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Interactional Quality Depicted in Infant and Toddler Videos: Where are the Interactions?

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This study examined the social–emotional content and the quality of social interactions depicted in a sample of 58 DVDs marketed towards infants and toddlers. Infant-directed videos rarely used social interactions between caregiver and child or between peers to present content. Even when videos explicitly targeted social–emotional content, correlations between educational claims and the actual content of the videos were modest at best. Similarly, other domain content (e.g. language skills) that is best learned through high-quality social interactions was typically depicted without social interactions. The results suggest that producers of infant-directed media are not applying developmental principles or research evidence in ways that take full advantage of developmentally appropriate interaction strategies to present their content. Copyright © 2010 John Wiley & Sons, Ltd.

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Infants' and toddlers' social–emotional development results from an interplay among social interactions with others. These include the formation of early attachment relationships with significant others (e.g. Ainsworth, 1973; Bowlby, 1951), cooperative play and problem solving with adults and peers (e.g. Vygotsky, 1978), and behavioral modeling and imitation from multiple sources (e.g. Bandura & Walters, 1963; Dromi, 1993). Vygotsky (1978) emphasized the important role of social interaction in cognitive development, observing that children can master more sophisticated tasks when working jointly with adults or more competent peers than when playing alone. Higher-order cognitive processes, such as language and reasoning, arise from the cumulative set of

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social exchanges that young children participate in with their caregivers and more competent others. These exchanges provide multiple opportunities to observe others' behavior, to hear linguistic content (e.g. caregivers talking), and to imitate behavior or speech (Vygotsky, 1978). Social exchanges provide a foundation through which children come to learn the cultural norms of their societies broadly and their families specifically. Participation in these social exchanges moves children from listeners and observers of their social and cultural worlds to active participants.

Vygotsky's emphasis on social exchanges as necessary prerequisites for early development has framed research on the role of caregiver–child interactions (CCIs) during early childhood. For example, the extent to which low-income parents engage in high-quality interactions with their children in the earliest years of life predicts their children's early literacy skills at school entry. In fact, engagement with a parent is a stronger determinant of kindergarten literacy skills than early literacy skills or the quality and nature of the home literacy environment (Dodici, Draper, & Peterson, 2003).

In addition to early literacy development, cognitive, language, and social skills are also predicted by CCI during early infancy (Hart & Risley, 1995; Landry, Smith, Miller-Loncar, & Swank, 1997), especially when the quantity and quality of maternal responsiveness is consistent throughout infancy and preschool (Landry, Smith, Swank, Assel, & Vellet, 2001). Between 9 and 18 months, maternal responsiveness, positive emotion, and stimulation longitudinally predict more sophisticated cognitive, language, and social abilities (Clark-Stewart, 1973), whereas toddlers' engagement with others in intellectually stimulating activities between 12 and 33 months more strongly predicts IQ at age 3 when compared with other, more solitary, activities (Carew, 1980).

The quality of early relationships with adult caregivers is associated with later social competence with peers (Sroufe, 1983; Waters, Wippman, & Sroufe, 1979). Infants' and toddlers' early peer friendships, particularly those that are subsequently maintained over time, play an important role in the development of social skills (Howes, 1996). Moreover, the complexity of toddlers' social play with peers predicts increased prosocial behavior and decreased social withdrawal in the preschool years (Howes & Phillipsen, 1998). Social competence with peers is also linked to the ability to moderate or adjust one's behavior or delay gratification in order to accommodate new situations and circumstances (i.e. ego resiliency), empathy during the preschool years (e.g. Sroufe, 1983), and better school performance during early elementary school (e.g. Hartup, 1983).

Screen media content that models desirable interactions has the potential to benefit children through both improved quality of caregiver involvement and observational learning of appropriate interactions with caregivers and peers. This is particularly relevant to the study of infant-directed screen media. Many of the top-selling infant-directed screen media products claim to promote aspects of CCI and early social–emotional development as part of their educational content (Garrison & Christakis, 2005; Fenstermacher *et al.*, this volume).

How can Media for Infants Effectively Model High-Quality Interactions?

During the first few years of life, imitation comprises a major avenue for learning and practicing new behaviors (Barr & Hayne, 2003; Fenstermacher & Saudino, 2006; Piaget, 1962). The capacity for young children to learn via observation is a key feature of Bandura's Social Learning Theory, which includes learning from

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televised as well as live models (Bandura, 2002; Bandura & Walters, 1963). Given the key role played by high-quality CCI and peer–peer interaction (PPI) in promoting healthy socio-cognitive development, video content that models quality interactions and effective social problem-solving strategies may facilitate observational learning of positive social behaviors by both caregivers and their babies. This idea is supported by recent research examining the impact of infant media exposure on caregiver–child interactional quality. Caregivers viewing infant-directed screen media that modeled high-quality active caregiver–child interactional behaviors shifted their own interactional style towards more positive developmentally appropriate interactions when compared with caregivers who viewed infant-directed screen media lacking CCIs (Pempek, Demers, Hanson, Kirkorian & Anderson, in press).

An additional way that actively engaged onscreen characters may facilitate learning is by drawing infants' attention to what is being presented onscreen. From birth, infants preferentially attend to faces (for review see Meltzoff, 2007). As such, infants and young toddlers are primed to engage with other people in their everyday environments. Depictions of onscreen characters, especially those whose faces can be seen and who are actively engaged with one another, are likely to be particularly engaging for infants and, when present, evoke and sustain their attention. Indeed, research suggests that infants and toddlers will learn onscreen content when onscreen characters engage in dialogue with one another (Linebarger & Walker, 2005; O'Doherty *et al.*, 2010). Furthermore, infant learning of vocabulary through the observation of third-party interactions (Akhtar, 2005; Akhtar, Jipson, & Callanan, 2001; O'Doherty *et al.*, 2010) suggests that this active engagement is not only an effective tool for presenting content but also a crucial element in the observational learning process. In these studies, the presence of an actively engaged dyad was a key determinant in whether or not new words were learned. Overall, then, media presentations may improve infant social and emotional development by: (1) modeling high-quality interactions with caregivers and peers; and (2) presenting material via onscreen characters who are actively engaged with one another and who may draw infants' attention to that material.

The Present Study

The existing research indicates that media depictions of social–emotional content, including quality interactions between children and adults and children and their peers, may benefit both caregivers and their infants via observational learning and may be of particular interest to infants given their peak period of social–emotional development. Moreover, recent research on learning via observation of third-party exchanges indicates that *actively engaged* onscreen interactions between characters are a particularly effective means for successfully conveying educational content to infants (e.g. Akhtar, 2005; Akhtar *et al.*, 2001; O'Doherty *et al.*, 2010). Based on this literature, the purpose of the present study was to document interactional quality and social–emotional content in videos designed for, and marketed towards, young infants and toddlers. We tested the association between four variables: (1) overall content, (2) content specifically matching producers' social–emotional claims, (3) quality of onscreen CCIs, and (4) quality of PPIs. We predicted that producers' social–emotional claims would be associated with social–emotional content and higher-quality onscreen interactions between caregivers and children and between peers.

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METHOD

Sample

This sample was the same one used in a formal feature analysis conducted by Goodrich, Pempek, and Calvert (2009). Following the procedure used by Garrison and Christakis (2005), an Internet search was conducted for all screen media available for children under the age of three, utilizing both popular retail sites (e.g. Amazon.com) and search engines (e.g. Google). Based on the results of this search, a comprehensive and exhaustive list of all commercially available English language DVDs produced in the US specifically for babies and toddlers aged 0–3 between Fall 2007 and Spring 2008 was compiled ($n = 218$ DVDs). All companies found in this search were included in the final sample ($n = 31$ different companies). With the exception of five individually marketed infant DVDs, the majority of videos produced for infants were part of a series of two or more products. For each of these 26 series, two video titles were randomly selected for inclusion in our final sample by drawing them from a hat. In one case, due to packaging, three videos in a series were included. The final sample was 58 DVDs.

Coding Procedure

Overview
Proportions of educational claim types, domain content, and interactional quality were calculated for each of the 58 videos. