Infants prefer motionese to adult-directed action
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Abstract
In two studies, we investigated infants’ preference for infant-directed (ID) action or ‘motionese’ (Brand, Baldwin & Ashburn, 2002) relative to adult-directed (AD) action. In Study 1, full-featured videos were shown to 32 6- to 8-month-olds, who demonstrated a strong preference for ID action. In Study 2, infants at 6–8 months (n = 28) and 11–13 months (n = 24) were shown either standard ID and AD clips, or clips in which demonstrators’ faces were blurred to obscure emotional and eye-gaze information. Across both ages, infants showed evidence of preferring ID to AD action, even when faces were blurred. Infants did not have a preference for still-frame images of the demonstrators, indicating that the ID preference arose from action characteristics, not demonstrators’ general appearance. These results suggest that motionese enhances infants’ attention to action, possibly supporting infants’ learning.

Introduction
Our day-to-day social environment is complex and dynamic, comprising numerous actors, sounds, objects, and motions. However, when we watch other people’s actions, we do not see the movements of individual limbs, objects, and people as an overwhelming flood of activity. Rather, we recognize distinct action units and make ready sense of the intentions that motivate them (e.g. Baldwin & Baird, 2001; Zacks & Tversky, 2001). Even infants demonstrate sophisticated action-processing skills. Prior to their second year of life, infants can segment streams of action into discrete units, and can understand the movements of others in terms of goal-directedness (Baldwin, & Baird, 1999; Baldwin, Baird, Saylor & Clark, 2001; Buresh & Woodward, 2007; Carpenter, Akhtar & Tomasello, 1998; Meltzoff, 1995; Olineck & Poulin-Dubois, 2005; Saylor, Baldwin, Baird & LaBounty, 2007; Woodward, Sommerville & Guajardo, 2001).

One possible means of support for infants in their rapid development of social-cognitive skills may come from interactions with their caregivers (Csibra & Gergely, 2006; Darwin, 1872; Rogoff, 1990; Stern, Beebe, Jaffe & Bennett, 1977; Uzgiris, Benson, Kruper & Vasek, 1989). When adults interact with infants, they modify their behavior across a whole host of domains, including speech (Fernald & Mazzie, 1991; Fernald, 1992; Grieser & Kuhl, 1988; Snow, 1972), facial expressions (Chong, Werker, Russell & Carroll, 2003; Stern, 1974), and gestures (Iverson, Capirci, Longobardi & Caselli, 1999; Masataka, 1996; O’Neill, Bard, Linnell & Fluck, 2005). Additionally, mothers provide special synchrony between their speech and their movements when naming objects, referred to as ‘multimodal motherese’ (Gogate, Bahrick & Watson, 2000).

Recent research (Brand et al., 2002; Brand, Shallcross, Sabatos & Massie, 2007; Rohlfing, Fritsch, Wrede & Jungmann, 2006) has demonstrated that parents modify their bodily actions in a variety of ways when interacting with infants. This suite of modifications has been called ‘infant-directed action’ or ‘motionese’. Specifically, Brand and colleagues found that when mothers demonstrate objects to 6- to 8- and 11- to 13-month-old infants relative to adults, their actions are characterized by closer proximity to the partner; greater enthusiasm; a larger range of motion; greater repetitiveness; higher interactivity, including more and longer gazes to infants’ faces and more turn-taking; and greater simplification, in terms of the number of distinct actions performed during each turn. In addition, Rohlfing et al. (2006) used a 3D tracking system to code actions of fathers and mothers and found that ID actions to 8- to 11-month-old infants relative to adults, their actions are characterized by closer proximity to the partner; greater enthusiasm; a larger range of motion; greater repetitiveness; higher interactivity, including more and longer gazes to infants’ faces and more turn-taking; and greater simplification, in terms of the number of distinct actions performed during each turn. In addition, Rohlfing et al. (2006) used a 3D tracking system to code actions of fathers and mothers and found that ID actions to 8- to 11-month-old infants contained a greater proportion of pauses relative to actions and proceeded in a less smooth path through space than AD actions.

ID modifications are found to have benefits to infants’ processing within and across domains (Booth, McGregor & Rohlfing, 2005; Iverson & Goldin-Meadow, 2005). For instance, Gogate et al. (2000; Gogate, Bolzani & Betancourt, 2006) found that infants learn novel...
word-sounds better when objects and utterances are presented in temporal synchrony. Also, ID speech has been shown to increase infant arousal (Dominey & Dodane, 2004; Werker & McLeod, 1989), aid in the segmentation of speech (Kemler Nelson, Hirsh-Pasek, Jusczyk & Cassidy, 1989; Thiessen, Hill & Safran, 2005), and communicate affective quality (Bryant & Barrett, 2007; Burnham, Kitamura & Vollmer-Conna, 2002; Fernald, 1992). ID modifications may even contribute to infant growth rate (Monnot, 1999).

One benefit common to all infant-directed modifications studied thus far is enhancement of infant attention. When offered the opportunity to experience ID versus AD input, infants consistently pay more attention to ID input in speech (Fernald, 1985; Lockman & McHale, 1989; Zangl & Mills, 2007), in sign (Masataka, 1996), and in speech-action synchrony (Gogate et al., 2006). The attention-focusing quality of ID input likely confers benefits to the developing infant including facilitated processing of relevant stimuli, distraction reduction, and increased opportunity to absorb information. Importantly, it may signal to infants that this behavior is relevant to them (Csibra & Gergely, 2006), which would enable their learning from it.

Brand et al. (2002) proposed that the diverse features of ID action may in fact provide attention benefits as well as other types of benefits (see also Parrinello & Ruff, 1988). For instance, characteristics such as closer proximity, greater enthusiasm, larger range of motion (e.g. bigger actions), and increased interactiveness may primarily serve to enhance infant attention to the actor’s motions. To illustrate, the increased gaze-checking involved in high interactiveness is likely to be attractive to infants (Haines & Muir, 1996). Another benefit of ID action proposed by Brand et al. (2002) is the highlighting of unit boundaries within the flow of motion. For instance, repetition may be particularly effective at segmenting a given unit from the actions surrounding it.

To date, only one published study has investigated the potential benefits of ID action. Reid, Belsky and Johnson (2005) investigated factors related to infants’ ability to distinguish impossible from possible human movements. They reasoned that infants whose mothers tended to exhibit increased levels of motionese might show enhanced ability on this measure. They did not find evidence for this particular benefit. However, as the authors point out, exposure to normal, everyday movements might suffice to teach infants to recognize impossible actions.

In the present study, we investigated whether attention enhancement is a benefit of infant-directed action. That is, do infants seek out ID action if both ID and AD action are available to view? In order to examine this question, we showed 6- to 8-month-old infants and 11- to 13-month-old infants pairs of ID and AD clips, presented simultaneously side-by-side in a split-screen preferential looking paradigm. Action clips depicted mothers of infants who had been videotaped while demonstrating novel objects to either their infant or to an adult partner. Clips were presented in silence to test for infant reaction to action divorced from the effects of ID speech. We predicted that infants would gaze a greater proportion of the time to ID versus AD action.

The ID and AD actions in the action clip sequences were collected from natural, spontaneous demonstrations. The procedures for collecting these clips were largely the same as those used in Brand et al. (2002); presumably, we captured the motionese features documented in that paper. We collected video clips of mothers’ demonstrations in a between-subjects fashion: mothers demonstrated four different objects either for their own infant or for their husband (or in a small number of cases, a close friend or family member). This design balanced the degree of familiarity between mothers and their partners in the two conditions and allowed us to avoid carry-over effects (for instance, mothers showing an adult partner the ID actions that she had just performed for her baby). Further, mothers remained naïve to the ID versus AD comparison we had in mind, increasing the likelihood that we were capturing natural and spontaneous behaviors. As a result, however, the ID and AD clips in each pair necessarily contained different mothers.

To reduce the possibility that infants would respond to factors other than action type (ID versus AD), we took great pains to pair clips of actions that were very similar. Paired clips were identical in length, began and ended with the mother wearing a neutral emotional expression, and were balanced as much as possible for the appearance of the mother (e.g. hair style) and the appearance of the room (e.g. lighting conditions due to time of day). We were particularly careful to match pairs of mothers on their attractiveness, since research indicates that 6- and 12-month-old infants prefer faces that are judged as attractive by adults (e.g. Langlois, Ritter, Roggman & Vaughn, 1991; Langlois, Roggman & Rieser-Danner, 1990). Details of the matching procedure are included in the Method section.

