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EMPIRICAL STUDY

Gestures and Words in Naming: Evidence From Crosslinguistic and Crosscultural Comparison

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We report on an analysis of spontaneous gesture production in 2-year-old children who come from three countries (Italy, United Kingdom, Australia) and who speak two languages (Italian, English), in an attempt to tease apart the influence of language and culture when comparing children from different cultural and linguistic environments. Eighty-seven monolingual children aged 24–30 months completed an experimental task measuring their comprehension and production of nouns and predicates. The Italian children scored significantly higher than the other groups on all lexical measures. With regard to gestures, British children produced significantly fewer pointing and speech combinations compared to Italian and Australian children, who did not differ from each other. In contrast, Italian children produced significantly more representational gestures than the other two groups. We conclude that spoken language development is primarily influenced by the input language over gesture production, whereas the combination of cultural and language environments affects gesture production.

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Introduction

Motor, gestural, and vocal productions are closely linked in typically developing children (Capirci & Volterra, 2008; Goldin-Meadow & Alibali, 2013; Iverson & Thelen, 1999). Both verbal and gestural productions emerge at around one year of age, and infants show an early preference to communicate via gestures over speech (Iverson, Capirci, & Caselli, 1994). Although spoken language quickly becomes the dominant form of communication, the gestural and verbal modalities are closely coupled developmentally. For instance, gesture use predicts subsequent gains in spoken language (e.g., Bates, Benigni, Bretherton, Camaioni, & Volterra, 1979; Butcher & Goldin-Meadow, 2000; Capirci, Iverson, Pizzuto, & Volterra, 1996), and in the adult system, the two modalities are closely integrated. While the use of gestures for early communication appears common to all humans (e.g., Liszkowski, Brown, Callaghan, Takada, & de Vos, 2012), crosscultural differences in gesture use are manifest. However, crosscultural comparisons are invariably confounded by linguistic differences between groups. In the present study, we attempted to tease apart the influence of language and culture on both gestural use and vocabulary development. Using a picture naming task, we compared two groups of children who shared the same language but were culturally distinct—Australian and British children—to a group of Italian children, who differ both linguistically and culturally from the former groups.

Background Literature

Pointing, Representational Gestures, and Word Development

The developmental course of gesture use has been well described. During the first year of life, infants begin to produce deictic gestures (i.e., POINTING, RITUALIZED REQUEST, GIVING, SHOWING),[1] which direct another's attention to an external object, and often precede or accompany the appearance of the first words, usually nouns (Bates, Camaioni, & Volterra, 1975). At the same time, infants also begin to repeat behaviors that are successful in gaining adult attention (e.g., CLAPS HANDS, BYE-BYE). Just before the onset of naming at around 12 months, children start to reproduce brief meaningful actions with objects (e.g., PLACING A COMB ON OWN HAIR), and soon after, perform the same actions without the objects. These actions are frequently used by children to communicate in a variety of situations and contexts, similar to those in

which first words are produced (Acredolo & Goodwyn, 1988; Caselli, 1994). The type of gestures, referred to as representational gestures (Caselli, Rinaldi, Stefanini, & Volterra, 2012; Pettenati, Sekine, Congestrì, & Volterra, 2012; Volterra, Caselli, Capirci, & Pizzuto, 2005), include a large set of hand and body movements or facial expressions that come to be associated with relatively stable meanings across different contexts of productions. These representational gestures stand for or represent a referent, class of referents, or relation between referents (e.g., fingers wrapped around the imaginary handle of a comb, flapping the hands for bird, fingers of the hand represent the teeth of a comb, bringing a closed fist to the ear to represent a telephone).

At around 16 months, children become easily able to map both words and gestures to objects, actions, or events, resulting in a substantial equipotentiality between the verbal and gestural modalities (Abrahamsen, 2000; Volterra et al., 2005). Hence, the onset of pointing is a reliable predictor of the appearance of first words (Bates et al., 1979; Tomasello, Carpenter, & Liszkowski, 2007), in particular, nouns (Iverson & Goldin-Meadow, 2005). Further, the production of gesture–word combinations that convey two distinct pieces of information (supplementary combinations) predicts the emergence of two-word utterances (Butcher & Goldin-Meadow, 2000; Fasolo & D'Odorico, 2012; Pizzuto & Capobianco, 2005).

On the other hand, the findings that looked at the onset of representational gestures that depict actions with the onset of word productions are not consistent, but seem to indicate that the link between the word and representational gesture productions is cultural. In Italian children, representational gestures have been reported to emerge as early as 12 months, to occur with increasing frequency between 16 and 20 months, and to precede or to be simultaneously produced with infants' first verbs (Iverson, Capirci, Volterra, & Goldin-Meadow, 2008). In contrast, North American children's representational gestures emerge roughly six months later, and typically precede the production of first verbs (Özçalışkan, Gentner, & Goldin-Meadow, 2014).

Overall, gesture use is a key predictor of progress in verbal language abilities (Capirci et al., 1996; Iverson & Goldin-Meadow, 2005; Longobardi, Rossi-Arnaud, & Spataro, 2012), and as such, gestures likely scaffold early language development. The tightly coupled relationship between gestures and language suggests a close link between motor programs associated with actions and gestures as well as spoken linguistic representations in children (Capirci, Contaldo, Caselli, & Volterra, 2005; Iverson et al., 1994; Volterra, Capirci, Caselli, Rinaldi, & Sparaci, 2017).

Gesture Production in Crosscultural and Crosslinguistic Spontaneous Interactions in the First Two Years

Work on the role of gestures in language development has directly explored the similarities and differences across children acquiring different languages (for a review, see Gullberg, de Bot, & Volterra, 2010). The picture is currently complex and points to similarities in early gesture use accompanied by discernible differences later in development. In a pioneering crosscultural and crosslinguistic study comparing the gestural and vocal repertoires of 25 Italian and American infants observed between 9 and 13 months of age (Bates et al., 1979), striking similarities were found between early vocal and gestural productions in which both groups performed similar schemes of symbolic play (e.g., holding an empty fist to the ear for TELEPHONE). Similarly, Blake, Vitale, Osborne, and Olshanksy (2005) reported remarkably similar gesture development in 9–15 month old infants of Anglo-Canadian, Italian-Canadian, European French, and Japanese origin, although there were some group differences in the relative use of different gesture types. Tamis-LeMonda, Song, Leavell, Kahana-Kalman, and Yoshikawa (2012) analyzed four types of gestures including pointing, showing objects, giving objects, and conventional gestures (e.g., waving, or open fist to request objects) in infants at 14 months and 2 years of age among three US ethnic groups (Mexican, Dominican, and African American). No differences were found in the use of gestures, possibly because the infants lived in the same geographical areas and, therefore, had shared cultural experience. Finally, Liszkowski et al. (2012) provided evidence for the universality of pointing gestures by 10–14 months in seven cultures, revealing similar handshape (i.e., extended index finger) and frequencies of use.

Other research suggests larger effects of culture on the spontaneous production of representational gestures. Iverson et al. (2008) followed three American and three Italian children longitudinally between the ages of 10 and 24 months, and reported more frequent production of representational gestures in the Italian children. The American children, in contrast, relied primarily on deictic gestures, which were also found in the Italian children's gesture repertoires, but to a lesser extent. The exposure to a rich gestural model may attune Italian children to the ways in which representational information can be captured by the manual modality. Indeed, the representational gestures produced by Italian children included object/action gestures (e.g., eating) and attributive gestures (e.g., big), whereas American children almost exclusively produced conventional gestures (e.g., hi, yes). Despite these differences in gesture vocabulary, in both cultures,

gesture plus speech combinations (co-speech) reliably predicted the onset of two-word combinations.

One recurrent problem in the interpretation of these studies is the confound between cultural and linguistic factors; that is, to-be-compared groups usually differ both linguistically and culturally. The course of oral language development itself, which is, as we have seen, closely linked to gestural development, can vary greatly depending on the language being learned. Such language-specific effects on learning are found for early phonological processing and lexical–prosodic processing influencing vocabulary growth (see Adam & Bat-El, 2009; Bleses et al., 2008; Bouchon, Floccia, Fux, Adda-Decker, & Nazzi, 2015; Delle Luche, Floccia, Granjon, & Nazzi, 2017; Höhle, Bijeljac-Babic, Herold, Weissenborn, & Nazzi, 2009; Nazzi, Floccia, Moquet, & Butler, 2009; Thordardottir, 2005). In the aforementioned context, it is difficult to conclude whether differences in gestural use observed in crosscultural studies (e.g., Iverson et al., 2008) are due to cultural environments (such as a rich gestural model from adults, for example), or differences in language growth, which then cascade onto differences in gestural development.

A final problem arising in previous investigations of crosscultural gestural development is that data were usually collected in spontaneous interactions with caregivers, making a comparison across children less reliable. More recently, studies adopting picture naming tasks to assess lexical abilities have found that young children often produce spontaneous gestures accompanying or substituting for the requested verbal responses. These picture naming tasks have several advantages: (a) They provide a common set of referents for communication that are known to the experimenter and to the coder; (b) they can be used to test different word types (e.g., nouns vs. predicates); and (c) they provide a controlled linguistic setting allowing for a comparable set of gestures across individuals and between groups (Stefanini, Bello, Caselli, Iverson, & Volterra, 2009). Using a picture naming task, Huttunen, Pine, Thurnham, and Khan (2013) found that Finnish children aged 2–5 years produced fewer deictic and representational gestures than British children. They argued that the result may reflect the conversational style observed in Finnish adults, which has been described as silence appreciating, slow paced, and receiver oriented. Two additional crosscultural studies have been conducted using the same picture naming task adopted in the current study, that is, the "Words in Game" or "Parole in Gioco" task (Bello, Giannantoni, Pettenati, Stefanini, & Caselli, 2012). Using this task, Italian and Japanese 2-year-olds did not differ in the frequency of representational gestures (Pettenati et al., 2012). In contrast, Italian children produced twice as many representational gestures as Canadian

English-speaking children, but their gestures had similar form, including similar hand-as-object, hand-as-hand, and size and shape gestures (Marentette, Pettenati, Bello, & Volterra, 2016).

The Current Study

We examined the linguistic and cultural confound associated with past studies by comparing Italian, Australian, and British (i.e., UK) 2-year-old children on a common picture naming task. Australian and British English are highly similar languages. Although the two varieties possess minor differences in standard vocabulary[2] and have distinct accents, they are mutually intelligible, owing to Australia's status as a former British colony.

To evaluate cultural distance between these three countries we needed to evaluate how the three populations differ in terms of communication style, particularly via their use of gesture. In the communication style and gesture literature, there are qualitative observations collected in the field rather than objective measures of cultural distance (Hall, 1976; Hall & Hall, 1990; Kendon, 2004). The communication style, or the typical communication pattern of both Australia and the United Kingdom, is defined as low context (Hall, 1976). In low-context culture, most information is transmitted in the message, with a heavy reliance on words to explicitly convey the meaning. Italian, however, is described as a high-context communication style in which a high significance is given to nonverbal communication, and stronger emphasis is given to the role of nonverbal communication than in many other cultures. In addition, Italian is anecdotally categorized as a high gestural culture (Kendon, 2004), whereas Australian and British speakers are not particularly known for their frequency and diversity of gesture use. Given the relatively large amount of gestures that adult Italian speakers display, it is quite possible that young Italian children will also develop a relatively large frequency of gestures, presumably larger than those developed by British and Australian children.

Broad scales of cultural distance are scarce in psychology, but a quantification has been developed in the field of international business studies (Håkanson & Ambos, 2010). The authors asked respondents to indicate to what extent, compared to their home country, they perceived foreign countries to be close or far away in terms of a sum of factors such as cultural or linguistic differences and geographical distance. The responses showed that the absolute physical geographical distances are a dominant influence on psychological distance perception. So, following this scale, the most culturally distant countries were Australia and Italy, followed by Australia and the United Kingdom, then Italy and the United Kingdom.

By comparing British English, Australian English, and Italian preschoolers on a common picture naming task (Bello, Caselli, Pettenati, & Stefanini, 2010; Bello et al., 2012; Cattani, Krott, Dennis, & Floccia, 2019), we aimed to tease apart the role of cultural and linguistic factors in gestural and lexical development. If spoken language development is purely affected by the target language, then Australian and British children, who are both acquiring English, should perform similarly in the naming task, but may differ from the Italian learners. Finally, if broad cultural distance exerts an effect, either solely or in addition to language, then performance in the three populations may be different, both in terms of vocabulary and gesture production.

We also investigated the relationship between gesture and spoken vocabulary development by examining the lexical–semantic element in the picture naming task. Specifically, we asked how the lexical category (nouns and predicates) might interface with the pattern of similarities and differences of gesture type in reference to languages and cultures. Using the picture naming task, Canadian English-speaking and Japanese children, like Italian children, produced more representational gestures in association with the predicate subtest (Marentette et al., 2016; Pettenati et al., 2012). Therefore, we expected Italian, British, and Australian children to also produce more representational gestures in association with the predicate than with the noun subtests. No comparative work has examined the production of pointing gestures on the semantic categories of the picture naming task. What we know so far is largely based on spontaneous interaction studies, which have linked the pointing gestures to the noun referents. Pointing gestures are considered a tool to refer to objects and are often associated with noun productions (Iverson et al., 2008; Iverson & Goldin-Meadow, 2005); therefore, we hypothesized that pointing gestures are used more often in the noun than the in the predicate subtests.

Next, we looked at whether the frequencies of pointing and representational gestures produced alone or with the accompanying spoken responses (i.e., unimodal vs. bimodal gesture productions) are equally represented across countries. Typically, 2- and 3-year-old children use gesture plus speech combinations (i.e., combinations of words with pointing or representational gestures) more frequently than unimodal gesture expressions in naming tasks, which has been shown for Italian children (Marentette et al., 2016, Stefanini et al., 2009), Australian children (Hall, Rumney, Holler, & Kidd, 2013), British children (Huttunen et al., 2013), and Canadian English-speaking children (Marentette et al., 2016).

Finally, we investigated the relationship between gestures produced during the production task and word accuracy in comprehension and production tasks. As we have seen, gestures play an important facilitating role in communicative development, with deictic gesture production predicting subsequent language development (Bates, Bretherton, Shore, & McNew, 1983; Iverson et al., 1994, 2008; Iverson & Goldin-Meadow, 2005; Özçalışkan & Goldin-Meadow, 2005), and with children using representational gestures to expand their repertoire of action meanings (Özçalışkan et al., 2014). However, spontaneous gesture production does not facilitate word production in a naming task. Indeed, when children increase the use of spoken words in a naming task, their use of spontaneous gestures gradually declines with age (Stefanini et al., 2009). Here, our narrow age range of 24–30 months could hinder the chance to reveal a negative relationship between gesture and word production. Thus, we did not expect to find any relationship between words and gesture production.

Method

Participants

Eighty-seven typically developing children participated ($M_{age} = 26.90$ months, $SD = 1.87$, *range* = 24–30). Age was normally distributed, with skewness of 0.17 ($SE = 0.26$) and kurtosis of –0.93 ($SE = 0.51$). The data were drawn from a larger database of children who participated in a naming task. A sample size of 81 children was needed for a repeated-measures ANOVA with three groups and four repeated measures, with power = .80, $\alpha = .05$, under the assumption of a medium effect size ($f = 0.25$). Given that we had a sample of 87 children, we were confident to have sufficient power. The sample included 35 British English-speaking children (19 females; $M_{age} = 26.83$ months, $SD = 1.77$), 30 Australian English-speaking children (19 females; $M_{age} = 26.50$ months, $SD = 1.67$), and 22 Italian-speaking children (12 females; $M_{age} = 27.55$ months, $SD = 2.15$).

The British children were recruited through the database held in the Babylab of the University of Plymouth. The Australian participants were Anglo-Celtic children recruited through personal contacts and mothers' groups across metropolitan Melbourne. The Italian children's videos were extracted from a database of children that took part in the Italian normative data collection (Bello et al., 2010, 2012), recruited from public nursery schools of Parma and Rome. None of the children had known hearing problems or developmental delays; all were born full-term and had been regularly exposed to a monolingual environment.

The highest education level between the two parents was used for the British and Italian cildren as an index of socioeconomic status. The proportion of parents having completed high school at most was 33% for British and 32% for Italian parents; parents with a university degree or above were at 67% for British and 50% for Italian parents. An additional 18% of Italian parents left school at the age of 14. The educational levels of Australian parents were not recorded. However, it is possible to infer the average socioeconomic status from publicly available statistics, which provide ranked indices of relative socioeconomic advantage and disadvantage.[3] The sample was drawn from 20 suburbs within an approximate 8-kilometer radius of La Trobe University, Melbourne. Of these suburbs, the median index of relative socioeconomic advantage and disadvantage was medium to high (*Mdn* percentile rank = 77.5), although the range was quite large (5–98). Preliminary nonparametric analyses confirmed that the children did not differ significantly across the three groups for age (Kruskal-Wallis $p = .16$) or gender, $\chi^2(2) = .64$, $p = .73$, Cramer's $V = .09$.

Materials

The picture naming task was designed to assess verbal lexical comprehension and production of young children. This instrument is validated for Italian and for British English-speaking toddlers aged 19 to 37 months, using the "Parole in Gioco" version of the task (Bello et al., 2010, 2012) and the "Words in Game" version of the task (Cattani et al., 2019). In both versions, the picture naming task is divided into four subtests: (a) noun comprehension, (b) noun production, (c) predicate comprehension, and (d) predicate production. The test includes 132 picture cards with a color photograph of an object (e.g., bus) or context defining an action (e.g., singing), a descriptive word (e.g., short), or a locative word (e.g., behind). Forty-four pictures are assigned as targets for the comprehension set, 44 for the production set, and 44 are used as distractors. The first two picture cards of each set for both comprehension and word production tests are used for the training phase. The noun comprehension and noun production subtests include 60 photographs divided into 20 triplets (plus two training triplets) depicting pictures in the following semantic categories: familiar objects of everyday use (15), clothing (11), furniture and objects of the house (9), animals (8), places and outside objects (7), food and drink (5), transport (4), and toys (1). The predicate comprehension and predicate production subtests include 60 photographs divided in 20 triplets (plus two training triplets) depicting actions (36), and pictures that can be described using adjectives (17)

Figure 1 Examples of picture naming game sets of triplets of picture cards for the noun and predicate subtests (either of an event or a descriptor) comprising a comprehension target (cat, building, short), a production target (dog, phoning, long), and a distractor picture (television, ripping, wet). Pictures are displayed in order as an example (comprehension, production, and distractor). [Color figure can be viewed at wileyonlinelibrary.com]

and adverbs (7). Examples of noun and predicate picture sets are presented in Figure 1.

The English version was developed independently in Australia and England. In the comprehension subtests, two targets of the noun comprehension subtest were replaced (the Italian picture of a bidé was replaced with a toilet for the Australian set and a sink for the UK set; the Italian picture of a balcony was replaced with a backyard for the UK set only). The replacement items were close to the original target picture; therefore, 20 items were retained in each comprehension subtest. In the production subtests, the Australian team replaced one item in the noun production subtest (a radiator) and two items

of the predicate production subtest (spinning and heavy) with pictures that were functionally different from the original version. As such, those three pictures were excluded from the current analyses, leaving 19 test pictures for the noun production subtest and 18 pictures for the predicate production subtest. The remaining comprehension, production, and distractor target words were matched in the three languages.

Procedure

The picture naming task was administered individually, beginning with two training trials designed to familiarize the child with the test. The three pictures were displayed in a row in front of the child on a small table or on the floor, but in random positions for each set. Each picture triplet contained a comprehension picture (comprehension target card), a related semantic picture (production target card), and a nonsemantic distractor picture (distractor card). The order of picture presentation within each subtest was predetermined according to the record form list. For each set of three pictures, the comprehension question was asked first. The experimenter said the corresponding target word, ensured that the child paid attention to all three pictures, and waited for the child to choose a picture. The child responded by pointing, touching, or picking up a picture. A trial ended once a child pointed to a picture (correct or incorrect card). However, if she spontaneously changed her mind, the new response was scored. When a child did not provide any response (by touching or picking up the card), another chance was given (i.e., the comprehension word was repeated). In the noun comprehension subtest, the experimenter's request was a noun such as cat or bus. In the predicate comprehension subtest, the verbal requests depended on the target word, either a verb (e.g., singing or sleeping), an adjective (e.g., big or full), or an adverb (e.g., outside or behind).

The production subtests were conducted parallel to the comprehension subtests. After a child responded to a comprehension request, the comprehension target picture and the nonsemantic distractor picture were removed from display, so that only the related semantic picture was left; this remaining card was used for the production subtest. At that point, the experimenter asked the child to name the picture. For the noun production subtest, the request was, "What is it?" and for the actions in the predicate production subtest, "What is s/he doing?" or "What is this child doing?" For the adjectives and adverbs, the question was "What is this like?" or "Where is this?" A maximum of two naming attempts were permitted in the production task. After the child's response (or absence of), the experimenter moved on to the next triplet. The noun subtests

were administered first, followed by the predicate subtests, with a short break in between. The entire session lasted approximately 30 minutes. All sessions were video-recorded for later transcription.

Data Analysis

We coded all communicative exchanges between experimenter and child, beginning when the picture was initially placed in front of the child and ending when the picture was removed.

Verbal Coding

In the comprehension tasks, children's responses were coded as correct when the child showed, indicated, or chose the photograph corresponding to the comprehension target. When the child pointed to the wrong picture or did not respond, the response was classified as incorrect or as a no response. In the production tasks, verbal responses were classified as correct, incorrect, or no response. A vocal response was coded as correct when the child provided the expected production target. Phonologically altered forms of correct words and onomatopoeic forms were accepted (e.g., for the picture of a hen: English "cluck cluck" instead of hen and Italian "coccodè" instead of *gallina*). For some pictures, more than one answer was considered correct. For example, the picture of a bag could be called *sacchetto*, *busta*, or *borsa* in Italian, and the lorry could be called lorry or truck in English. If children did not respond or gave an initial incorrect response, they had an additional chance to respond. In the case of two responses, a "best criterion" response was adopted: If the child provided a correct verbal response on the second attempt, she was given credit. Responses were marked as incorrect if the child answered with a word that was different from the target, or for responses that were unintelligible. Finally, if the child did not answer, produced a gesture but did not say a word, or informed the experimenter that she did not know the answer, a no response was counted.

Gesture Coding

Children produced various categories of gestures: deictic, representational, conventional, beats, and self-adaptor (for more details on classification of gesture types, see Butcher & Goldin-Meadow, 2000, and Stefanini et al., 2009). All visible actions (e.g., posture, body movements, and facial expressions) depicting pointing and representational gestures produced by the children interacting with the experimenter during the production (noun production and predicate production) tasks were coded as gestures (Kendon, 2004). These included

gestures produced with and without speech, and those occurring both before and after the child's verbal response. The other deictic (showing and giving), conventional, beats, and self-adaptor gestures were coded but not included in the analyses. Given the specific nature of the production tasks (asking children to name pictures), the criteria for coding an action as a gesture (Pettenati, Stefanini, & Volterra, 2010) were as follows: (a) The gesture was produced after the experimenter made the request to name the picture until the time the picture was removed; (b) the gesture could be performed with an empty hand or while holding the picture; and (c) the gesture was not an imitation of any preceding adult gesture (if the experimenter made an accidental gestural production). We coded the pointing and representational gesture productions in the production tasks. If a child produced several instances of the same repeated gesture (pointing or representational) for a picture or different representational gestures such as FALLING + BIKE to reproduce one communicative act, only one production was counted. Further, all productions containing gestures were coded for modality of expression as either unimodal if produced without speech, or bimodal if produced together with a correct or incorrect verbal responses.

Pointing Gestures

Pointing was defined as an extension of the index finger; for example, when asked to label a picture of a dog, the child points with the index finger extended toward the picture while saying "dog" (Stefanini, Caselli, & Volterra, 2007). Instances of pointing with multiple fingers extended were included, as were instances where children patted an object with the palm extended, which indicated the object on the picture or its location. Show and give gestures were excluded because these communication acts could be confused with the actions involved in the picture naming task, that is, when the children give or show the picture to the experimenter with the intention to place it back in the pile.

Representational Gestures

Representational gestures are pictographic representations of the meaning (or meanings) associated with the represented object or event (e.g., moving an arm with hand open and bended fingers for LION, rotating the arms for SWIMMING, and holding a hand close to the ear for PHONING).

Reliability

The interrater reliability for the picture naming task's comprehension and production subtests and gesture type was calculated based on the coding by speakers of each language. Two Italian coders (fourth and fifth authors) independently

coded the data of all Italian children (100%). All Australin and British children's data were processed by two British coders, who also coded independently responses from 9 Australian and 10 British children randomly selected from the datasets (30% and 29%) for reliability. All disagreements or uncertainties about verbal comprehension and production, gesture identity, and gesture type were resolved by discussion between the two coders within the Italian- and English-speaking languages.

