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The role of demonstrator familiarity and language cues on infant imitation
from television

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Abstract

An imitation procedure was used to investigate the impact of demonstrator familiarity and language cues on infant learning from television. Eighteen-month-old infants watched two pre-recorded videos showing an adult demonstrating a sequence of actions with two sets of stimuli. Infants' familiarity with the demonstrator and the language used during the demonstration varied as a function of experimental condition. Immediately after watching each video, infants' ability to reproduce the target actions was assessed. A highly familiar demonstrator did not enhance infants' performance. However, the addition of a narrative, developed from mothers' naturalistic description of the event, facilitated learning from an unfamiliar demonstrator. We propose that the differential effect of demonstrator familiarity and language cues may reflect the infants' ability to distinguish between important and less important aspects in a learning situation.

Key words: learning, television, behavioural recall, infancy, mothers, imitation

Social interactions provide considerable opportunities for infants to gather information about the world around them. Through observing people's actions and reactions, infants can, for example, learn what objects in the room might be interesting to attend to (e.g., D'Entremont, Hains, & Muir, 1997), safe to approach (e.g., Stenberg & Hagekull, 2007) and what actions could be performed with those objects (e.g., Meltzoff, 1988; Barr, Dowden & Hayne, 1996). In their second year of life, infants learn two to three novel behaviours per day through simply watching and reproducing the actions of people around them (Barr & Hayne, 2003). By capitalising on infants' natural interests and ability in copying the actions of others, research using imitation procedures has afforded valuable insight into the development of infant learning and memory (for reviews see Hayne, 2004; Jones & Herbert, 2006).

In a typical imitation procedure, an experimenter demonstrates a series of actions with novel objects and the infant's ability to reproduce the actions is subsequently assessed. Using this procedure, age-related increases have been observed in the speed of learning (e.g., Barr et al., 1996, Barr, Muentener, & Garcia, 2007a), the duration of retention (e.g., Herbert & Hayne, 2000a), and in the range of sources infants learn from (e.g., Hayne, Herbert & Simcock, 2003; Simcock & Dooley, 2007). Although age-related changes are well documented, performance at a given age can also be facilitated by manipulations at encoding or retrieval, such as increasing the number of demonstrations (e.g., Barr et al., 1996), providing the opportunity to practice the target actions immediately after learning (e.g., Hayne, Barr, & Herbert, 2003), or providing verbal information to accompany the event (e.g., Hayne & Herbert, 2004).

In contrast to other popular infant learning procedures such as operant conditioning or the visual paired comparison task, imitation incorporates a social component into the learning event: an experimenter demonstrates the actions to the infant. Traditionally, the imitation procedure is

conducted by an unfamiliar adult, although infants can successfully imitate the actions demonstrated by unfamiliar peers and adults (Hanna & Meltzoff, 1993; Ryalls, Gul, & Ryalls, 2000), and more familiar adults (Devouche, 2004; McCabe & Uzgiris, 1983). The social context within which learning occurs does, however, impact on infants' subsequent behaviour. For example, from the end of their first year onwards, infants will interpret the intentions of an experimenter, completing unsuccessful attempts at performing target actions (Bellagamba & Tomasello, 1999; Legerstee & Markova, 2008; Meltzoff, 1995), at least when the entire person is visible to them during the demonstration (Slaughter & Corbett, 2007). Furthermore, infants' memory for an imitation task is disrupted if the person demonstrating the target actions is replaced by a completely unfamiliar experimenter at the test (Learmonth, Lambert, & Rovee-Collier, 2005). To date, all of these studies have been conducted within the context of live demonstrations.

When perceptual and social cues are reduced, such as when the demonstration is presented on television, infants show reduced levels of learning in imitation tasks (e.g., Barr et al., 2007a; Barr & Hayne, 1999; Hayne et al., 2003), as well as in other cognitive tasks such as object retrieval (e.g., Troseth, 2003). There is initial support for the idea that the same manipulations that improve learning from live demonstrations may facilitate learning from televised media. For example, increasing the number of demonstrations shown on the video facilitates imitation at young ages (Barr, Muentener, Garcia, Fujimoto & Chavez, 2007b). The potential role of social cues has been largely ignored within the context of learning from pre-recorded videos, with the exception of the finding that imitation performance is similar irrespective of whether the experimenter at the test is the same or different from the demonstrator on the video (Hayne et al., 2003; Nielsen, Simcock & Jenkins, 2008). In contrast, social cues have played an important role in research examining infants' learning from live video. Recent studies using closed-circuit tele-

vision as the presentation medium have shown that imitation is facilitated by the infant engaging in a contingent social exchange with the on-screen experimenter prior to the task (Nielsen et al., 2008; Troseth, Saylor, & Archer, 2006). For example, 24-month-old infants in Nielsen et al. (2008) showed an increase in successful imitation from an on-screen demonstrator if they were first provided with the opportunity to respond directly to the questions and directions given by the on-screen experimenter.

The findings of research using live video suggest that a previous learning history created through social interactions may be important in facilitating learning from on-screen presentations. It is important to note, however, that the learning history created in live video studies are unlike what most children will experience during their television viewing, where events are pre-recorded and not responsive to the individual infant. One alternative way to establish a learning history on a pre-recorded video may be to use a demonstrator who is highly familiar to the infant, such as the infant's own mother.

From birth, infants show a preference for looking at their mother's face compared to a stranger (e.g., Pascalis, de Schonen, Morton, Deruelle, & Fabre-Grenet, 1995; Sai, 2005), and spend the majority of their time in her presence. This experience could result in infants' showing different levels of learning from their mother compared to a stranger. A small body of imitation research suggests that for live demonstrations there may be no learning advantage in a mother demonstration compared to a stranger demonstration (Devouche, 2004; McCabe & Uzgiris, 1983; Meltzoff & Moore, 1992). It is possible, however, that differences may be observed when infants encounter a more difficult learning situation, such as when the demonstration is presented on a pre-recorded video.

In the present study, we examined 18-month-old infants' learning from a pre-recorded video of their mother or an unfamiliar female demonstrating a series of target actions with novel objects. Whilst 18-month-old infants can remember these actions for up to two weeks from a live demonstration by an unfamiliar adult (Herbert & Hayne, 2000a), imitation is considerably reduced when the demonstration is presented on video (Hayne et al., 2003). Consistent with studies using live video (e.g., Nielsen et al., 2008; Troseth et al., 2006), learning was therefore assessed in the current study immediately after infants had watched the demonstration video. We hypothesised that if a previous learning history can improve learning performance, infants watching their own mother's demonstration should show higher levels of imitation than infants watching an unfamiliar demonstrator.

To ensure that infants observed their mother demonstrating the events in her natural style, in the present study we allowed each mother to narrate the events as she typically would when showing her infant a new toy. It is well established that there are a variety of maternal narration styles (e.g., Cleveland & Reese, 2005; Reese, Haden, & Fivush, 1993), thus we anticipated considerable individual variability in what the mothers would say in their demonstration videos. To account for differences in narration we therefore also included three experimenter demonstration conditions which varied narration style as well as degree of familiarity. Given that language cues included in live demonstrations facilitate retention at 18 months (Hayne & Herbert, 2004) and enable 24-month-old infants to express their memories in new situations (Herbert & Hayne, 2000b), we hypothesised that infants would show higher levels of learning from the video of an unfamiliar experimenter when they narrated the event than when the experimenter used only empty language.

Method

Participants

The final sample consisted of 60 infants (30 females) who participated within ten days of their 18-month-birthday. All infants were full-term and typically-developing. They were drawn from a pool of volunteers recruited in the neonatal unit of a local hospital. Infants were predominantly of European descent and came from a wide range of socioeconomic backgrounds. Eight additional infants were excluded due to crying (n=1), refusal to watch the demonstration video or to touch the stimuli at test (n=2), maternal interference during test (n=2), and procedural error (n=3).

Materials

The two stimuli (a rattle and a rabbit) were identical to those used and described by Herbert and Hayne (2000a). The rattle stimuli consisted of a green stick (12.5 cm long) attached to a white plastic lid (9.5 cm in diameter), with Velcro attached to the underside of the lid; a round green block (3 cm in diameter x 2.4 cm in height); and a clear plastic square cup with Velcro around the top (5.5 cm in diameter x 8 cm in height). The opening of the plastic cup (3.5 cm in diameter) was covered with a 1-mm black rubber diaphragm, with 16 cuts radiating from the centre. The rabbit stimuli consisted of two plastic eyes (3 x 2 cm) attached to a 9 x 6 cm piece of plywood with Velcro on the back, a 12-cm orange wooden carrot with green string attached to the top, and a white circle of wood (the head, 15 cm in diameter) mounted horizontally on a white rectangular wooden base (30 x 20 cm). A 3-cm (in diameter) hole was drilled at the bottom of the head, and a 5 x 15 cm piece of white Velcro was attached to the top of the head. Two white "ears" (20 x 5 cm) decorated with strips of pink felt were hidden behind the head. A 10-cm wooden stick attached to the top of the right ear allowed the ears to be pulled up from behind the

head in a circular motion to a point above the head.

Videos

The identity of the model and the type of language used during demonstration varied as a function of experimental condition (see Table 1). Order of stimulus presentation (rattle or rabbit first) was counterbalanced across the demonstration group.

Insert Table 1 about here

Mothers videos. Mother videos were recorded on a previous visit to the lab. These videos showed each infant's own mother seated at a table demonstrating the target actions with each set of stimuli. Prior to creating their video, each mother watched a demonstration of the target actions and had the opportunity to practice the sequences. A visual reminder of each step was also visible to the mother throughout the filming of her demonstration video. Mothers were asked to narrate the event in a style they would normally use at home when showing their infant something novel, with the exception that they were asked not to use their child's name. Each mother was recorded completing three successful demonstrations of the target actions for each set of stimuli. The average duration of the mother's videos was 63.83s with the rabbit stimuli (range 31 – 142s) and 70.25s with the rattle stimuli (range 38 – 109s).

Experimenter videos. Three different experimenter videos were created for the demonstration groups. In the *Experimenter Empty* video, the female experimenter demonstrated the target actions at the table three times in succession with each set of stimuli. During the demonstration, the experimenter used empty narration. This style of narration maintains the infants' attention, but does not contain any information about the stimuli or the target actions (see Hayne &

Herbert, 2004) and is traditionally used in studies of infant imitation from television (e.g., Hayne et al., 2003; Barr et al., 2007a,b). In the *Experimenter Naturalistic* video, the female experimenter's demonstration of the target actions was accompanied by language that was similar in style that used by mothers. The script for this narration was developed from transcripts of the videos in the Mother Naturalistic condition. Only those words and expressions used by the majority of mothers were included in this "mother-style" narration. The final narration contained information about the event actions (e.g., "Look! What's this? You put the ball in here. And then you put this on there. And what do we do now? We shake it, wheee!"). A second experimenter video (*Stranger Naturalistic*) was created using the same "mother-style" narration to accompany the demonstration of the target actions. This demonstration was conducted by a female experimenter who would not meet the child before or during the imitation session. The average duration of rabbit stimuli video was 54s for Experimenter Empty; 50s for Experimenter Naturalistic, and 58s for Stranger Naturalistic. The average duration of rattle stimuli video was 56s for Experimenter Empty; 51 s for Experimenter Naturalistic, and 57s for Stranger Naturalistic.

An experimenter video was also created for the *Baseline* control condition. This video contained an experimenter demonstration of two sets of stimuli which were unrelated to those used in the test session. The purpose of this video was to ensure that baseline condition had also watched a short video of a female demonstrator putting together a set of stimuli, prior to the test with the target stimuli from the demonstration conditions.

Language questionnaire

The language production ability of infants in narration groups was established using the MacArthur-Bates Communicative Development Inventory: Words and Sentences (CDI).

Procedure

All infants were tested individually at the University of Sheffield infant lab. Where appropriate, language questionnaires were sent out a week prior to the infant's visit and collected during their visit or posted back after the visit. On arrival, the purpose of the study was explained and informed consent was obtained from the mother. When the infant appeared comfortable, the experimenter accompanied mother and infant to the experimental room. The mother and infant sat on a floor cushion in front of a TV (50 cm screen), approximately 1.5m from the screen. The experimenter sat on the floor beside the mother and infant. Mothers were requested not to provide any verbal or physical prompts to their infants while they watched the demonstration video or during the test session. Each infant was then shown the first video (either the rattle or the rabbit in the demonstration conditions). Immediately after watching the demonstration, the television was turned off and the first set of stimuli were revealed and placed within the infant's reach. Infants had 60 seconds from the time of first touch to reproduce the target actions. After the test period, the stimuli were removed from sight and infants watched the second demonstration video. The test procedure was then repeated with the second set of stimuli. All sessions were video taped for subsequent coding.

The session was identical for infants in the baseline control condition with the exception that they had not seen the target stimuli or actions prior to the test. Their two videos were unrelated to the target stimuli.

Results

Language inventories. 23 out of 36 questionnaires from the narration groups were returned and had been completed correctly. Infants' productive vocabularies were analysed by calculating their overall scores of the vocabulary checklist of the CDI. The mean productive vocabulary

score for these groups was 83.22. Consistent with previous research using this parent-report measure for 18-month-old infants (Hayne & Herbert, 2004), there were considerable inter-individual differences in the infants' vocabulary scores (range 4 - 521 words, $SD = 120.13$). To assess any group differences in vocabulary, the data were subjected to separate one-way Analysis of Variances (ANOVAs) across experimental conditions. There was no significant effect of condition, $F(2,20) = 0.207$, $p = 0.814$, indicating that the narration groups did not differ in their comprehension abilities.

Visual attention to the screen. The amount of time infants spent looking at the screen during the demonstration was monitored online by the experimenter. To be included in the final sample, infants had to watch at least two out of three demonstrations of the target actions. One additional infant in the baseline condition failed to meet this criterion and was excluded from the study. Overall, infants' attention to the videos was very high.

Imitation scores. Infants were awarded one point for each target action performed during the 60-second test. A maximum score of 3 was obtainable for each set of stimuli. For the rattle stimuli, the three target actions consisted of (1) pushing the ball into the plastic jar, (2) putting the stick on the jar, attaching with the Velcro, and (3) shaking the stick to make a noise. Target actions for the rabbit were (1) pulling the lever in a circular motion to raise the ears, (2) placing the eyes on the face, attaching with the Velcro, and (3) putting a carrot in the rabbit's "mouth". One observer scored the presence or absence of each target action during test from video tape. A second independent observer scored 50% percent of the videos. Interobserver reliability was calculated using a Pearson product-moment correlation and yielded a coefficient of $r = 0.93$.

Preliminary analyses indicated that there was no difference in the infants' performance with the two sets of stimuli (rattle or rabbit). Therefore, the data were averaged across both sets of stimuli for all further analyses.

Insert Figure 1 about here

Figure 1 shows the mean imitation scores of infants as a function of experimental condition. To assess if there were any group differences in imitation scores, the data were subjected to a one-way ANOVA across experimental conditions. There was a significant effect of condition, $F(4,55) = 3.410, p = 0.015$, indicating that imitation performance differed significantly as a function of the video they watched during the learning session.

Whilst this ANOVA reveals group differences, it does not indicate whether infants in any of the experimental groups exhibited significant evidence of learning. In imitation studies, learning is evidenced if mean number of target actions produced by a demonstration group is significantly greater than the mean number produced spontaneously by the Baseline control group who have not seen the stimuli prior to the test. A series of one-sided Bonferroni planned comparisons indicated that infants in both the *Experimenter Naturalistic* and the *Stranger Naturalistic* condition exhibited evidence of learning, imitating significantly more actions than infants in the baseline condition (smallest $t(22) = 2.538, p = 0.01$). There was no evidence of learning in the *Mother Naturalistic* or *Experimenter Empty* conditions (p 's > 0.05). Taken together, these analyses reveal that familiarity, in itself, does not enhance imitation from television, and in some cases may disrupt imitation performance.

To test the hypothesis that language cues may play an important role facilitating imitation from television, we compared the performance of the two experimenter narration conditions to the performance of the Experimenter Empty condition using separate one-sided Bonferroni planned comparisons. These comparisons revealed that infants in both the *Experimenter Naturalistic* and the *Unfamiliar Experimenter Naturalistic* condition exhibited significantly higher scores than infants in the Experimenter empty condition (smallest $t(22) = 2.360$, $p = 0.014$). Thus, learning from the experimenters' videos was enhanced by the addition of narration.