In addition to matching clips based on adults’ judgments, we tested infants’ preference of mothers’ general appearance by showing them still-frame pictures taken from each of the action clips. Before viewing the ID and AD action pairs, infants viewed one 5-sec presentation of each corresponding pair of still-frame photos. If infants showed no preference for the still-frame pictures, we could be more certain that any preference for ID versus AD action was due to the quality of the actions rather than the appearance of the mothers.

Infant preference for ID modifications would presumably be most beneficial early on in development, as support for infants’ early-developing skills. Such age differences in modification preferences exist in other domains (Fenson, Dale, Reznick, Bates, Thal & Pethick, 1994; Fernald, 1985). Therefore, in the first study, we began by testing the preference of infants aged 6 to 8 months, the lower boundary for which motionese has been documented (Brand et al., 2002; Rohlfing et al., 2006).
Study 1

Method

Participants

Thirty-two infants (17 males and 15 females; 6 to 8 months of age \( M = 223 \text{ days}, SD = 28.81, \text{range} = 173 \text{ to} 280 \text{ days} \)) comprised the final sample. Potential participants were identified through a direct marketing list or community advertising, and were contacted by a letter and phone call. All infants who participated were full term, were developing normally, possessed normal vision, and had no history of serious ear infections. Sixteen additional children participated but were removed from analyses: five because they showed a side bias across all trials of more than 75%; six because of experimental error; four because their eyes were not visible for coding; and one because he fussed and did not complete the procedure.

Materials

Infants viewed sequences of action clips presented in a split-screen video preferential looking paradigm (Golinkoff, Hirsh-Pasek, Cauley & Gordon, 1987; Hirsh-Pasek & Golinkoff, 1996; Meints, Plunkett & Harris, 1999; Spelke, 1979; Tincoff & Jusczyk, 1999). On each trial, one side of the screen depicted a mother of an infant demonstrating a novel object to her infant (ID) while the opposite side simultaneously depicted a different mother demonstrating the same novel object to another adult (AD). Only the mother (not her partner) was visible in each video and the camera angle was such that the mothers’ gaze appeared to be directed at the viewer.

These video clips were collected in a procedure similar to Brand et al. (2002). Specifically, 52 mothers of infants (age 6–13 months) were asked to demonstrate four novel objects to either their infant or a well-acquainted adult (typically their spouse). Mothers were given short descriptions of the objects, and then demonstrated them one at a time in whatever manner they chose. Objects were an orange noisemaker toy, a green ball covered in suction cups, a clear plastic salt dispenser, and a white clothesline pulley. The camera was set up directly behind and above the (infant or adult) partner, in order to capture the mothers’ actions from the partner’s point of view.

Test stimuli were then constructed by selecting clips so that an ID demonstration of an object was paired with an AD demonstration of the same object. Demonstrators within a given pair were carefully matched for attractiveness, attire, appearance of the room, and any minor differences in camera angle. Clips were selected so that they began and ended at points at which the mother’s face was neutral in expression. We used the longest available clip for each demonstration such that pairs of clips were identical in length. Eight potential pairs of action clips were constructed, with two ID/AD pairs for each demonstrated object. These were then subjected to testing to select the best four pairs. In order to measure attractiveness, we selected a still-frame image from each clip in which the demonstrator had her eyes directed down toward the object and wore a neutral expression on her face (see Figure 1a). Adult subjects (\( n = 35 \)) judged the attractiveness of these pictures on a scale of 1–10. We then selected the one pair for each object that was best matched for attractiveness. In the resulting four pairs (the pairs ultimately shown to infants), there was no difference in attractiveness between ID (\( M = 4.36, SD = 1.21 \)) and AD (\( M = 4.49, SD = 1.27 \)) demonstrators, paired-samples \( t(139) = 1.977, p = .45 \), two-tailed, \( d = .07 \). In summary, the four pairs of clips included in the stimulus videos represent the best-matched examples of demonstrations of each of the four objects.

Stimulus videos that infants viewed comprised four pairs of still-frame photographs, with ID on one side and AD on the other (5 s each), followed by the corresponding four action clip pairs (\( M \) clip length = 16.5 s), and then followed by a second presentation of the four action clip pairs. One sample sequence is depicted in Figure 2. All still images and videos were presented in silence. In between each trial, an attention-getting audio-visual stimulus was displayed in the center of the screen, with audio emanating from stereo speakers at the top corners of the screen. This served to re-orient infants if their attention was flagging, and also to ensure that their attention was centered, so that each test trial represented an independent choice of which video to watch. For the first four trials, the attention-getter was a baby’s face accompanied by ‘Hey Look!’ in infant-directed speech (1 s). For the remaining trials, the attention-getter was a flashing checkerboard accompanied by a beeping sound (3 s).

Infants were randomly assigned to view clips arranged in one of four possible orders, with equal numbers of infants viewing each order. Within each order, ID versus AD stimuli were counterbalanced in a left-right-right-left pattern. Across orders, side of the first ID clip was counterbalanced.

Procedure

After a brief warm-up period, during which time the infant could acclimate to the study room, the procedures were explained to the parent, who then signed an informed consent form. Videos were presented on a 60” \( \times \) 80” projection screen. Infants sat on their parents’ laps approximately 78” from the screen. Parents were asked to remain quiet and close their eyes during the study to avoid inadvertent parental influence. Infants’ gaze was recorded by a Sony digital camcorder mounted below the screen.

Coding

Using a computerized stopwatch program, BabyTime (Piccin, 2005), or a digital coding program with frame-
by-frame capability, SuperCoder (Hollich, 2003), infant gaze direction was coded off-line by a research assistant who was blind to the condition and to the hypotheses of the study. Amount of looking time to the right or left side of the projection screen was calculated in seconds and averaged separately for still-frame versus action clip trials. A second blind coder rated 88% of the videos to assess inter-rater reliability. Interclass correlation coefficients (model 2; Shrout & Fleiss, 1979) were over .94, which is considered excellent (Cicchetti, 1994).

**Results and discussion**

Mean looking times to ID and AD stimuli are shown in Table 1. To examine whether infants showed a preference for ID versus AD action clips, we computed infants’ looking to ID clips as a proportion of their total looking (ID + AD), and compared that to chance performance (.50). As expected, infants looked at the ID clips more than would be expected by chance (*M* = .58, *SD* = .10), one-sample *t*(31) = 4.81, *p* < .0005, Cohen’s *d* = .85, which is considered a large effect size. Further, of 32 infants, 25 looked longer to ID than AD clips, which is more than would be expected by chance according to a sign test, *p* = .002.

In order to assure that infant preference for ID action was due to action characteristics rather than the appearance of the demonstrators, we also analyzed infant looking times to the still-frame pictures excerpted from the action clip sequences. As expected, infants did

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**Table 1** Mean looking times (and SDs) in seconds. S1 and S2 refer to Study 1 and Study 2, respectively

<table>
<thead>
<tr>
<th></th>
<th>Still frames</th>
<th>Movies</th>
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<tr>
<td></td>
<td>ID</td>
<td>AD</td>
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<tr>
<td>S1 (6–8 months, standard)</td>
<td>1.56 (0.50)</td>
<td>1.68 (0.53)</td>
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<tr>
<td>S2 6–8 months</td>
<td>1.46 (0.62)</td>
<td>1.64 (0.71)</td>
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<tr>
<td>Standard</td>
<td>1.84 (1.09)</td>
<td>2.07 (1.39)</td>
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<tr>
<td>S2 11–13 months</td>
<td>2.28 (1.13)</td>
<td>2.30 (1.09)</td>
</tr>
<tr>
<td>Standard</td>
<td>1.99 (1.16)</td>
<td>1.94 (0.87)</td>
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not show a preference for ID versus AD demonstrators in the still-frame clips ($M_{ID} = .48$, $SD = .06$), $t(31) = −1.50$, $ns$.

ANOVA with sex and order as independent variables and proportion looking to ID versus AD as the dependent variable revealed no differences in either videos or still images, $F$s = 0–1.57, $ns$. Analysis of side (left versus right) showed a general side bias during the videos, looking to the right more than would be expected by chance ($M = .56$, $SD = .13$), one-sample $t(31) = 2.59$, $p = .014$, $d = .46$. To ensure that the side bias did not interact with infant preference for ID versus AD action, we conducted a repeated-measures ANOVA on the raw looking times with action type (ID versus AD) and side (left versus right) as independent variables. The analysis showed a lack of interaction, $F(1, 29) = 1.56$, $ns$. Unlike during the action clips, there was no side bias during the still-frame pictures ($M = .50$, $SD = .20$), $t(31) = −.13$, $ns$.