Verbal Accuracy

For comprehension, Italian raters agreed on every decision (100% agreement, Cohen's $\kappa = 1.00$, assessed following Fleiss, Levin, & Paik, 2003), and English raters agreed on 98.8% (355/360 decisions, $\kappa = .99$, $SE = .006$) for Australian children and 98.3% (394/400 decisions, $\kappa = .99$, $SE = .006$) for British children. For production, Italian raters agreed on 94.1% for Italian children (766/814 labels, $\kappa = .88$, $SE = .012$), and English raters agreed on 99.1% (330/333 labels, $\kappa = .99$, $SE = .005$) for Australian children and on 97.8% (362/370 labels, $\kappa = .98$, $SE = .008$) for British children.

Gesture Identification

Reliability checks were calculated for gesture identification (a binary choice: gesture occurred or did not occur) in the production task. Raters generally agreed on the gestures identified, with the following agreement rates: 87.9% for Italian children, 97.9% for Australian children, and 97.3% for British children. Finally, gestures were further coded for gesture type. For the pointing gestures, raters agreed on 92.6% of the gestures for Italian children (327 of 353 pointing coded, $\kappa = .85$, $SE = .02$), 93.8% for Australian children (107 of 114 pointing coded, $\kappa = .94$, $SE = .023$), and 93.6% for British children (73 of 78 pointing coded, $\kappa = .95$, $SE = .025$). For the representational gestures, the agreement rate was 90.8% (119/131, $\kappa = .81$, $SE = .36$) for Italian children, 100% for Australian children (3 of 3 gestures, $\kappa = 1.00$), and 83.3% for British children (25 of 30 gestures, $\kappa = .83$, $SE = .07$).

Statistical Analyses

We tested the children's correct verbal responses with a $3 \times 2 \times 2$ repeated-measures ANOVA, with group (Italian children, Australian children, British children) as a between-participant variable and lexical category (nouns, predicates) and task (comprehension, production) as within-participant variables (see Table 1 for the descriptive vocabulary data and Figure 2 for the pictorial representation). Similar ANOVAs were conducted to analyze the incorrect and

Table 1 Means and standard deviations (in parentheses) for raw frequencies of word comprehension and production by Italian, Australian, and British children in the nouns and predicates subtests

	Italian children ($n = 22$)		Australian children ($n = 30$)		British children ($n = 35$)	
Words	Nouns	Predicates	Nouns	Predicates	Nouns	Predicates
Comprehension						
Correct	18.00 (1.69)	14.68 (2.87)	15.27 (2.84)	12.43 (3.48)	15.54 (2.95)	12.03 (4.20)
Production						
Correct	11.41 (3.61)	8.59 (3.89)	8.47 (3.67)	4.07 (2.97)	7.86 (4.12)	4.60 (3.28)
Errors	5.50 (3.85)	6.09 (3.28)	5.80 (2.02)	6.70 (3.15)	5.86 (3.09)	7.14 (2.91)
No response	1.95 (2.17)	2.91 (3.72)	4.73 (3.67)	7.20 (4.30)	5.29 (4.90)	6.26 (4.91)

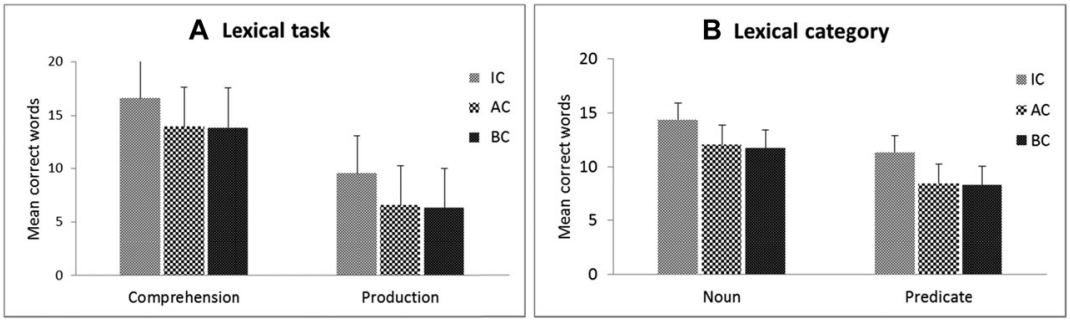

Figure 2 Mean number of correct words for (a) lexical task (comprehension and production) and (b) lexical category (nouns vs. predicates) identified by Italian (IC), Australian (AC) and British (BC) children.

no response categories, but only in the production task, as comprehension responses were only coded as correct or incorrect. Based on Mauchly's test for repeated measures with two levels, the assumption of sphericity was always met (Field, 2013). We report partial eta squared (η_p^2) as an estimation of effect size for ANOVA terms and report Cohen's *d* (and 95% confidence intervals) for effect sizes following pairwise comparisons and Cohen d_{rm} for within-participant factors.

For the pointing and representational gesture analyses, nonparametric statistics were conducted for the main factors and their single levels, because the data were not normally distributed. Kruskal-Wallis tests were performed for the analysis of the three groups and, when significant, further Mann-Whitney U statistics were conducted as post hoc comparisons. Wilcoxon signed rank tests were run for a sample group to measure the different conditions of pointing and representational gestures for each participant. The results of the pointing and representational gesture analyses with the *p* values are presented in Tables 2

Table 2 Summary of the Kruskal-Wallis analyses for the overall and subtasks targeting the pointing gestures produced by Italian (IC), Australian (AC), and British (BC) children

				Mdn			Kruskal-Walis *U (p)*		
	df, *n*	χ^2	*p*	IC	AC	BC	IC vs. AC	IC vs. BC	AC vs. BC
Lexical category									
Noun	2, 87	13.24	.001	4	7	2	354.5 (.649)	214.0 (.005)	279.5 (.001)
Predicate	2, 87	9.39	.009	4	3	2	290.5 (.461)	219.0 (.006)	349.0 (.019)
Modality of expression									
Unimodal	2, 87	0.48	.788	1	1	1	—	—	—
Bimodal	2, 87	17.35	<.001	7	8	2	304.5 (.636)	168.0 (.001)	265.0 (.001)
Lexical category × Modality of expression									
Noun unimodal	2, 87	1.81	.404	0	1	0	—	—	—
Noun bimodal	2, 87	16.01	<.001	4	6	1	332.5 (.963)	183.5 (.001)	267.5 (.001)
Predicate unimodal	2, 87	0.41	.815	1	1	0	—	—	—
Predicate bimodal	2, 87	10.70	.005	3	2	1	271.5 (.269)	202.0 (.002)	356.0 (.023)

and 5, and the effect sizes (absolute *r*s[4]) are reported in the text. The alpha level for all analyses was set at .05 (two-tailed).

Results

Vocabulary Accuracy

Correct Responses

This analysis revealed a significant main effect for group, $F(2, 84) = 10.99$, $p < .001$, $\eta_p^2 = .21$ (see Table 1 and Figure 2). The pairwise comparisons showed that the Italian children ($M = 13.17$, $SE = 0.58$) scored higher than the Australian children ($M = 10.06$, $SE = 0.50$) and the British children ($M = 10.01$, $SE = 0.46$). These mean differences were associated with large effect sizes (Italian vs. Australian children = 3.11, $p < .001$, $d = 1.14$, 95% CI [–1.73, –0.55]; Italian vs. British children = 3.16, $p < .001$, $d = 1.16$, 95% CI [–1.73, –0.58]). In contrast, the Australian and British children did not differ (Australian vs. British children = 0.05, $p = .676$, $d = 0.02$, 95% CI [–0.51, 0.47]). Further, there was also a significant main effect of lexical category (comprehension and production tasks collapsed), $F(1, 84) = 177.31$, $p < .001$, $\eta_p^2 = .68$, with more accurate responses for the nouns ($M = 12.76$, $SE = 0.31$) than predicates ($M = 9.40$, $SE = 0.34$). The mean difference (noun task vs. predicate task = 3.36, 95% CI [2.86, 3.86]) was associated with a large effect size $d_{rm} = 1.06$. Finally, the main effect of task (noun and predicate tasks collapsed) was significant, $F(1, 84) = 565.36$, $p < .001$, $\eta_p^2 = .87$, with children's responses being more accurate in the comprehension task ($M = 14.66$, $SE = 0.31$) than in the production task ($M = 7.50$, $SE = 0.35$). This mean difference (comprehension task vs. production task = 7.16, 95% CI [6.56, 7.76]) was associated with a large effect size $d_{rm} = 2.13$. There were no significant interactions.

All children performed more accurately in the comprehension than the production task and in the noun than in the predicate task. The most accurate task was noun comprehension for which 5/22 Italian children and 2/35 British children were at ceiling; no Australian children were at ceiling. No children reached ceiling in either language group for any of the three remaining tasks. The least accurate task was predicate production, for which 1/22 Italian children, 4/30 Australian children, and 4/35 British children performed at 0, not producing any correct response. In sum, the first analysis showed an overall language difference so that the accuracy of both English-speaking groups of children for verbal responses was lower than that of Italian-speaking children across the board, revealing a larger vocabulary in Italian-speaking children in production and comprehension. In particular, this vocabulary difference was not affected by lexical categories or tasks.

Incorrect Responses

The only statistically significant effect for incorrect responses was that of lexical category, $F(1, 84) = 5.85$, $p = .02$, $\eta_p^2 = .66$, due to children producing more errors on predicates ($M = 6.65$, $SE = 0.34$) than nouns ($M = 5.72$, $SE = 0.33$). This mean difference (noun task vs. predicate task = 0.93, 95% CI [0.17, 1.69]) was associated with a small effect size $d_{rm} = 0.30$.

No Responses

This analysis revealed a significant main effect of group, $F(2, 84) = 6.64$, $p = .002$, $\eta_p^2 = .14$. The Italian children ($M = 2.43$, $SE = 0.82$) produced fewer no responses than the British ($M = 5.77$, $SE = 0.65$) and Australian ($M = 5.97$, $SE = 0.70$) children. The mean differences and effect sizes were large for these findings (Italian vs. Australian children = –3.54, $d = 0.93$, 95% CI [–5.67, –1.40]; Italian vs. British children = –3.34, $p = .002$, $d = 0.87$, 95% CI [–5.41, –1.27]). However, the Australian and British children did not differ (Australian vs. British children = 0.20, $p = .84$, $d = 0.05$, 95% CI [–1.70, 2.09]). The effect of lexical category was also significant, $F(1, 84) = 15.14$, $p < .001$, $\eta_p^2 = .15$, with predicates ($M = 5.46$, $SE = 0.48$) generating more no responses than nouns ($M = 3.99$, $SE = 0.43$). The mean difference for this finding (predicates vs. nouns = 1.46, $d_{rm} = 0.37$, 95% CI [0.72, 2.21]) was associated with a small effect size. The group × lexical category interaction was not significant, $F(2, 84) = 1.87$, $p = .16$, $\eta_p^2 = .04$.

Gesture Frequencies

Pointing Gestures

A total of 863 pointing gestures were coded, of which 202 were unimodal (98 for nouns and 104 for predicates) and 661 bimodal (406 for nouns and 255 for predicates). All but three children produced at least one pointing gesture; the maximum frequency of pointing gestures per child surpassed 30 (Italian children = 31, Australian children = 36, British children = 31). Figure 3 displays the median and range of pointing gestures produced in the noun and predicate production tasks by language group. The boxplots indicate a wide variability in the children's gesture productions with three British child outliers in each task and one Italian and one Australian child outlier in the predicate task.

The distribution of the pointing gestures was not normal across the three groups (Shapiro-Wilk test, with all $p < .01$), and the Levene's test of homogeneity of variance was violated for the unimodal noun measure $F(2, 84) = 5.79$, $p = .004$. Therefore, a nonparametric Kruskal-Wallis test was carried out

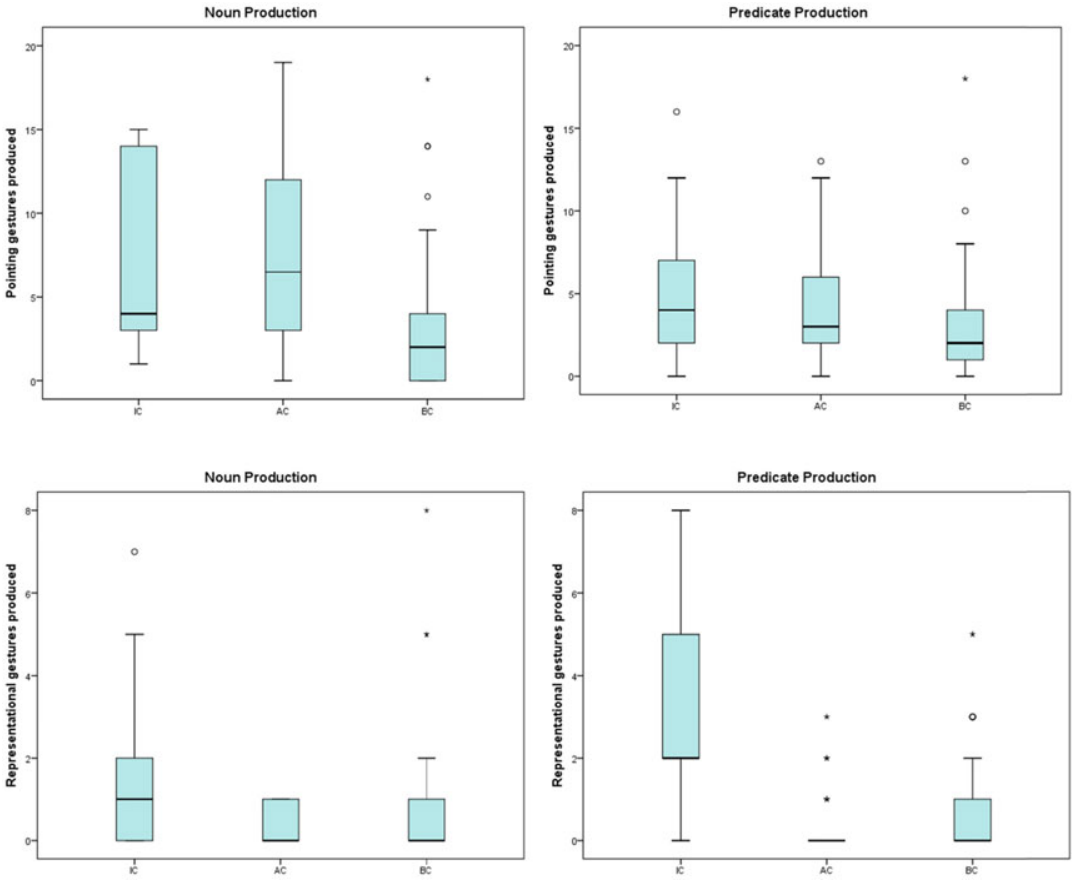

Figure 3 Box plots for the number of pointing (top) and representational (bottom) gestures produced by task for Italian (IC), Australian (AC), and British (BC) children. Outliers are depicted by small circles and extreme outliers by asterisks. [Color figure can be viewed at wileyonlinelibrary.com]

for three groups on the overall pointing gestures produced, revealing strong evidence of a difference between the mean ranks of at least one pair of groups, $\chi^2(2) = 13.87$, $p = .001$. The Mann-Whitney U test showed that the British children produced fewer pointing gestures than the Italian children, $U = 202.0$, $p = .007$, $r = 0.40$, and the Australian children, $U = 278.5$, $p = .001$, $r = 0.40$. However, no evidence was found for a difference between the Italian and Australian children, $U = 326.5$, $p = .948$, $r = 0.01$.

With regard to the lexical category (Table 2), there was evidence of a strong difference across groups in the noun task, $\chi^2(2) = 13.24$, $p = .001$, and the predicate task, $\chi^2(2) = 9.39$, $p = .009$. In the noun task, the British children produced fewer pointing gestures than the Italian children ($r = .37$) and the Australian children ($r = .40$). However, there was no evidence of a difference between the Italian and Australian children ($r = .06$). In the predicate task, the

British children produced fewer pointing gestures than the Italian ($r = .36$) and Australian ($r = 0.29$) children, but we found no evidence of a difference between the Italian and Australian children ($r = .10$). The within-group comparisons highlighted that the scores of the pointing gestures to an object/animal set or to action/characteristic set did not vary in most children. Wilcoxon signed ranks test indicated that the Italian children, $Z = 1.60$, $p = .111$, $r = .34$, and the British children, $Z = 1.47$, $p = .142$, $r = .25$, had a similar frequency of pointing gestures in association with the noun and the predicate tasks; however, the frequency of the pointing gestures of the Australian children was significantly greater in the noun than in the predicate task, $Z = 3.52$, $p < .001$, $r = .64$.

