extend to many different tasks and domains.

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Introduction

Children do not just imitate, they *over*imitate. That is, in certain tasks they copy all demonstrated actions, including those they know to be unnecessary, idiosyncratic or incorrect (Flynn, 2008; Lyons, Damrosch, Lin, Macris, & Keil, 2011; Lyons, Young, & Keil, 2007). Importantly, this imitation bias appears to increase (rather than decrease) with age (McGuigan, Makinson, & Whiten, 2010; McGuigan, Whiten, Flynn, & Horner, 2007) and may be universal (Nielsen & Tomaselli, 2010).[1] Yet, children are not blind imitators. When an action is followed by "Whoops!" children inhibit imitating the model and instead generate the intended action rather than the demonstrated action (Carpenter, Akhtar, & Tomasello, 1998). Given this flexibility, an important question is why is it that children overimitate? Various hypotheses have been offered to explain this rather curious and seemingly maladaptive behavior. Lyons and colleagues' automatic causal encoding (ACE) hypothesis (Lyons, 2009; Lyons et al., 2007, 2011) argues that overimitation is restricted to the artifact domain, a product of distorted causal reasoning. Alternatively, a number of researchers have offered social hypotheses for overimitation. According to one group of social theorists, children overimitate out of a desire to affiliate with or "be like" others (Over & Carpenter, 2012). Consistent with this hypothesis is work showing that children do not overimitate when the model who demonstrated the irrelevant action(s) leaves the room and is replaced by a different model (Nielsen & Blank, 2011) and when the model is not socially responsive (Nielsen, 2006). Another social account stresses that children overimitate in order to conform to social norms or conventions (Kenward, Karlsson, & Persson, 2011; Rakoczy, Warneken, & Tomasello, 2008). According to this normativity hypothesis, overimitation is the result of children encoding causally irrelevant actions as part of a larger action sequence that must be imitated together because all actions are represented as conventionally "essential and obligatory" (Keupp, Behne, & Rakoczy, 2013, p. 394).

To date, overimitation research has been restricted to the artifact domain. In fact, the most robust and compelling evidence for overimitation has come from studies that require children to operate puzzle boxes among other artifacts (Horner & Whiten, 2005; Lyons et al., 2007; McGuigan et al., 2010; Nielsen & Tomaselli, 2010). But children imitate across a broad range of tasks and domains. In addition to actions on objects, children imitate everything from gestures (Bekkering, Wohlschlager, & Gattis, 2000; Lennox, Cermak, & Koomar, 1988) to abstract rules (Subiaul, Anderson, Brandt, & Elkins, 2012; Williamson, Jaswal, & Meltzoff, 2010) to real words and nonwords (Bannard, Klinger, & Tomasello, 2013; Coady & Evans, 2008; Gathercole & Baddeley, 1989; Zamuner, Gerken, & Hammond, 2004). Independent of *why* children overimitate, it remains an empirical question *whether* children overimitate in these other domains as well.

The linguistic domain might be a particularly interesting domain in which to explore overimitation because it is highly conventionalized and does not involve interacting with artifacts. Lyons and colleagues (2007) defined overimitation as the tendency to "reproduce an adult's obviously irrelevant actions" (p. 19751). However, just copying irrelevant actions is insufficient to differentiate overimitation from imitation learning. In addition, the standard that actions be "obviously irrelevant" is problematic because it assumes knowledge without any verification that participants actually know what is necessary and what is irrelevant in a given task. This is a concern given that adults possess various folk physical biases that are incorrect and perform actions on object-based tasks that are causally unnecessary (Silva, Page, & Silva, 2005; Silva & Silva, 2006). For these reasons, here we define *overimitation* as (a) copying an idiosyncratic, incorrect, or irrelevant response or action[2] where (b) the copying of the demonstrated response or action occurs despite knowing the conventional, necessary, or correct response or actions. Without this second criterion, overimitation is indistinguishable from mimicry ("blind imitation"), copying an action without understanding the goal of the model (Bannard et al., 2013; Tomasello, Kruger, & Ratner, 1993), or from imitation learning, copying as a means of acquiring *new* knowledge. Moreover, without this second criterion, a logical assumption on the part of participants might be that all responses or actions must be imitated as demonstrated (Lyons, 2009).

[1] See Berl and Hewlett (2015) for evidence of cross-cultural variation.

[2] Responses may include specific physical actions, gestures, pronunciations, and word use.

Using this more strict definition for overimitation, might children imitate an incorrect pronunciation of a common noun that is present in their productive lexicon? The ACE hypothesis (Lyons et al., 2007) makes no specific prediction about overimitation outside the artifact domain. However, there are several possible constraints to vocal overimitation. From a normativity perspective, children should not overimitate incorrect or idiosyncratic pronunciations of common words given that language is premised on conforming to linguistic conventions governing not only semantics and grammar but also phonology. Moreover, because children need to acquire the standard pronunciation for their dialect, they should avoid producing alternate pronunciations that do not change the meaning of a word. In fact, word learning biases encourage unique mappings between words and referents to avoid multiple phonological forms that map to a single lexical form (Clark, 1987; Golinkoff, Mervis, & Hirsh-Pasek, 1994; Markman, 1990). If children violated these biases, it would potentially slow vocabulary development.

Vocal overimitation might also be constrained linguistically by lexical frequency. Children tend to produce familiar words more accurately than unfamiliar words and tend to imitate wordlike nonwords more accurately than non-wordlike nonwords or nonwords that do not conform to the phonotactic patterns of their language (Beckman & Edwards, 2000; Edwards, Beckman, & Munson, 2004; Gathercole, Frankish, Pickering, & Peaker, 1999; Zamuner et al., 2004). A child's response in a vocal imitation task may also be constrained by linguistic processing and knowledge. For example, in nonword repetition tasks, children tend to sometimes lexicalize elicited nonwords, producing common words instead (Zamuner et al., 2004). These findings demonstrate that children are unwilling to use atypical or incorrect pronunciations, particularly with familiar or high-frequency words.

The variation inherent in children's production of word forms during the preschool period may further act as a production constraint, limiting vocal overimitation. Between 18 and 30 months of age, children's speech production varies in terms of both individual sound accuracy and accuracy of whole words (Sosa & Stoel-Gammon, 2006). Sounds may be produced correctly in some words and incorrectly in others (Ferguson & Farwell, 1975; Sosa & Stoel-Gammon, 2006). By 4 or 5 years of age, children have acquired adult forms, but there may still be variability in production, particularly for complex word forms and late acquired sounds (Macrae, Tyler, & Lewis, 2014). Because children's phonological systems are still developing, they may be less likely to intentionally alter a word form (particularly for a familiar word).

Alternatively, children might overimitate, copying an incorrect pronunciation of a common word for social or sociolinguistic reasons. This hypothesis is supported by work on phonetic convergence. Adult speakers have been shown to match not just the actions but also the speech patterns of their conversational partners, a phenomenon that has been referred to as the "chameleon effect" (Bailenson & Yee, 2005; Chartrand & Bargh, 1999; Pardo, 2006). Children who are willing to adopt an atypical or incorrect pronunciation might be at an advantage in development because they would be able to adapt to sociolinguistic variation in speech such as regional and standard accents.

To assess whether children overimitate in the vocal domain, Experiment 1 presented children with incorrect pronunciations of high-frequency proper and common nouns that children were very likely to know. As a control, we included low-frequency proper and common nouns that children were unlikely to know as well as nonwords with sound patterns matching those of high-frequency nouns. During testing, some of the words included primary stress on the second syllable rather than the first syllable (standard pronunciation). Although children should imitate the stressed second syllable when presented with low-frequency words and nonwords, it is an open question whether they would also imitate the stressed second syllable for high-frequency words. If children overimitate in the vocal domain, then they should imitate the stressed second syllable when presented with high-frequency words.

Experiment 1

Method

Participants

A total of 80 participants were included in Experiment 1: 40 3-year-olds ($M = 41.7$ months, range = 36–47, 20 female) and 40 4-year-olds ($M = 54.63$ months, range = 48–59, 20 female). One quarter (25%, $n = 20$) of the children belonged to a racial or ethnic minority group, and 15%

(n = 12) were identified by parents as bilingual. Bilingual children were included in the final sample because a preliminary analysis revealed that their performance did not statistically differ from that of monolinguals in any of the measures. In Experiments 1 and 2, participants were recruited from the Smithsonian National Zoo's Think Tank and the Smithsonian National Museum of Natural History's Discovery Room. Recruitment required parental consent followed by participant assent for the experiment.

Materials

The experiment used stickers for establishing rapport with the participants before the start of the experiment. A 17-inch white Apple iMac computer with a detachable Apple A1048 keyboard was used to present a custom PowerPoint presentation to the child. A commercially available audio-recorder was used to record all vocal responses. All audio clips used in the experiment were recorded in a soundproof booth using Standard American English (SAE) pronunciation and attached to a corresponding PowerPoint slide (e.g., the word /'pizza/ was paired with the picture of a slice of pizza). See Appendix for a list of words used.

Procedures

After obtaining parental consent and participant assent, the experimenters established rapport with participants by playing with stickers and encouraging them to place the stickers on a piece of paper. During this time, the primary experimenter asked each participant about his or her favorite color, food, or animal in order to expose and familiarize the participant with the primary experimenter's speech. This "warm-up" period lasted approximately 5 min.

Training

Four training trials were used to establish that the participant understood and would comply with the procedures. Training trials included familiar common nouns with appropriate pictures and SAE pronunciations. The training trials included PowerPoint slides with the following sound files and images: *dog*, *basketball*, *firetruck*, and *ice cream*. At the start of training, the primary experimenter told the child that the experiment was a picture-naming task: "We are going to name the pictures that we see on the computer." Then, the child was given the following instructions: "The computer goes, I go, then you go." The child was never invited to repeat after or to explicitly copy the experimenter. The experimenter advanced to the first slide with a picture, a prerecorded audio clip naming the picture played automatically, and the experimenter then named the picture, always matching the pronunciation of the previous audio clip, and then waited for the participant to name the same picture. Each trial typically lasted no more than 5 s. With the completion of the training slides, the participant advanced to the testing procedure.

Testing

Following training, participants were immediately introduced to one of four randomized word lists consisting of 80 two-syllable nouns varying in class (common or proper) and frequency (familiar or novel) using the same procedures described above. Only one noun was presented per trial (n = 80 trials). Half of the trials (n = 10 familiar common, 10 familiar proper, 10 novel common, and 10 novel proper nouns) included nouns with the standard (correct) pronunciation (i.e., stress on the first syllable). The other half of the trials included nouns with the incorrect pronunciation (i.e., stress on the second syllable). As noted previously, each noun was paired with a visual stimulus freely available on the World Wide Web (cf. Fig. 1). The presentation followed the procedures described above for training.

After the participant named the noun, the experimenter nodded, smiled, and then moved on to the next noun regardless of the pronunciation used (correct or incorrect). That is, children were nondifferentially reinforced for their responses. If a participant hesitated (>5 s) for any reason, the experimenter would repeat the noun. If the participant did not produce the noun after the experimenter named it twice, the experimenter would advance to the next slide (e.g., Parra, Hoff, & Core, 2011). When children produced unintelligible or inaudible responses, they were asked to repeat what they said.

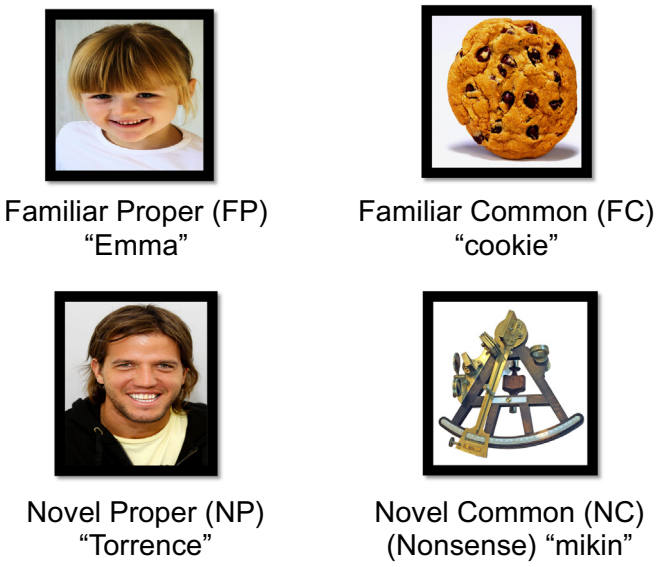

Fig. 1. Picture naming task stimuli. Different pictures were presented to children corresponding with familiar (high frequency) and novel (low frequency) nouns, including nonword nouns.

Brief breaks were included for participants who wanted more stickers during the trial.[3] Most children generally completed all 80 trials in approximately 8 to 10 min.

Word lists were randomized within participants for word order and pronunciation type (standard or novel). Familiar common nouns were selected from the top 75% of words acquired and used by children ages 2.5 to 3.5 years based on lexical norms from the MacArthur–Bates Communicative Development Inventories and published age of acquisition data (Dale & Fenson, 1996; Gilhooly & Logie, 1980). Familiar proper nouns (male and female first names) were selected from the Social Security online database's list of top 40 baby names for 2008, and novel proper nouns (also first names) were selected from the top 40 baby names for 1928. Nonwords were developed by manipulating sounds and syllables from the familiar common and proper noun lists to form phonologically matched nonwords.

Stress, rather than individual sounds, was manipulated in this experiment for several reasons. First, we wanted to avoid altering individual speech sounds (e.g. substituting or "mispronouncing" individual sounds) because we wanted forms that were easy for children to produce and that were not confounded with other typical or developmental pronunciation errors. Second, stress is an acoustically salient feature of words (Fowler, 1995). Children produce primarily trochaic (strong–weak) stress patterns early in their language development for both strong–weak and weak–strong word forms until around 3.5 years of age (Gerken, 1996). So, changing the production of lexical stress from the common strong–weak (trochaic) pattern for two-syllable words in English to the uncommon weak–strong (iambic) pattern is neither a part of the typical developmental pattern nor an error pattern that has been recorded in children learning SAE (Gerken, 1996). Third, we chose to alter the prosodic pattern using stress to underscore to children that this was not a word-learning task.[4] Because stress does not distinguish word pairs commonly known by young children, we hypothesized that they should recognize the novel pronunciation as an alternate form of a known word.

This procedure makes the task comparable to overimitation tasks using objects where the actions are never causally obligatory (i.e., irrelevant), as would be the case with a contrastive sound pattern.

[3] There was a 94.8% average completion rate among participants, with only eight participants completing fewer than the total 80 trials.

[4] A novel pronunciation involving sounds could be interpreted as either an unintentional mispronunciation or a novel word.

Finally, given the participants' ages, the use of a simple stress rule was necessary to minimize working memory (WM) confounds (Best & Miller, 2010; Garon, Bryson, & Smith, 2008). Phonological awareness tasks at the syllable level impose relatively low executive functioning and WM demands (Liberman, Shankweiler, Fischer, & Carter, 1974). Lessening WM demands was important given that previous work has shown that increasing WM load decreases overimitation (Dickerson, Gerhardstein, Zack, & Barr, 2013; Subiaul & Schilder, 2014).

Coding

All audio-recordings were coded by two raters. The experimenter who collected the data served as the primary coder. A second coder, who was blind to the methods or hypotheses being tested, was used to establish inter-rater reliability (kappa = .79). For productions that were not in agreement, a consensus method was used to resolve the discrepancies (Shriberg, Kwiatkowski, & Hoffmann, 1984).

Measures

We focused specifically on children's responses on trials that included an incorrectly pronounced noun. Following the conventions used in the social learning literature (Want & Harris, 2002; Whiten, McGuigan, Marshall-Pescini, & Hopper, 2009), we classified children's responses either as (a) goal emulation (henceforth emulation), correctly pronouncing the incorrectly accented noun (i.e., achieving the goal of naming the picture on the screen using the correct or conventional pronunciation), or as (b) imitation, copying the incorrectly accented noun following a demonstration. We analyzed the proportion of total words imitated or emulated separately for novel and familiar words resulting in four measures: Familiar Imitation (overimitation), Familiar Emulation (correctly pronouncing the mispronounced word), Novel Imitation (imitation learning where the child correctly reproduced the model's pronunciation of the novel word), and Novel Emulation (stressing the first syllable following a demonstration where the model stressed the second syllable of a novel word).

Hypothesis

If children overimitate in the vocal domain, then imitation rates should be greater than 22%—the approximate frequency that SAE speakers stress the second syllable (Cutler & Carter, 1987)[5]—for familiar words. Alternatively, if children do not overimitate in the vocal domain, then imitation rates *should not* differ from 22% for familiar words. Finally, we predicted that emulation rates would be significantly *greater* than imitation rates for familiar words but not for novel words.

Results

We did not include an analysis of trials where the model correctly pronounced words (i.e., stressed first syllable) because children performed at ceiling, imitating the model at rates greater than 95%. As such, we focused only on trials where the model mispronounced words. Preliminary analysis of data from trials where the model stressed the second syllable showed no significant effect for sex or age. There was also no effect of noun class. Consequently, we did not analyze these variables further. We first tested whether the proportion of incorrectly pronounced nouns was imitated at rates greater than 22%. The proportion of nouns that were incorrectly imitated significantly differed from 22% regardless of noun frequency ($M_{\text{familiar}} = .60$, $M_{\text{novel}} = .73$; all $ts > 9.00$, all $ps < .005$, one-sample t-test: test value = .22, two-tailed). A comparison of imitation rates during the first half and second half of testing was not statistically significant for familiar words, $t(74) = -1.46$, $p = .16$, two-tailed, but was statistically significant for novel words (novel words: $M_{\text{first-half}} < M_{\text{second-half}}$), $t(74) = -2.50$, $p = .02$, two-tailed.

[5] More than 75% of two-syllable SAE words have primary stress on the first syllable. There are very few word pairs that use lexical stress to contrast meaning (e.g., 'record vs. re'cord, 'project vs. pro'ject) in SAE where the second syllable is stressed in nearly every case (Cutler & Carter, 1987). Given that none of the words used in the current study stresses the second syllable and that children tend to stress the first syllable regardless of whether the word has a stressed second syllable (Gerken, 1996), 22% is a very conservative estimation of the baseline frequency of stressing the second syllable for young children.

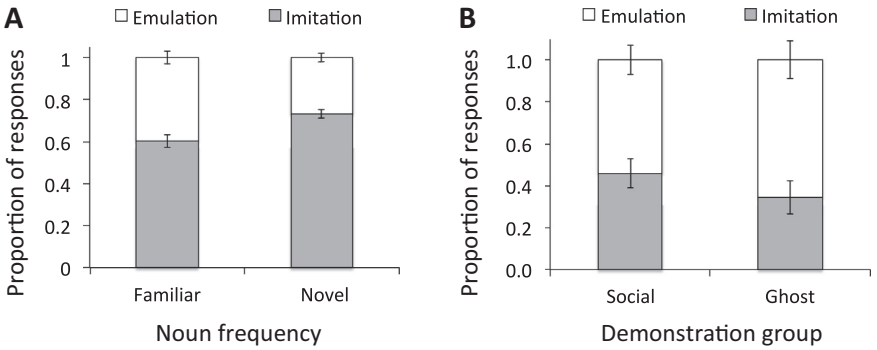

Fig. 2. Proportions of social learning responses in Experiments 1 and 2. Imitation corresponds with copying the mispronounced word. Emulation corresponds with correcting the mispronounced word by stressing the first syllable rather than the second syllable. (A) Experiment 1: Rate of responses by noun frequency. (B) Experiment 2: Rate of responses by demonstration type (only familiar words were used).

Table 1
Proportions of children's responses (and standard errors) in Experiments 1 and 2.

	Experiment 1		Experiment 2	
	Social Familiar	Social Novel	Social Familiar	Ghost Familiar
Baseline[a]	–	–	.72 (.02)	.76 (.03)
Emulation	.40 (.03)	.27 (.02)	.54 (.07)	.65 (.08)
Imitation	.60 (.03)	.73 (.02)	.46 (.07)	.35 (.09)

Note. Social and Ghost correspond with demonstration type. Familiar and novel correspond with word frequency. Emulation corresponds with children correcting the model's mispronounced word (i.e., accenting the first syllable rather than the second syllable). Imitation corresponds with children copying the mispronounced word (i.e., accenting the second syllable). For familiar words, imitation corresponds with overimitation.