The finding that infants in our sample looked preferentially to the right side of the screen, while interesting in its own right, does not detract from our results. In fact, research and anecdotal lore suggest a natural right-looking inclination among infants (J.A. Colombo, personal communication, 3 May 2006; Colombo, Frick & Ryther, unpublished manuscript; Turnbull & Lucas, 1996). In addition, during the data collection for Study 1, the lab used two stereo speakers, mounted on the top corners of the video screen. Although the speakers were channeling identical audio output and seemed to be equally loud to an adult listener, some feature of reflection of sound in the room (which was not perfectly symmetrical) may have given a slight bias in loudness to one side that may have influenced infants’ looking. However, in the current study, infant- versus adult-directed actions were fully counterbalanced, both within and across infants. Further, infants’ side preference did not interact with their preference for ID actions. Therefore, whatever the cause of the side bias, it cannot account for the ID preference. As a precaution, before Study 2 began, the stereo speakers were replaced with a single central speaker behind the screen.

To determine the generality of the ID preference, we examined the proportion of looking to ID for each of the four pairs of mothers separately. Three out of the four pairs contributed to the ID preference effect, with infants allocating more than 50% of their looking to the ID mother in the gigglestick pair, the gripper pair, and the pulley pair, but less than 50% to the ID mother in the dispenser pair. Examining the dispenser video revealed that the ID mother in this pair did not behave in a typically ID fashion; for instance, she emoted and made eye contact very little. Clearly, there was a large preference for ID despite the behavior of that specific mother, but in Study 2, in order to best represent the phenomenon of motionese, we substituted a more typical ID mother into that pair. As before, we balanced as much as possible the appearance of the mother and the room.

In sum, the results from Study 1 show that 6- to 8-month-old infants have a preference for object demonstrations enacted for infants relative to those enacted for adults. Motionese has also been documented for infants up to 11 to 13 months (Brand et al., 2002; Rohlfing et al., 2006), and Brand et al. (2007) uncovered age differences across these groups. Specifically, adult looking behavior to older infants (11- to 13-month-olds) tended to be divided into shorter, more frequent gazes than to younger infants (6- to 8-month-olds), and older infants received more offers of the object than younger infants. One goal of Study 2 was to expand the age range to see whether the preference for ID action is uniform across the first year.

Because possible age differences in infants’ preferences were of interest, and infants might have stronger preferences for the variety of motionese demonstrated to their own age range, we wanted the demonstrations to be characteristic of the entire range. Accordingly, the
mean age of the infants of the four mothers in the ID condition was 285 days, with a range of 193–405 days ($SD = 88$ days). While the AD mothers demonstrated to adults rather than infants, we also attempted to ensure that they were mothers of infants across the whole possible range. The mean age of the infants of mothers in the AD condition was 309 days, with a range of 241–439 days ($SD = 92$ days), which did not significantly differ from infants’ ages in the ID condition, independent $t(6) = .373, p = .72, d = .28$.

As described by Brand et al. (2002, 2007), motionese is a multi-faceted phenomenon. Some of the features which are relevant to motionese are arguably part of infant-directed interactions more generally, and, more importantly, have already been shown to enhance infant attention. For instance, infants have demonstrated sensitivity to eye gaze (Hains & Muir, 1996) and to enthusiastic and positive emotional expressiveness (Termine & Izard, 1988; Wilcox & Clayton, 1968). To truly understand the entire suite of infant-directed modifications, it will be important to determine whether infants’ preference for motionese is driven by these facial features, or whether there are modifications to the hands, arms, and general body posture which may independently enhance infant attention. Thus, in Study 2, we included a condition in which the mothers’ faces in the videos were digitally blurred. This allowed us to obscure both eye gaze and emotional expression while retaining all other features of the actions. In sum, in Study 2, we attempted (1) to replicate the preference for motionese; (2) to extend the findings to a second age group (11- to 13-month-olds); and (3) to determine whether infants in each group would continue to prefer ID videos to AD videos despite obscuring the faces of the mothers.