With regard to the modality of expression, the unimodal pointing expressions (gesture produced without a verbal response) were equally distributed across groups, $\chi^2(2) = .48$, $p = .79$. For the bimodal expressions (pointing gestures produced with a verbal response), we found a strong difference between the mean ranks of at least one pair of groups, $\chi^2(2) = 17.35$, $p < .001$. Mann-Whitney U tests revealed that the British children produced fewer pointing gestures with a verbal response than the Italian ($r = .47$) and the Australian ($r = .43$) children, but showed no evidence of a difference between the Italian and Australian children ($r = .07$). Looking at the median values for the modality of expression in Table 2, pointing gestures produced alone occurred rarely in all children. Pointing gestures produced with a verbal response were significantly more likely to occur than gestures produced without a verbal response for the Italian children, $Z = 3.53$, $p < .001$, $r = .75$, for the Australian children, $Z = 3.71$, $p < .001$, $r = .68$, and for the British children, $Z = 2.64$, $p = .008$, $r = .45$.

When exploring potential differences involving the interaction of the lexical category and modality factors (noun unimodal, noun bimodal, predicate unimodal, and predicate bimodal), the bimodal factors revealed significant group differences for bimodal noun production, $\chi^2(2) = 16.01$, $p < .001$, and for bimodal predicate production, $\chi^2(2) = 10.7$, $p = .005$. In post hoc comparisons, the British children produced fewer pointing gestures in the noun task ($r = .44$) and in the predicate task ($r = .40$) than the Italian children, and also produced fewer pointing gestures in the noun task ($r = .43$) and in the predicate task ($r = .43$) than the Australian children, with no difference between the Italian and Australian children across both tasks ($r = .01$ and $r = .15$, respectively). In sum, the British children produced fewer pointing gestures overall than the other groups of children, but this was restricted to when the pointing gesture was produced with a verbal response in the noun and the predicate subtests.

Table 3 Frequencies of elicited representational gestures for nouns by Italian ($n = 22$), Australian ($n = 30$), and British ($n = 35$) children, as a function of the presented picture in the naming task

Image	Italian	Australian	British	Total
Beach	0	0	1	1
Lorry/truck	1	0	0	1
Seal	0	0	0	0
Bag	0	0	0	0
Banana	0	0	1	2
Picture	1	0	0	0
Hen/chicken	0	1	1	2
Book	0	0	0	0
Socks	0	0	1	1
Comb	8	2	5	15
Table	0	0	0	0
Roof	0	0	0	0
Umbrella	6	0	3	9
Fork	2	1	2	5
Lion	5	1	2	8
Flags	3	2	4	9
Glass	2	0	1	3
Nappy	1	0	0	1
Gloves	3	2	6	11
Total	32	9	27	68

Representational Gestures

Tables 3 and 4 presents a list of pictures with frequencies of representational gestures, and Table 5 summarizes the results of the representational gesture analyses. The majority of pictures (33 out of 37) elicited at least one occurrence of spontaneous representational gesture. Highly familiar pictures that could involve manual or body actions were those that elicited the highest occurrences of representational gestures in all groups (e.g., COMB, GLOVES, SWIMMING, WASHING HANDS). The pictures that did not elicit representational gestures (e.g., bag, table) were familiar items that do not usually involve physical interaction in children.

We counted 172 spontaneous representational gestures, which included 48 unimodal (16 nouns and 32 predicates) and 124 bimodal responses (52 nouns and 72 predicates). Forty-nine children produced at least one representational gesture (21/22 or 95% of the Italian children, 11/30 or 37% of the Australian

Table 4 Frequencies of elicited representational gestures for predicates by Italian (n = 22), Australian (n = 30), and British (n = 35) children, as a function of the presented picture in the naming task

Image	Italian	Australian	British	Total
Small	3	0	1	4
Swimming	4	3	5	12
Empty	1	0	0	1
In	2	0	0	2
Kissing	6	1	2	9
Clean	0	0	0	0
Falling	3	0	0	3
Eating	2	0	2	4
Washing hands	12	3	5	20
Smiling	4	1	2	7
In front of	3	0	0	3
Playing	2	0	0	2
Phoning	11	1	2	14
Far apart	1	0	1	2
Driving	4	0	0	4
Opening	6	0	1	7
Long	2	0	1	3
Pushing	3	1	3	7
Total	69	10	25	104

children, and 17/35 or 48% of the British children), for a 4–15 range in the maximum frequency of representational gestures per child (Italian children = 15, Australian children = 4, British children = 10). The proportion of children who produced at least one representational gesture versus the children who did not produce any representational gestures was higher for the Italian children than for the Australian and British children, $\chi^2(2) = 19.26$, $p < .001$. The boxplots (Figure 3b) indicate an important variability of the Italian children's representational gesture productions, particularly in the predicate production subtest (only one outlier was present in the noun production subtest). Three Australian child extreme outliers were found in the predicate production subtest, and the Australian children were most likely to produce no gestures at all (no box shown). The British children had two extreme outliers in the noun and two in the predicate production subtest.

Normality checks on the representational gestures across the three groups showed that the assumption of normality had not been met (Shapiro-Wilks test

Table 5 Summary of the Kruskal-Wallis analyses for the overall and subtasks targeting the representational gestures produced by Italian (IC), Australian (AC), and British (BC) children

				Mdn			Kruskal-Walis *U (p)*		
	df, *n*	χ^2	*p*	IC	AC	BC	IC vs. AC	IC vs. BC	AC vs. BC
Lexical category									
Noun	2, 87	7.47	.024	1	0	0	207.0 (.010)	270.0 (.033)	540.0 (.804)
Predicate	2, 87	38.57	<.001	2	0	0	48.0 (.001)	95.5 (.001)	628.0 (.096)
Modality of expression									
Unimodal	2, 87	5.48	.064	0	0	0	—	—	—
Bimodal	2, 87	30.70	<.001	3	0	0	68.5 (.001)	126.0 (.001)	584.5 (.357)
Lexical category × Modality of expression									
Noun unimodal	2, 87	0.79	.673	0	0	0	—	—	—
Noun bimodal	2, 87	8.05	.018	1	0	0	206.0 (.007)	273.5 (.036)	563.0 (.514)
Predicate unimodal	2, 87	7.99	.018	0	0	0	223.0 (.007)	295.0 (.062)	577.5 (.270)
Predicate bimodal	2, 87	36.80	<.001	2	0	0	66.0 (.001)	111.0 (.001)	549.0 (.659)

with $p < .05$), and the homogeneity of variance was violated for all levels of the lexical category and modality of expression factors, according to Levene's test (all $p < .05$). The Kruskal-Wallis test carried out for the overall number of representational gestures provided strong evidence of a difference between the mean ranks of at least one pair of groups, $\chi^2(2) = 29.78$, $p < .001$. Mann-Whitney U tests showed that there was a difference between the Italian and the Australian chidren, $U = 60.5$, $p < .001$, $r = .72$, and between the Italian and the British children, $U = 132.5$, $p < .001$, $r = .56$, with the Italian children producing more representational gestures. However, there was no difference in the performance of the Australian and British children, $U = 600.0$, $p = .271$, $r = .14$.

With regard to the lexical category, a strong difference across groups was found in the noun task, $\chi^2(2) = 7.07$, $p = .03$, and in the predicate task, $\chi^2(2) = 38.53$, $p < .001$. In the noun task, the Italian children produced more representational gestures than the Australian ($r = .36$) and the British ($r = .28$) children; there was no difference between the Australian and the British children ($r = .03$). In the predicate task, the Italian children produced more representational gestures than the Australian ($r = .77$) and the British ($r = .65$) children, but there was no evidence of a difference between the Australian and the British children ($r = .21$). Based on the within-group comparisons, the frequencies of representational gesture productions were equally distributed across the noun and predicate tasks for the Australian children ($Z = 0.31$, $p = .755$, $r = .06$) and the British children ($Z = 0.48$, $p = .634$, $r = .08$). The Italian children produced more than twice as many representational gestures during the predicate task than the noun task ($Z = 3.34$, $p = .001$, $r = .71$).