[a] Children in Experiment 2 were tested only on words that they correctly pronounced during Baseline.

We then evaluated the frequency of imitation versus emulation. To do so, we performed two repeated measures analyses of variance (ANOVAs). The first compared Familiar Imitation with Familiar Emulation. The second ANOVA compared Novel Imitation with Novel Emulation. Both were significant (familiar: $F(1, 79) = 12.80$, $p < .002$, $\eta^2 = .14$; novel: $F(1, 79) = 111.36$, $p < .001$, $\eta^2 = .56$; Greenhouse–Geisser, Mauchly's $W = 0$). In both cases, children imitated significantly more than they emulated. Results are summarized in Fig. 2A and Table 1.

Discussion

Results showed that children imitate low-frequency words and nonwords as expected but that they also imitate high-frequency (familiar) words. Results also showed that children were more likely to imitate than they were to emulate for both low- and high-frequency words. In effect, children were as likely to imitate an incorrectly accented word that they were likely to know as they were to imitate an accented word that they were *un*likely to know.

It is unclear why children's imitation performance increased with successive testing (at least for novel words). One possible explanation comes from the testimony literature (Jaswal, Croft, Setia, & Cole, 2010; Sobel & Kushnir, 2013). For instance, although children heard the experimenter name familiar words incorrectly, which should have dampened their trust of the experimenter and suppressed overimitation, children also heard the experimenter correctly name familiar words as well as unfamiliar words that children were unlikely to know. This might have led children to view the model as an expert, making children more likely to trust the experimenter's sometimes idiosyncratic

responses in later trials. Regardless, children in the current experiment overwhelmingly (>60%) adopted incorrect pronunciations of familiar words as much as they adopted the pronunciations of novel words.

Nonetheless, Experiment 1 had a number of limitations. First, what if some children individually accented the second syllables of some words? Imitation in this case would fail to satisfy our second criterion for overimitation (i.e., copying an incorrect response despite knowing the correct form) because the models' response would not be perceived as atypical or incorrect. Second, what if some of the familiar words used in the experiment were not, in fact, familiar to some participants? If the children who imitated the incorrect pronunciations did not know (or were unsure about) the correct pronunciation of the target words, again, the second criterion for overimitation is not satisfied. Third, what if children regarded the two demonstrations as representing two different models (computer and experimenter) providing converging evidence that the stressed second syllable is, in fact, the "conventional" pronunciation (Keupp et al., 2013)? In this case, children should overimitate familiar words.

Given these limitations, Experiment 2 replicated many of the procedures used in Experiment 1 but included a number of methodological changes. First, only familiar words were used, excluding any possibility for word learning. Second, children were given firsthand experience in naming the familiar words themselves prior to testing, emphasizing that the goal of the task was to name the pictures on the screen as well as priming the words' conventional phonological representations and standard pronunciations. This pretesting procedure also allowed us to determine whether children spontaneously stressed the second syllable and shared the experimenter's "accent." We modeled these procedures after various studies in the artifact domain that include a "prior experience" condition/phase (Hoehl, Zettersten, Schleihauf, Gratz, & Pauen, 2014; Nielsen, Moore, & Mohamedally, 2012; Subiaul & Schilder, 2014; Williamson & Meltzoff, 2011).

Third, to exclude the perception of two different models providing converging evidence for a linguistic norm, we tested two independent groups of children: Social and Ghost conditions. Each group received two demonstrations from *one* model prior to testing. One group heard the live experimenter twice prior to testing. Another group heard the computer twice prior to testing. The addition of this second group also allowed us to assess whether children equally privilege social and asocial (computerized) demonstrations when controlling for agency and the need for live input from a model. Following the convention of the artifact domain, we refer to this second asocial condition as the Ghost condition/control (Hopper, 2010).

Having primed the correct phonological representation prior to testing and providing children with only one model—methodological features that should suppress vocal overimitation—might children, nonetheless, alter their previously correct response to incorrectly accent a word following a demonstration? If children persist in imitating a mispronounced familiar word immediately after they correctly pronounced the same word, then we can more convincingly conclude that children overimitate in the vocal domain.

Experiment 2

Method

Participants

A total of 40 children ranging from 36 to 59 months of age were included in Experiment 2. Half of the children were tested in a Ghost (computer) condition (M = 44 months, range = 36–59), and the rest were tested in a Social condition (M = 47 months, range = 39–57). There were equal numbers of male and female children. Participants were recruited from the same locations and followed the same recruitment process and standards as in Experiment 1. Of the sample, 6 participants (14%) identified as bilingual. These children were included in the final sample because their performance did not significantly differ from that of monolinguals and their exclusion did not alter the reported results.

Materials

Only the familiar words and images used in Experiment 1 were used in Experiment 2. All other materials (i.e., computer and audio-recorder) were the same as in Experiment 1.

Training procedures

These were the same as in Experiment 1.

Testing procedures

Testing included two conditions: Baseline and Demonstration. Children received one of two types of demonstration: Social or Ghost (between participants). In contrast to Experiment 1, we used only high-frequency familiar nouns.

Baseline condition. Participants were instructed to "name the pictures you see on the computer." The primary experimenter used a custom PowerPoint program that featured 18 images of familiar common nouns used in Experiment 1 and 2 in addition to the images from the training slides (dog and ice cream) for a total of 20 images, 1 per trial. The primary experimented asked "What is this?" for each image to elicit naming from participants. No demonstration was provided. Baseline testing lasted between 5 and 10 min.

Demonstration conditions. During Demonstration conditions, children were told that they were going to play a similar naming game as in the Baseline condition except that they received a demonstration prior to responding. The same 18 familiar common nouns (plus 2 practice nouns) used during Baseline were presented in a randomized order across 18 trials following the 2 practice trials. During Demonstration, a model (computer or experimenter) pronounced half of the images ($n = 9$) correctly (i.e., stressing first syllable). The other half ($n = 9$) were consistently mispronounced (i.e., stressing the second syllable).

There were two Demonstration conditions: Ghost and Social. Children were tested in only one of these conditions and were provided with one of the following instructions prior to the start of testing:

Demonstration–Ghost (computer): "This time, the computer will take two turns and then you will go." During this condition, the experimenter controlled the slides but did not name any of the pictures. The computer generated an audio-recording on a female experimenter producing either a standard or accented form of each noun twice.

Demonstration–Social: "This time, I will take two turns and then you will go." During this condition, the experimenter repeated either the standard or accented form of each noun two times before the participant was allowed to respond.

Coding

Results were recorded for each participant with a video camera and microphone and were coded by two raters. The primary coder recorded results from both the Baseline and imitation conditions during the trial. A second coder, who was blind to the methods and hypotheses, was used to establish inter-rater reliability (kappa = .81). Disagreements were resolved using consensus transcription (Shriberg et al., 1984).

Measures

During the Baseline condition, coders evaluated whether children spontaneously named the pictures from the slides using the correct (conventional) pronunciation (i.e., stressed first syllable). Responses were defined as "correctly pronounced" (1) or "incorrectly/not pronounced" (0). During testing (Social or Ghost), we analyzed only those words that were correctly pronounced during Baseline; mispronounced words were excluded from analysis. As in Experiment 1, children's responses were classified as emulation when mispronounced nouns were pronounced correctly by children and as imitation when children imitated the mispronounced nouns. Because all of these nouns were familiar nouns that have been correctly pronounced during Baseline, imitation corresponds with overimitation.

Results

As in Experiment 1, we did not include an analysis of trials where the model correctly pronounced words (i.e., stressed first syllable) because children performed at ceiling, imitating the model at rates greater than 95%. Preliminary analyses showed that children's responses did not significantly correlate

with sex ($r < .10$, $p > .50$). In addition, although age significantly correlated with accurately naming words spontaneously during Baseline ($r = .48$, $p < .005$), it did not correlate with any other measure ($r < .05$, $p > .90$). Given these results, we did not evaluate sex or age further.

In contrast to Experiment 1, the Baseline condition showed that none of the children ever stressed the second syllable for any of the target words. As such, the Baseline rate of stressing the second syllable spontaneously was zero. Nonetheless, out of an abundance of caution, we also tested whether imitation rates exceeded 22%, the approximate percentage of words with a stressed second syllable in SAE. Results showed that children in both the Social and Ghost demonstrations imitated the incorrectly stressed second syllable at rates greater than 0 (all $ps < .01$, two-tailed). The same was true when imitation rates were compared with 22%. However, this effect was more robust for the Social demonstration ($M = .46$, $SD = .42$), $t(21) = 2.70$, $p < .02$, than for the Ghost demonstration ($M = .29$, $SD = .27$), $t(20) = 1.87$, $p = .08$, two-tailed, binomial test.

As in Experiment 1, we also compared whether children imitated the incorrectly stressed second syllable more during the first half or the second half of testing. Imitation rates did not significantly differ for either demonstration (Social or Ghost) during the first half and second half of testing (all $ps > .15$, paired samples t-test, two-tailed).

We next analyzed whether children imitated more than they emulated between and within the two test groups. Neither imitation nor emulation rates significantly differed between demonstrations (Ghost vs. Social, all $ps > .10$, independent samples t-test). Within demonstrations, however, emulation rates were significantly greater than imitation rates in the Ghost demonstration, $t(20) = -2.30$, $p = .04$, two-tailed, but not the in the Social demonstration, $t(18) = -0.43$, $p = .68$, two-tailed, paired samples t-test. Results are summarized in Fig. 2B and Table 1.

Discussion

Whether the model was a live experimenter (Social) or a computer (Ghost), children imitated a mispronounced familiar word at rates greater than 0, the rate of stressing the second syllable during Baseline. The same was true when children's imitation performance in the Social and Ghost test groups (albeit marginally) were compared to 22%, corresponding with the frequency that children in SAE generally produce a stressed second syllable. These results broadly replicate those reported in Experiment 1, providing additional evidence for vocal overimitation.

Although children in the Social demonstration group did not overimitate more relative to children in the Ghost test group, children in the Ghost demonstration group were more likely to emulate, correcting the model's incorrect pronunciation, than they were to overimitate, copying the model's incorrect pronunciation. The same analysis for children in the Social demonstration group revealed no significant differences between emulation and imitation rates (cf. Fig. 2B and Table 1).

General discussion

This study sought to test whether overimitation—a peculiar feature of children's social learning in the artifact domain—extends to a very different domain, language. Results from two experiments showed that children imitate mispronounced familiar words. The mispronunciation of familiar words persisted even after children had correctly pronounced the target words prior to test, providing robust evidence of vocal overimitation. However, in contrast to results from the artifact domain (McGuigan et al., 2007, 2010), vocal overimitation did not significantly increase with age. As such, vocal overimitation was independent of increasing linguistic knowledge much like overimitation in the artifact domain appears to be independent of physical (causal) reasoning knowledge. Together, these results demonstrated that overimitation is not restricted to the artifact domain (Lyons, 2009).

To date, no study has specifically tested or reported overimitation in the vocal domain. Although some studies have required children to imitate words versus nonwords (Coady & Evans, 2008; Gathercole & Baddeley, 1989; Zamuner et al., 2004) and explored whether children adopt novel adjectives in familiar phrases to make a request (Bannard et al., 2013), none has explored whether children imitate "accents" or non-contrastive phonological variants of common words whose conventional pronunciations are very familiar to them. As such, no study has directly extended the concepts or methods

used to study overimitation in the artifact domain to the linguistic or vocal domain. This may be because there are many reasons why children should *not* overimitate in the vocal domain. For instance, according to some theorists, overimitation results from encoding all demonstrated actions (relevant and irrelevant) as part of one conventional norm (Kenward et al., 2011; Rakoczy et al., 2008). Some of these studies have shown that children protest when individuals violate norms in social games even when those norms are arbitrary and children learned the rules in a few trials (Rakoczy et al., 2008). Given children's insistence on maintaining norms, children should be particularly resistant to violations of linguistic norms, including phonological norms. Consistent with this conclusion is linguistic evidence showing that children over-regularize irregular verbs (Marcus et al., 1992) and are more accurate when imitating nonwords that conform to the speech pattern of their language over nonwords that do not conform to the sound patterns of their language (Beckman & Edwards, 2000; Edwards et al., 2004; Zamuner et al., 2004). There is also evidence from grammatical and phonological development suggesting that children should conform to, rather than deviate from, linguistic norms (Clark, 1987; Golinkoff et al., 1994; Markman, 1990). In other words, multiple lines of evidence predict that children should *not* overimitate. But that is not the case. The current study demonstrates that children overimitate in the vocal domain much like they overimitate in the artifact domain.

Children's overimitation in the vocal domain is best explained by social hypotheses. These hypotheses broadly predict that children overimitate to affiliate with and "be like" others (Over & Carpenter, 2012) rather than as a mechanism to acquire lexical or local phonological patterns. Consistent with this conclusion is evidence showing that whereas children in the Social demonstration imitated and emulated with equal frequency, in the Ghost demonstration nearly twice as many children emulated than imitated. These results provide evidence that children generally know and apply the trochaic (strong–weak) phonological rule of SAE in ambiguous circumstances and are sensitive to the identity of the speaker. This may be an adaptive behavior that helps children to learn important phonological variations, such as dialect variations, in their native language. Children may also overimitate as a way to accomplish social goals (Clark, 1996) or to align linguistic representations by converging communication patterns with their conversational partners, for example, in communicating to attain a particular goal (Garrod & Doherty, 1994; Pickering & Garrod, 2004). Regardless of why children overimitate in the vocal domain, the current study makes clear that they do. Specifically, children are willing to violate their own linguistic knowledge—much like they are willing to violate their own causal knowledge—by altering their speech production to match that of a model. This surprising result demonstrates that the tendency to overimitate is strong and potentially present in many different domains.