**Study 2**

**Method**

Participants

A total of 52 infants participated in Study 2. Infants were of two different age groups: 6 to 8 months (14 males and 14 females; $M = 227$ days, $SD = 32.73$, range = 182 to 277 days) and 11 to 13 months (11 males and 13 females; $M = 374$ days, $SD = 25.29$, range = 326 to 429 days). Half of infants at each age were assigned to the standard (non-blur) condition and half to the blur condition, resulting in four cells: 6–8 standard ($n = 12$); 6–8 blur ($n = 14$); 11–13 standard ($n = 12$); 11–13 blur ($n = 12$). (A power analysis on the findings of Study 1 indicated that cell sizes of approximately 12–13 would be adequate for Study 2.) Potential participants were recruited in the same fashion as in Study 1. Infants who participated in Study 1 were excluded from Study 2. Eight additional children participated but were removed from analyses: one because she showed a side bias across all trials of more than 75% (11–13 standard); three because of experimental error (one each in 6–8 standard, 11–13 standard, and 11–13 blur); and four because they fussed and did not complete the procedure (two each in 6–8 standard and 11–13 blur).

**Materials**

Videos in the standard condition were identical to those in Study 1 with three exceptions. One, in order to get more reliable information, and because infants’ performance on Study 1 suggested their attention spans would bear it, we included a second set of still-frame trials just before the second set of motion trials. Two, as a result of infants’ looking behavior in Study 1, a new ID mother was substituted into the dispenser pair. The clips continued to be balanced in all of the ways described in Study 1. In the new set of pairs shown to infants, there remained no difference in attractiveness between ID ($M = 4.40, SD = 1.83$) and AD ($M = 4.49, SD = 1.27$) demonstrators, $t(139) = .304, p = .62$, two-tailed. In order to avoid any possibility of unbalanced sound in the room, the stereo speakers were replaced by a single speaker, centered behind the video screen.

In the blur condition, videos were identical to the standard condition videos except that the mothers’ faces were digitally blurred in both the still frames and the demonstration clips. Video editing was done on Adobe Premiere version 5.1. For each mother, a circular ‘mask’ was defined which encompassed her entire face, from her hairline to her chin. This portion of the video was then pixilated with the Premiere ‘mosaic’ effect, such that the resulting image of the face was represented by approximately $6 \times 6$ pixels (see Figure 1b). This circular area was set so that it smoothly followed the face as it moved throughout the video, always keeping the blurred area directly over the mother's face. Thus, mothers’ gaze and emotional expression were obfuscated. Design, procedure, and coding were the same for Study 2 as for Study 1.

**Results and discussion**

Preliminary analyses showed no sex, order, or side effects. Specifically, across all infants, ANOVAs with sex and order as independent variables and proportion looking to ID versus AD as the dependent variable revealed no differences in either videos or still images, $F$s = .178–.585, $ns$. A one-sample $t$-test on the proportion of looks to the left versus right revealed no side bias across all infants, $t(51) = .75, ns$.

Infants’ looking times in each age and condition are displayed along with the means from Study 1, in Table 1. To examine whether infants showed a preference for ID versus AD action clips, we computed infants’ looking to ID clips as a proportion of their total looking (ID + AD), and compared that to chance performance (.50). We first tested whether Study 2 replicated the findings.

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from Study 1. We found that 6- to 8-month-old infants in the standard condition looked to the ID clips more than 50% ($M = .54, SD = .11$), although this trend did not reach significance, one-sample $t(13) = 1.37, p = .192, d = .368$.

Our second question was whether older infants also prefer ID action. We found that they did: 11- to 13-month-olds looked at standard ID clips relative to standard AD clips more than would be expected by chance ($M_{ID} = .59, SD = .08$), one-sample $t(11) = 4.00, p = .002, d = 1.15$. Our third question was whether the preference for ID action would persist even when mothers’ faces were blurred. We found that 6- to 8-month-olds and 11- to 13-month-olds in the blur condition showed a significant ID preference, looking at the ID clips more than would be expected by chance ($M_{6,8} = .60, SD = .08$), one-sample $t(13) = 4.50, p = .001, d = 1.20$; ($M_{11,13} = .59, SD = .08$), one-sample $t(11) = 3.77, p = .003, d = 1.09$.

As in Study 1, to examine the robustness of the effect, we compared the number of individual infants preferring the ID action clips to chance expectations. Across all conditions – 6–8 standard, 6–8 blur, 11–13 standard, and 11–13 blur – a total of 40 out of 52 infants looked longer to ID than to AD movie clips, which is significant according to a sign test, $p = .0001$.

In order to assure that infant preference for ID action was due to action characteristics rather than the appearance of the demonstrators, we also analyzed infant looking times to the still-frame pictures excerpted from the action clip sequences. As expected, infants did not show a preference for ID versus AD demonstrators in the still-frame clips in either condition at either age ($M_{ID} = .47–.50$), $t$s $= -.048$ to $-1.01$, ns.

**General discussion**

Prior research has shown that adults spontaneously enact a constellation of action characteristics when in the presence of infants, collectively referred to as motionese or infant-directed action (Brand et al., 2002, 2007; Rohlfing et al., 2006). However, research to date has not demonstrated how infants respond to such action displays. In this study, we investigated whether 6- to 8-month-olds and 11- to 13-month-olds would show a systematic preference for ID action over AD action in a split-screen preferential looking paradigm. Results indicate that infants at both ages prefer to view ID action compared to AD action.

The preference for ID action among the younger group (6- to 8-month-olds) appeared quite strong in Study 1; however, the same trend failed to reach significance among the 6- to 8-month-olds viewing the standard videos in Study 2. It is likely that the attention of infants in this age range is more variable than that of the older infants, and with the smaller cell sizes in Study 2, atypical behavior by one or two infants could account for the somewhat lower mean in this group. Infants of the same age did show a clear preference for the ID action when the faces in the videos were blurred. Taken together, the findings of Studies 1 and 2 indicate a fairly robust preference for ID action among the infants across both younger and older infants.

The fact that infants at both ages continued to prefer ID action even when the faces were blurred is remarkable. Previous research indicates that ID action is made up of a constellation of features (e.g., interactiveness, repetitiveness, enthusiasm). In the video clips used in the current research, mothers were free to vary all of these (with the exception of proximity to partner, which was highly constrained). Any one of these features may prove sufficient to attract infants’ attention, and in fact, given previous research, one might not be surprised to see enhanced attention to ID facial expressions and eye gaze (Hains & Muir, 1996; Termine & Izard, 1988; Wilcox & Clayton, 1968). However, the current research indicates that these facial features are not necessary to engage infants’ attention. Infants’ preference for motionese with blurred faces indicates that ID modifications involving hands, arms, bodies, and/or objects are also sufficient to engage attention.

The current research suggests that highly social aspects of motionese, such as the voice and face, are just two of several possible methods of marking behavior that is relevant for infants (Csibra & Gergely, 2006). The current study indicates that infants judge bodily motionese as relevant to them as well. This finding does not require that infants understand the intentions behind these actions, nor that they understand, in any explicit sense, that these actions are performed for them. Rather, it may be that action modifications that encompass salient low-level features of actions (sharp changes in trajectory, large sweeping motions, etc.) function as adults’ invitation to infants to pay attention. For instance, the large expansive range of motion might tap infants’ preferences for expanding versus contracting visual images (Shirai, Kanazawa & Yamaguchi, 2004). Infants’ attention to the low-level patterns in these movements may then allow them to build a bottom-up knowledge base about patterns of human action, which may ultimately enable their learning about intentions. The fact that bottom-up segmenting of actions seems to line up with adults’ top-down, intention-driven interpretations of the same actions (Zacks, 2004) suggests that this type of boot-strapping could be highly informative for infants.

Results from the current study demonstrate that infants are not passive in viewing the behavior of those around them. Rather, they seek out action that is modified in infant-directed ways. This preference for ID action may help infants to comprehend the intricacies of human behavior. As infants learn new skills – for instance, feeding themselves with a spoon – they may be better supported in the analysis and re-enactment of the relevant motions if their caregivers use ID rather than
AD action. That is, when adults use small, complex actions as they might when showing another adult how to use an object, these behaviors may be difficult to emulate. On the other hand, when adults use large, simplified, repetitive movements, they likely engage infants’ attention and support their learning. Important next steps include unpacking these findings even further to determine whether specific features, such as range of motion or repetitiveness, can independently capture infants’ attention, and whether specific features indeed educate infants’ action processing. Work is currently under way in our lab to test these questions.

In summary, we now have evidence of ID action’s benefits in garnering infant attention to action displays. The finding that infants looked longer at AD action than ID action – even with faces obscured – complements the well-established findings that infants prefer specialized ID speech (Fernald, 1985), sign (Masataka, 1996) and facial expressions (Chong et al., 2003). Further, it bolsters the claim that infant-directed bodily action is a bona fide member of the suite of infant-directed modifications, with its own specialized role to play. Continued investigations of ID action will contribute to a fuller understanding of infants’ nascent understanding of the behaviors of others.

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