With regard to the modality of expression, the representational gestures produced without a verbal response (unimodal expressions) were not significantly different across groups, $\chi^2(2) = 5.48$, $p = .06$. For the representational gestures produced with a verbal response (bimodal expressions), there was a difference between the mean ranks of at least one pair of groups, $\chi^2(2) = 30.70$, $p < .001$. Mann-Whitney U tests revealed that the Italian children produced more bimodal espressions than the Australian ($r = .71$) and the British ($r = .59$) children, but showed no evidence of a difference between the Australian and the British children's groups ($r = .11$). Indeed, the within-group comparisons highlighted that the representational gestures of the Italian children produced with a verbal response were significantly more likely to occur than gestures produced without a verbal response, as shown through Wilcoxon tests, $Z = 3.46$, $p = .001$, $r = .74$, while either the Australian children, $Z = 1.81$,

$p = .07$, $r = .33$, or the British children, $Z = 1.18$, $p = .237$, $r = .20$, showed no differences in the scores of unimodal and bimodal expressions.

The Kruskal-Wallis tests conducted to explore potential differences involving the interaction of the lexical category and modality factors (noun unimodal, noun bimodal, predicate unimodal, and predicate bimodal) revealed significant group differences for bimodal noun production, $\chi^2(2) = 8.05$, $p = .018$, for unimodal predicate production, $\chi^2(2) = 7.99$, $p = .018$, and for bimodal predicate production, $\chi^2(2) = 36.80$, $p < .001$. Post hoc comparisons showed that the Italian children produced more representational gestures with a verbal response than the Australian and the British children in bimodal noun production ($r = .71$ and $r = .28$, respectively) and in bimodal predicate production ($r = .65$ and $r = .74$, respectively). Within the unimodal gesture productions, the Italian children produced more representational gestures than the Australian children ($r = .74$) in the predicate subtest only. In sum, the Italian children produced significantly more representational gestures than the other two groups; in particular, they produced more bimodal representational gestures overall.

Relationship Between Gestures and Vocabulary

To determine whether gesture production was related to age and/or to the vocabulary accuracy, we correlated the children's pointing and representational gesture scores with their total accurate comprehension and production picture naming scores and with age. Neither of these variables correlated with the pointing gesture scores, but representational gestures were positively associated with age, $r = .23$, $p = .04$, and with vocabulary scores for comprehension, $r = .24$, $p = .03$, but not for production, $r = .04$, $p = .75$. We then carried out these analyses separately for individual groups, but correlations did not reach significance.

Discussion

The main goal of this study was to investigate the degree to which early speech (comprehension and production of words) and gesture development is influenced by language and culture. We compared two groups of English-speaking children, namely, British and Australian, and a group of Italian children, who all completed the same picture naming task. Any differences between the Italian and the English-speaking child groups would be attributable to both language and culture, while differences between British and Australian children would be caused by differences in cultural background.

Comprehension and Production of Words

In terms of spoken word knowledge, the Australian and British English-speaking children were remarkably similar on all measures of vocabulary. On the assumption that Australian and British lexicons share the same English language heritage, but that linguistic groups are geographically distant and culturally different, we did not exclude a priori vocabulary differences. Indeed, large discrepancies have been found in the parental reports of the Communicative Development Inventories (Hamilton, Plunkett, & Schafer, 2000) in the United Kingdom and the United States, with lower scores in comprehension and production for British children when compared to American children of the same age. Hamilton et al. (2000) argued for cultural differences between the two countries in terms of parental expectations; specifically, it is possible that American parents expected their children to talk more. They also discussed the possibility of differences in word frequency in infant-directed speech, which would modulate the rate of word acquisition. Of relevance is also the documented difference in the infant-directed speech style itself, with American parents producing more extreme prosodic variations than British parents (Fernald et al., 1989). Since prosodic cues assist children in extracting words from continuous speech (e.g., Thiessen, Hill, & Saffran, 2005), different styles in infant-directed speech might modulate the availability of segmentation cues (Floccia, Nazzi, Delle Luche, Poltrock, & Goslin, 2014), and therefore the growth of vocabulary (Bleses et al., 2008). The fact that we found no differences between Australian and British children in their spoken vocabulary suggests that children from these cultures share greater similarity of experience in their early communicative development than they share with North American children.

In contrast, our sample of Italian children outperformed the English-speaking children on all verbal measures. Previous findings from similar cross-language comparisons have reported that Italian children were more accurate in verbal performance than Canadian English-speaking children (Marentette et al., 2016) and Japanese children (Pettenati et al., 2012). Furthermore, recent normative data collected on British English children using the same picture naming task (Cattani et al., 2019) confirm that British English-speaking children tend to acquire words later than Italian children. For example, in the respective normative data from the Italian and the British versions of the production subtest, British children in the median percentile at 36 months of age say 25 words, whereas Italian children say 31 words. Thus, although the data are not indicative of the growth of vocabulary in this age group, these findings suggest that the Italian children are, all things being equal, slightly ahead.

Notwithstanding the cultural and geographical distance, our word data suggest that Australian and British children follow the same developmental path regarding vocabulary growth, and that there are closer links between these two populations than between British and American children. Having established a strong similarity in terms of vocabulary development between Australian and English children, we can now assume that any differences in terms of pointing and representational gesture production would be due to cultural backgrounds rather than linguistic factors.

Pointing Gestures

Across all country groups, all but three children produced at least one spontaneous pointing or one representational gesture, and overall produced more pointing gestures than representational gestures (see also Hall et al., 2013; Pizzuto & Capobianco, 2005). A previous crosscultural observational study recording the use of pointing in infants aged 10–14 months reported that its frequency did not differ across seven different cultures (Lizkowski et al., 2012). In the current study, however, we found crosscultural differences: Australian and Italian children produced more pointing gestures overall than British children. In particular, British children produced significantly fewer bimodal pointing expressions compared to the Italian and Australian children, who did not differ from each another.

The reasons why the Australian children used as many pointing gestures as the Italian children are not yet clear. Different child-rearing practices seem to have an impact on children's gesture production, as demonstrated by Lieven and Stoll (2013) in longitudinal video recordings of naturalistic settings in Nepal (Chintang) and in rural Germany. A similar timetable for the emergence of pointing was observed in both cases, with a peak at 26 and 28 months. However, German children were almost always pointing at higher rates than the Chintang children. This was thought to be due to them experiencing more one-to-one interactions with adults rather than larger groups of children playing together, as is common for Chintang children in Nepal. These cultural differences provided German children with more opportunities to experience pointing from adults, and therefore, imitate this behavior. In fact, Callaghan et al. (2011), based on data with Canadian and Indian infants, suggested that once pointing is established in the infant repertoire, cultural differences start to develop as a function of parental attitudes to socialization. Following this thought, one plausible explanation is cultural: In comparison to British cultural convention, pointing to objects and people in Australia is generally accepted, especially for young children. An additional explanation concerns the physical environment:

Australian children spend more time outdoors than British children do, so they may point more often because objects are regularly within sight but out of reach. To our knowledge, there has been no experimental investigation of the effect of the size of physical space on the frequency of pointing gestures, so this explanation awaits empirical confirmation.

We expected that pointing gestures would be produced more often when the target represented an object to label (e.g., noun) rather than a predicate (Bates et al., 1979; Iverson et al., 1994, 2008; Iverson & Goldin-Meadow, 2005), yet this was significant only among Australian children. Indeed, the first gestures recorded in spontaneous interactions of infants and caregivers are deictic gestures (i.e., pointing at objects and places in the near environment, or showing objects to draw attention to adults). These gestures are linked to the emergence of the first word combinations (Bates et al., 1979), and are mainly directed to noun referents. It is possible that this link changes with age, such that the prevalence of the pointing gesture–noun combinations that was observed at the beginning of the second year, during the first months of infants' speech productions, may become less evident in the third year when two-word utterances emerge. Future longitudinal research using the picture naming task is needed to investigate the developmental pathway of pointing gestures with the noun and predicate combinations.

Representational Gestures

Overall, children produced few representational gestures. This trend mimics the low frequency with which representational gestures occur in the input (Iverson, Capirci, Longobardi, & Caselli, 1999; Quinn & Kidd, 2019). For production of representational gestures, clear differences were observed across languages, which supports the view that these differences relate to a combination of linguistic background and communication style linked to cultural differences. In our work, cultural distance, operationalized as geographical distance (Håkanson & Ambos, 2010), did not predict the use of representational gestures. In fact, Italian children's representational gestures significantly outnumbered those produced by the English-speaking groups, who did not differ from each other. Evidence suggests that children growing up in linguistic environments with a rich gesture input and high-context communication style, such as Italy, produce a great variety of representational gestures, and produce them at an earlier age than children learning English in the United States (Capirci et al., 2005; Iverson et al., 2008). A similar picture naming study (Pettenati et al., 2012) compared Italian and Japanese children, whose cultures are both categorized as high-context communication styles (Hall & Hall, 1990).

Pettenati et al. reported that Japanese 2-year-olds did not differ from their Italian peers in the production of representational gestures, and attributed the productions of these gestures to the prevalence of a "learning while observing" style typical in the Japanese culture (p. 161), but it is also possible that representational gestures are used more frequently in Japanese culture (Aqui, 2004). In addition, we note that Australian children produced fewer representational gestures than British children. However, this difference was not significant. In general, the production of representational gestures was very low in the English-speaking groups.

The higher frequency of representational gestures for predicates as compared to nouns in Italian children was particularly noteworthy. This result is in line with previous crosscultural comparisons that have reported more representational gestures in association with actions or events than with object words (Pettenati et al., 2012; Marentette et al., 2016). In contrast, British and Australian children did not produce more representational gestures in association with the predicates than the noun subtests. They also produced few predicate words in comparison to the Italian children. These two results may be related: If gesture scaffolds spoken language development, then a lack of gestural representation for actions and attributes may slow down the acquisition of verbal labels.

Overall, children produced more pointing and representational gestures in combination with speech than gestures alone. This is consistent with previous findings that 2- and 3-year-old children use bimodal combinations more frequently than unimodal gesture expressions in naming tasks (e.g., see Marentette et al., 2016, and Stefanini et al., 2009, for Italian children; Hall et al., 2013, for Australian children; Huttunen et al., 2013, for British children; and Marentette et al., 2016, for Canadian English-speaking children). However, the Italian children produced significantly more crossmodal combinations of speech and representational gestures than the two English-speaking groups, who did not differ in this respect. This finding highlights the intimate link between the motor system and speech in early language acquisition. Stefanini et al. (2009) argued that children's lexical knowledge at this age is not yet fully decontextualized from their sensorimotor experience. That is, when children produce a gesture and a word to describe an action, they do so because the two modalities are connected through the representational properties of the motor system.

Finally, the overall production of representational gestures was positively associated with age. This is not surprising, given that previous data show an increase in the production of representational gestures at around 26 months of age (Özçalışkan & Goldin-Meadow, 2011). Representational gestures were

positively associated with the accuracy of vocabulary comprehension. Indeed, Caselli et al. (2012) argued that word comprehension constitutes a bridge between action/gesture production and word production, suggesting that the transition from action/gesture to word production is ontogenetically mediated by word comprehension. This may indicate an indirect cascading effect of culture on spoken language development, whereby living in a high-gesture culture could lead to a facilitated word comprehension and subsequently faster early vocabulary production.

Limitations and Future Directions

There are several limitations to this work. While we compared three samples of a given age range extracted from a corpus of data collected in a formal testing situation, we acknowledge that there are potential confounding variables related to the characteristics of the child populations and the testing environments. Children might invariably differ in the proportion of time spent in daycare, which potentially facilitates or inhibits their willingness to engage during a formal testing setting. Nevertheless, the fact that the vocabulary results are largely the same for the two English-speaking groups argues against the idea that home testing of the Australian children was an issue. It could also be argued that the gesture behavior (gesture production) of a child could be inhibited in a formal setting, but expressed when in everyday spontaneous interactions with caregivers or in children who are used to daycare and are more accustomed to formal testing. Rather, the high use of pointing gestures tells us that all children were highly engaged in the setting.

Further, we found that the Italian children outperformed the Australian and British children in the spoken task of the picture naming test. This difference may have emerged because the word items were originally selected by extracting the age of acquisition from the Italian MacArthur-Bates Communicative Development Inventory (Bello et al., 2010, 2012), reflecting possible cultural difference in the interpretation of the pictures. This limitation in the initial construction of the task could explain why the children from other languages and cultures (Japanese and Canadian children) gave fewer correct responses than Italian children. Future crosscultural comparisons should ideally include an additional independent measure of linguistic skills (e.g., MacArthur-Bates Communicative Development Inventory). We could not include a cross-comparison of percentiles in the Communicative Development Inventories because the normative data for the vocabulary size of the words understood and produced by British children, such as those available through the Oxford Communicative Development Inventory (Hamilton et al., 2000), are not yet available for our age

range (maximum age 25 months). In addition, there are no normative data for the words understood by Australian children as of yet (Kalashnikova, Schwarz, & Burnham, 2016). Notwhithstanding these limitations, the formal controlled linguistic setting and the systematic investigation of the research questions guiding this study have contributed to a better understanding of the relative influence of gestures and vocabulary in three cultures.

Conclusion

Overall, our results suggest that both language and culture affect vocabulary development and gesture production. Spoken language as measured by production and comprehension on a naming task is purely affected by the target language, as the Australian and British children performed similarly in the naming task but differed from the Italian children. A combination of language and culture, however, shapes the frequency and the type of gestures produced by children. The Italian children, who grow up in a gesture-rich culture and are exposed to a high-context communication style, produced significantly more representational gestures than the British and Australian children. However, we also observed differences between the British and Australian children, with the Australian children pointing more often—as often as the Italian children—compared to the British children, particularly when the pointing gesture was produced in combination with speech. These differences suggest that the frequency and type of gestures produced are influenced by cultural differences (which remain to be identified) rather than by the language.

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Notes

1 All glosses for gestures are reported in small capitals following a convention adopted in many studies on children's gestures.

2 Colloquial forms (e.g., hypocoristics) in adults are largely used by the Australian adults (e.g., Kidd, Kemp, & Quinn, 2011), but are not typically used in speech conversations with children.

3 Data available at http://www.abs.gov.au/ausstats/abs@.nsf/DetailsPage/2033.0.55.0012011?OpenDocument (accessed 9 July 2018); the 2011 data were used because the Australian children's data were collected in 2010.

4 Effect sizes for Wilcoxon signed rank tests were calculated using the following formula: $r = \frac{z}{\sqrt{observations}}$ (as recommended by Field, 2013) and can be interpreted according to Cohen's (1988) criteria, where .10 indicates a small effect, .30 indicates a medium effect, and .50 indicates a large effect.

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Appendix: Accessible Summary (also publicly available at https://oasis-database.org)

How Do Language and Culture Shape the Use of Gestures and Words by Toddlers?

What This Research Was About and Why It Is Important

Gesture use is a key predictor of progress in early development of language in children. Gestures are also believed to help early language development. Previous studies targeting the development of language and gesture included crosscultural comparisons that involved both cultural and linguistic differences between groups, which made it difficult to determine the roles played by language and culture. In this study, the researchers attempted to tease apart cultural and linguistic factors contributing to the development of vocabulary (e.g., in terms of understanding and producing words) and to the development of gestures (e.g., in terms of the incidence of pointing gestures). In particular, the researchers used a picture naming task to compare the performance of two groups of children who shared the same language but were culturally distinct (Australian and British children) to the performance of Italian children, who differ both linguistically and culturally from Australian and British children.

What the Researchers Did

- The researchers tested 35 British English-speaking children, 30 Australian English-speaking children, and 22 Italian-speaking children, all aged 24–30 months.
- The children performed a picture naming task measuring word learning in their language. The task, which is validated for Italian and for British English-speaking toddlers, focused on the comprehension and production of nouns and predicates (i.e., verbs or adjectives).
- The researchers also investigated the use of spontaneous gestures, including pointing gestures (usually expressed with the extension of the index finger) and representational gestures (e.g., flapping the hands for bird).
- Gesture use was also measured when gestures were produced in combination with a word (bimodal gesture expressions) or alone (unimodal gesture expressions).

What the Researchers Found

- For language (vocabulary) comprehension and production, Italian children outperformed both Australian and British English-speaking children, who performed similarly.

- For gesture production, children generally produced more gestures in combination with speech than gestures alone.
- Italian children produced more representational gestures than Australian and British children, who did not differ from each other.
- Australian and Italian children produced overall more pointing gestures than British children.

Things to Consider

- Because Australian and British children performed similarly but differed from Italian children in their language performance, language learning patterned in this study along linguistic lines.
- A combination of language and culture, however, shaped the frequency and the type of gestures produced by children.
  - The Italian children, who grew up in a gesture-rich culture, produced significantly more representational gestures than British and Australian children.
  - However, British and Australian children differed in their use of pointing gestures, with Australian children pointing more often (as frequently as the Italian children) compared to British children.
  - The reasons why Australian children used as many pointing gestures as the Italian children are unclear and should be explored in future research.

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