In Experiment 1, the imitation of the novel accent may have been due to the fact that some children individually accented the second syllables of some words. Experiment 2 excluded this possibility, showing that none of the children spontaneously accented the second syllable when generating the names of picture items during Baseline. Another concern from Experiment 1 was that some of the familiar words used may not have been familiar to some participants. This concern was addressed by the Baseline condition in Experiment 2 where children spontaneously and correctly generated the target words on their own prior to testing. Experiment 2 also addressed the possibility that in Experiment 1 children regarded the two demonstrations as representing two different models (computer and experimenter), providing converging evidence that the stressed second syllable is, in fact, the "conventional" pronunciation (Keupp et al., 2013). Despite providing only a single model, children continued to overimitate, including in a demonstration where the model was the computer (i.e., Ghost). However, it is clear that children overimitated less in Experiment 2 ($M = .46$) than in Experiment 1 ($M = .60$). The generally lower rate of overimitation in Experiment 2 relative to Experiment 1 may have to do with the fact that children's spontaneous production of words during Baseline primed their correct pronunciations, potentially inhibiting any alternation of these words following the demonstration for a subset of children.

The fact that children heard the model mispronounce some familiar words might have led participants to think of the model as unreliable or foreign. Previous research has shown than young children prefer to imitate in-group members rather than "foreign" out-group members (Buttelmann, Zmyj, Daum, & Carpenter, 2013). In the current study, if children thought that the model had an accent (and was an out-group member), then children should have been less likely, not more likely, to overimitate the mispronounced familiar words.

There are other important questions raised by the current study as well as possible limitations. First, why expand the definition of overimitation to include "idiosyncratic" or "incorrect" responses? The inclusion of idiosyncratic or incorrect responses is aimed at including behaviors that are generally "unnecessary" to achieve a goal. The second criterion for overimitation, however, is more consequential. Even adults display poor physical reasoning (Silva & Silva, 2006; Silva, Silva, Cover, Leslie, & Rubalcaba, 2008; Silva et al., 2005). As such, experiments should never assume that a given participant knows or understands what is necessary to achieve a goal. We suggest a higher bar for overimitation studies, one that involves demonstrating that participants violate their own knowledge and previous behavior(s) to match those of a model.[6]

Second, is accenting the second syllable in SAE "unnecessary" or "incorrect"? It is possible, of course, that children regarded the accenting of the second syllable as a stylistic flourish, an idiosyncratic response necessary to identify with the model. We do not reject these possibilities. But, we must emphasize that such interpretations of the data are not unique to the current study. In fact, most evidence of overimitation is open to the same interpretation. Any causally unnecessary action, whether blowing or tapping on a box prior to opening it, may be construed as a stylistic, idiosyncratic, or cultural norm. These accounts seek to explain *why* overimitation occurs, not *whether* overimitation occurs. Because no previous study had addressed *whether* children overimitate in the linguistic domain, this study was primarily designed to answer this latter question. The reason *why* children might overimitate is a separate empirical question. The current study shows that individuals copy an unnecessary accent much like they copy unnecessary actions in the artifact domain. As stated previously, we accept that the copying of accents, like the copying of arbitrary actions on an object, may serve to identify with the model. This "like me" hypothesis (Meltzoff, 2007) for overimitation was supported in the current study given the lower rates of overimitation among children in the Ghost demonstration group where the computer, rather than a live experimenter, served as the model.[7]

Children's strong tendency to incorrectly imitate a stressed second syllable (i.e., overimitate) even after they had correctly stressed the first syllable during Baseline begs the following question: What are the limits of vocal overimitation? The current study demonstrates that children are willing to violate standard phonological pronunciations, but are there limits to how much children are willing to alter a phonological form? For example, in our study all of the sounds of the elicited words were preserved, and only the stress patterns were altered. Although some infant studies have shown that infants recognize familiar words even when the word-initial consonant sounds are replaced with near sounds (Halle & de Boysson-Bardies, 1996; Swingley & Aslin, 2000; Vihman, Nakai, DePaolis, & Halle, 2004), we do not know whether children accept mispronunciations that deviate more widely from the correct form. Evidence from perception studies (Whiten & Morgan, 2008) suggests that children might reject phonetically distant forms (e.g., "shrog" for "dog") as referring to the same word, potentially inhibiting vocal overimitation in such instances. Another question is whether children would imitate a semantic violation such as a prompt to say "cat" instead of "dog." Finally, it is an open question what would happen in more socially interactive settings. Whatever the answers to these questions might be, understanding the boundary conditions of vocal overimitation will certainly shed greater light on the range of children's exceptional imitation abilities, but more important it might also shed new light on children's intuitive knowledge of their native language and the limits of communication.

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[6] We recognize, however, that outside experimental contexts, children (and adults) may "overimitate" precisely because they *do not* know what is causally necessary or that a response or action is "incorrect." For this reason, it is critical that overimitation research control for participants' knowledge directly in order to differentiate imitation from overimitation.

[7] See also work by Chartrand and Bargh (1999) on the chameleon effect.

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Appendix

Experiment 1: Sample list of words (training words are italicized; accented are bolded).

Dog	
Firetruck	**Muffin**
Basketball	Esta
Ice cream	**Supper**
	Shedrick
Kaylee	Ossie
Angel	Mardell
Apple	Durward
Nathan	Burnell
Ava	**Arlad**
Airwe	Chicken
Emma	**Appger**
Mikin	**Eunice**
Tiger	Chizza
Towyon	Hanna
Lauren	Mia
Verner	**Mildred**
Polly	**An-ter**
Jacob	Piddy
Orville	Quarnute
Brandon	Quarter
Norma	Pillow
Wayland	**Torrence**
Evert	Chloe
Matthew	**Candy**
Ethan	Pizza
Craylow	**Cangel**
Sarah	Pipper
Salad	**Mason**
Napple	**Army**
Crayon	**Napkin**
Summy	Noah
Armand	**Mucket**
Airplane	**Andrew**
Shower	**Burton**
Japlane	Ashley
Doris	**Sophie**
Jayden	**Towel**
Cooffin	Jacket
Showel	
Cookie	
Vonda	
Ti-cken	
William	
Audra	
Sakie	
Minute	

Experiment 2: Sample word list (accented are bolded).

Noun List 1 (Baseline)	Noun List 2 (Test)
Shower	Candy
Napkin	**Salad**
Crayon	**Airplane**
Cookie	Apple
Pillow	**Angel**
Towel	Pillow
Salad	**Pizza**
Candy	Chicken
Jacket	**Cookie**
Muffin	Army
Quarter	**Jacket**
Army	Napkin
Airplane	Muffin
Tiger	**Tiger**
Apple	Quarter
Angel	**Crayon**
Pizza	**Shower**
Chicken	Towel

References

Bailenson, J. N., & Yee, N. (2005). Digital chameleons: Automatic assimilation of nonverbal gestures in immersive virtual environments. *Psychological Science, 16*, 814–819.

Bannard, C., Klinger, J., & Tomasello, M. (2013). How selective are 3-year-olds in imitating novel linguistic material? *Developmental Psychology, 49*, 2344–2356.

Beckman, M. E., & Edwards, J. (2000). The ontogeny of phonological categories and the primacy of lexical learning in linguistic development. *Child Development, 71*, 240–249.

Bekkering, H., Wohlschlager, A., & Gattis, M. (2000). Imitation of gestures in children is goal-directed. *Quarterly Journal of Experimental Psychology A, 53*, 153–164.

Berl, R. E., & Hewlett, B. S. (2015). Cultural variation in the use of overimitation by the Aka and Ngandu of the Congo Basin. *PLoS ONE, 10*, e0120180.

Best, J. R., & Miller, P. H. (2010). A developmental perspective on executive function. *Child Development, 81*, 1641–1660.

Buttelmann, D., Zmyj, N., Daum, M., & Carpenter, M. (2013). Selective imitation of in-group over out-group members in 14-month-old infants. *Child Development, 84*, 422–428.

Carpenter, M., Akhtar, N., & Tomasello, M. (1998). Fourteen- through 18-month-old infants differentially imitate intentional and accidental actions. *Infant Behavior and Development, 21*, 315–330.

Chartrand, T. L., & Bargh, J. A. (1999). The chameleon effect: The perception–behavior link and social interaction. *Journal of Personality and Social Psychology, 76*, 893–910.

Clark, H. H. (1996). *Using language*. Cambridge, UK: Cambridge University Press.

Clark, E. (1987). The principle of contrast: A constraint on language acquisition. In B. MacWhinney (Ed.), *Mechanisms of language acquisition* (pp. 1–33). Hillsdale, NJ: Lawrence Erlbaum.

Coady, J. A., & Evans, J. L. (2008). Uses and interpretations of non-word repetition tasks in children with and without specific language impairments (SLI). *International Journal of Language and Communication Disorders, 43*, 1–40.

Cutler, A., & Carter, D. M. (1987). The predominance of strong initial syllables in the English vocabulary. *Computer Speech & Language, 2*, 133–142.

Dale, P. S., & Fenson, L. (1996). Lexical development norms for young children. *Behavioral Research Methods, Instruments, & Computers, 28*, 125–127.

Dickerson, K., Gerhardstein, P., Zack, E., & Barr, R. (2013). Age-related changes in learning across early childhood: A new imitation task. *Developmental Psychobiology, 55*, 719–732.

Edwards, J., Beckman, M. E., & Munson, B. (2004). The interaction between vocabulary size and phonotactic probability effects on children's production accuracy and fluency in nonword repetition. *Journal of Speech, Language, and Hearing Research, 47*, 421–436.

Ferguson, C. A., & Farwell, C. B. (1975). Words and sounds in early language acquisition. *Language, 51*, 419–439.

Flynn, E. (2008). Investigating children as cultural magnets: Do young children transmit redundant information along diffusion chains? *Philosophical Transactions of the Royal Society of London B: Biological Sciences, 363*, 3541–3551.

Fowler, C. A. (1995). Acoustic and kinematic correlates of contrastive stress accent in spoken English. In K. S. Harris, F. Bell-Bertin, & L. J. Raphael (Eds.), *Producing speech: Contemporary issues for Katherine Saffort Harris* (pp. 355–373). New York: American Institute of Physics.
Garon, N., Bryson, S. E., & Smith, I. M. (2008). Executive function in preschoolers: A review using an integrative framework. *Psychological Bulletin, 134*, 31–60.
Garrod, S., & Doherty, G. (1994). Conversation, co-ordination, and convention: An empirical investigation of how groups establish linguistic conventions. *Cognition, 53*, 181–215.
Gathercole, S. E., & Baddeley, A. D. (1989). Evaluation of the role of phonological STM in the development of vocabulary in children: A longitudinal study. *Journal of Memory and Language, 28*, 200–213.
Gathercole, S. E., Frankish, C. R., Pickering, S. J., & Peaker, S. (1999). Phonotactic influences on short-term memory. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 25*, 84–95.
Gerken, L. (1996). Prosodic structure in young children's language production. *Language, 72*, 683–712.
Gilhooly, K. J., & Logie, R. H. (1980). Age-of-acquisition, imagery, concreteness, familiarity, and ambiguity measures for 1,944 words. *Behavior Research Methods & Instrumentation, 12*, 395–427.
Golinkoff, R. M., Mervis, C. B., & Hirsh-Pasek, K. (1994). Early object labels: The case for a developmental lexical principles framework. *Journal of Child Language, 21*, 125–155.
Halle, P. A., & de Boysson-Bardies, B. (1996). The format of representation of recognized words in infants' early receptive lexicon. *Infant Behavior and Development, 19*, 463–481.
Hoehl, S., Zettersten, M., Schleihauf, H., Gratz, S., & Pauen, S. (2014). The role of social interaction and pedagogical cues for eliciting and reducing overimitation in preschoolers. *Journal of Experimental Child Psychology, 122*, 122–133.
Hopper, L. M. (2010). "Ghost" experiments and the dissection of social learning in humans and animals. *Biological Reviews of the Cambridge Philosophical Society, 85*, 685–701.
Horner, V., & Whiten, A. (2005). Causal knowledge and imitation/emulation switching in chimpanzees (*Pan troglodytes*) and children (*Homo sapiens*). *Animal Cognition, 8*, 164–181.
Jaswal, V. K., Croft, A. C., Setia, A. R., & Cole, C. A. (2010). Young children have a specific, highly robust bias to trust testimony. *Psychological Science, 21*, 1541–1547.
Kenward, B., Karlsson, M., & Persson, J. (2011). Over-imitation is better explained by norm learning than by distorted causal learning. *Proceedings of the Royal Society of London B: Biological Sciences, 278*, 1239–1246.
Keupp, S., Behne, T., & Rakoczy, H. (2013). Why do children overimitate? Normativity is crucial. *Journal of Experimental Child Psychology, 116*, 392–406.
Lennox, L., Cermak, S. A., & Koomar, J. (1988). Praxis and gesture comprehension in 4-, 5-, and 6-year-olds. *American Journal of Occupational Therapy, 42*, 99–104.
Liberman, I. Y., Shankweiler, D., Fischer, F. W., & Carter, B. (1974). Explicit syllable and phoneme segmentation in the young child. *Journal of Experimental Child Psychology, 18*, 201–212.
Lyons, D. E., Damrosch, D. H., Lin, J. K., Macris, D. M., & Keil, F. C. (2011). The scope and limits of overimitation in the transmission of artefact culture. *Philosophical Transactions of the Royal Society of London B: Biological Sciences, 366*, 1158–1167.
Lyons, D. E. (2009). The rational continuum of human imitation. In J. A. Pineda (Ed.), *Mirror neuron systems: The role of mirroring processes in social cognition* (pp. 77–106). Totowa, NJ: Humana Press.
Lyons, D. E., Young, A. G., & Keil, F. C. (2007). The hidden structure of overimitation. *Proceedings of the National academy of Sciences of the United States of America, 104*, 19751–19756.
Macrae, T., Tyler, A. A., & Lewis, K. E. (2014). Lexical and phonological variability in preschool children with speech sound disorder. *American Journal of Speech Language Pathology, 23*, 27–35.
Marcus, G. F., Pinker, S., Ullman, M., Hollander, M., Rosen, T. J., & Xu, F. (1992). Overregularization in language acquisition. *Monographs of the Society for Research on Child Development, 57*(4, Serial No. 228).
Markman, E. M. (1990). Constraints children place on word meaning. *Cognitive Science, 14*, 57–77.
McGuigan, N., Makinson, J., & Whiten, A. (2010). From over-imitation to super-copying: Adults imitate causally irrelevant aspects of tool use with higher fidelity than young children. *British Journal of Psychology, 102*, 1–18.
McGuigan, N., Whiten, A., Flynn, E., & Horner, V. (2007). Imitation of causally opaque versus causally transparent tool use by 3- and 5-year-old children. *Cognitive Development, 22*, 353–364.
Meltzoff, A. N. (2007). "Like me": A foundation for social cognition. *Developmental Science, 10*, 126–134.
Nielsen, M. (2006). Copying actions and copying outcomes: Social learning through the second year. *Developmental Psychology, 42*, 555–565.
Nielsen, M., & Blank, C. (2011). Imitation in young children: When who gets copied is more important than what gets copied. *Developmental Psychology, 47*, 1050–1053.
Nielsen, M., Moore, C., & Mohamedally, J. (2012). Young children overimitate in third-party contexts. *Journal of Experimental Child Psychology, 112*, 73–83.
Nielsen, M., & Tomaselli, K. (2010). Overimitation in Kalahari Bushman children and the origins of human cultural cognition. *Psychological Science, 21*, 729–736.
Over, H., & Carpenter, M. (2012). Putting the social into social learning: Explaining both selectivity and fidelity in children's copying behavior. *Journal of Comparative Psychology, 126*, 182–192.
Pardo, J. S. (2006). On phonetic convergence during conversational interaction. *Journal of the Acoustical Society of America, 119*, 2382–2393.
Parra, M., Hoff, E., & Core, C. (2011). Relations among language exposure phonological memory, and language development in Spanish–English bilingually developing two year olds. *Journal of Experimental Child Psychology, 108*, 113–125. http://dx.doi.org/10.1016/j.jecp.2010.07.011.
Pickering, M. J., & Garrod, S. (2004). Toward a mechanistic psychology of dialogue. *Behavioral and Brain Sciences, 27*, 169–190.
Rakoczy, H., Warneken, F., & Tomasello, M. (2008). The sources of normativity: Young children's awareness of the normative structure of games. *Developmental Psychology, 44*, 875–881.
Shriberg, L. D., Kwiatkowski, J., & Hoffmann, K. (1984). A procedure for phonetic transcription by consensus. *Journal of Speech and Hearing Research, 27*, 456–465.

Silva, F. J., Page, D. M., & Silva, K. M. (2005). Methodological–conceptual problems in the study of chimpanzees' folk physics: How studies with adult humans can help. *Learning and Behavior, 33*, 47–58.
Silva, F. J., & Silva, K. M. (2006). Humans' folk physics is not enough to explain variations in their tool-using behavior. *Psychonomic Bulletin and Reviews, 13*, 689–693.
Silva, F. J., Silva, K. M., Cover, K. R., Leslie, A. L., & Rubalcaba, M. A. (2008). Humans' folk physics is sensitive to physical connection and contact between a tool and reward. *Behavioral Processes, 77*, 327–333.
Sobel, D. M., & Kushnir, T. (2013). Knowledge matters: How children evaluate the reliability of testimony as a process of rational inference. *Psychological Reviews, 120*, 779–797.
Sosa, A. V., & Stoel-Gammon, C. (2006). Patterns of intra-word phonological variability during the second year of life. *Journal of Child Language, 33*, 31–50.
Subiaul, F., Anderson, S., Brandt, J., & Elkins, J. (2012). Multiple imitation mechanisms in children. *Developmental Psychology, 48*, 1165–1179.
Subiaul, F., & Schilder, B. (2014). Working memory constraints on imitation and emulation. *Journal of Experimental Child Psychology, 128*, 190–200.
Swingley, D., & Aslin, R. N. (2000). Spoken word recognition and lexical representation in very young children. *Cognition, 76*, 147–166.
Tomasello, M., Kruger, A., & Ratner, H. (1993). Cultural learning. *Behavioral and Brain Sciences, 16*, 496–511.
Vihman, M. M., Nakai, S., DePaolis, R. A., & Halle, P. (2004). The role of accentual pattern in early lexical representation. *Journal of Memory and Language, 50*, 336–353.
Want, S. C., & Harris, P. L. (2002). How do children ape? Applying concepts from the study of non-human primates to the developmental study of "imitation" in children. *Developmental Science, 5*, 1–13.
Whiten, A., McGuigan, N., Marshall-Pescini, S., & Hopper, L. M. (2009). Emulation, imitation, over-imitation, and the scope of culture for child and chimpanzee. *Philosophical Transactions of the Royal Society of London B: Biological Sciences, 364*, 2417–2428.
Whiten, K., & Morgan, J. A. (2008). Sub-segmental detail in early lexical representations. *Journal of Memory and Language, 59*, 114–132.
Williamson, R. A., Jaswal, V. K., & Meltzoff, A. N. (2010). Learning the rules: Observation and imitation of a sorting strategy by 36-month-old children. *Developmental Psychology, 46*, 57–65.
Williamson, R. A., & Meltzoff, A. N. (2011). Own and others' prior experiences influence children's imitation of causal acts. *Cognitive Development, 26*, 260–268.
Zamuner, T. S., Gerken, L., & Hammond, M. (2004). Phonotactic probabilities in young children's speech production. *Journal of Child Language, 31*, 515–536.