Finally, given the variation in the videos in the Mother Naturalistic condition, we examined whether there was a relationship between features of mother's videos and the level of imitation exhibited by their infants in this condition. Specifically, we examined whether (1) the length of the mothers' videos, (2) the total number of words they used during demonstration (task descriptors such as "rattle", "shake", "ears", "rabbit" plus task-irrelevant words such as "look", "What's this", "oh"), or (3) the percentage of task-describing words mothers used during demonstration was correlated with the imitation scores of infants in the *Mother Naturalistic* condition. There were no significant relationships between the length of demonstration or percentage of task descriptors used by the mothers and the infants' imitation scores, biggest $r = 0.408$, $p = 0.188$ (two-tailed). However, there was a significant positive relation between the total number of words used by the mothers during demonstration and infants' imitation scores, $r = 0.587$, $p = 0.045$ (two-tailed). Thus, mothers who spoke more on their demonstration video had infants who exhibited a higher level of imitation from video.

Discussion

Familiarity with the demonstrator did not facilitate 18-month-old infants' learning from television, regardless of whether familiarity had been created within the learning situation or re-

flected the established infant-mother relationship. Infants have previously been shown to learn actions equally well from their mother or a stranger's live demonstrations (e.g., Devouche, 2004; McCabe & Uzgiris, 1983, Meltzoff & Moore, 1992), and the current findings suggest that mother demonstrations provide no advantage in a video learning context. Imitation levels also remain consistent regardless of whether the experimenter at the test is the same or different from the demonstrator on the video. This finding replicates previous research examining 24-month-old infants' imitation from pre-recorded videos (Hayne et al., 2003; Nielsen et al., 2008) and suggests that familiarity created through consistency at demonstration and test has no impact on learning from television, even at young ages.

Social interactions via close-circuit television have previously been shown to facilitate infant performance on object retrieval (Troseth et al., 2006) and imitation tasks (Nielsen et al., 2008). What are infants learning in these interactions which facilitate performance? During the initial interactions in Troseth et al. (2006), the on-screen demonstrator encouraged direct responding from the child by using the child's name, asking them questions about their friends and pets, and then having them search under their chair for a sticker. A similar interactive procedure was utilized by Nielsen et al. (2008). The results from the present study suggest improvements in performance following social interactions are unlikely to be the result of increased familiarity with the on-screen presenter. Contingent responding opportunities may be central to the subsequent facilitative effect on learning in live-video situations. If this is the case, then studies utilizing live-video may only provide limited insight into how learning from pre-recorded videos can be facilitated.

In contrast to identity, language cues played an important role in facilitating learning from pre-recorded videos. In the present study, infants exhibited significant levels of learning

from an experimenter demonstration only if the demonstration was accompanied by language cues. This finding is consistent with previous research showing that language cues can facilitate the retention and generalisation of imitation from live demonstrations (Bauer & Herstgaard, 1993; Bauer, Herstgaard, Dropik, & Daly, 1998; Bauer, Hertsgaard, & Wewerka, 1995; Bauer, Wenner, Dropik, & Wewerka, 2000; Hayne & Herbert, 2004; Herbert & Hayne, 2000b). Thus, language cues appear to be an effective means for facilitating imitation across different mediums. Importantly, in the present study, these results were not due to differences in the infants' language development or due to differences in their visual attention to the different videos.

Those infants who watched videos of their own mother failed to show evidence of learning, even though the mothers' videos contained language cues. In contrast, infants who observed the experimenter videos did show evidence of learning. We believe that prototypicality may have been a key reason for why language had a facilitative effect on infants who watched an experimenter video. The narration in the experimenter videos contained only words and expressions used by the majority of mothers in the Mother Naturalistic condition. This way, the experimenters' language could be seen as the "best example" of maternal verbal behaviour. In contrast, there were a variety of narrations provided in the Mother Naturalistic condition. Differences in maternal narration styles have been well established in research on parent-child conversations about the past (e.g., Fivush & Fromhoff, 1988; McCabe & Peterson, 1991; Reese, 2002; Reese, Haden, & Fivush, 1993). For example, when discussing the past with their child, some mothers use an elaborative conversation style, providing richly detailed accounts, asking a wide range of questions, and providing supplementary information to the child's account (Hudson, 1990, 1993; Reese et al., 1993). In contrast, some mothers use a pragmatic conversation style, with short repetitive questions intended to elicit particular details from the child, and engage in less memory

conversation overall (Fivush & Fromhoff, 1988; Hudson, 1990, 1993; McCabe & Peterson, 1991; Reese et al., 1993). In verbal children, at least, the way mothers talk about an event affects the aspects that children recall about the event (Murachver, 2002; Tessler & Nelson, 1994).

Given the wide variety of narration occurring in the Mother Naturalistic condition in the present study, it is perhaps not surprising that a wide variation in imitation scores occurred in this condition. Overall, infants of mothers who used a high number of words during the demonstration exhibited higher levels of learning at test than infants of mothers who used only a small number of words. However, the percentage of task-describing words that were used was not related to infants' learning. This pattern raises the possibility that language may not only facilitate learning by providing valuable information about the task per se, but might also be effective in a more general sense by indicating a learning situation, and possibly directing the infants' attention to the important parts of the event.

Why did language cues influence 18-month-olds learning from television, but the identity of the model did not? One possible explanation is that at this age, infants have begun to distinguish between important and less important aspects of a learning situation (cf. Jones & Herbert, 2006). The language cues contained valuable information about the target actions and stimuli and thus might help to build a richer representation of the event, leading to better recall at test. The identity of the model, in contrast, did not provide the infant with any immediate information about the target actions. For this reason, infants may have given less attention to the model herself than to her actions and words during the demonstration. This explanation would suggest that even younger infants might behave in different ways towards different models, reflecting less experience in identifying which aspects of an event are more important to attend to. Alternatively, it could be that familiarity with a model only has a facilitative effect *within* a medium, and not

across different media. In the present study, the infants' mothers were highly familiar to the infants in "real" life, but not necessarily on television. It is possible that familiarity does not transfer across mediums. In contrast, a character that is repeatedly encountered on television, and is thus familiar in the context of watching television, might provide an effective teacher in the television context. These ideas remain to be tested.

It is important to note that the current study cannot tease apart the effects of learning from "a mother" compared to one's "own mother", or the possible impact of the different maternal narration styles. Due to our focus on familiarity, we designed our study to preserve the natural infant-mother dyad for learning, with all infants in the Mother Naturalistic condition observing a demonstration by their own mother. All mothers were trained how to physically demonstrate the actions, thus it is unlikely that there were large stylistic differences between the individual mothers, or between the mothers' and the experimenters' demonstrations. However, as already noted, there was considerable variability in how mothers narrated the event. Given that mothers have different narration styles which likely play an important role in the learning history they have with their child, we did not request mothers use identical language cues during their demonstration. Further studies are needed to identify whether there are effects of different maternal narration styles on the behavioural recall of early-verbal infants.

In sum, the present study provides further evidence that language cues can have a powerful impact on the learning performance of early-verbal infants. In contrast to previous studies of language and cognition where experimenters provide infants with labels (e.g., Balaban & Waxman, 1997; Fulkerson & Waxman, 2007; Waxman & Braun, 2005) or brief descriptions of the actions (e.g., Hayne & Herbert, 2004), we allowed for more naturalistic descriptions of the event. We believe that researchers can learn a lot from the way parents explain new events to their chil-

dren: prototypical “mother-style” narration led to the high level of infant learning from an experimenter’s demonstration in the present study. Using more naturalistic language cues in studies on infant learning and memory might give us a more realistic picture of what infants are capable of under conditions they are likely to encounter outside the laboratory.

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Table 1.

Identity of the model, their presence in the room throughout the demonstration and test session, and language used during the demonstration, as a function of experimental condition

Condition	Model	Language used by model
Experimenter Empty	Female experimenter. Present in Room.	Empty narration providing no additional information about the event or the target actions
Mother Naturalistic	Each infant's own mother. Present in Room.	Naturalistic narration by each individual mother
Experimenter Naturalistic	Female experimenter. Present in Room.	An "average" narration developed from the videos in the <i>Mother Naturalistic</i> condition.
Stranger Naturalistic	Second female experimenter. Not present in room	Identical narration as in <i>Experimenter Naturalistic</i> condition

Figure Captions

Figure 1.

Mean imitation scores ($\pm 1SE$) as a function of experimental group. An asterisk indicates that the performance of the group is significantly above baseline.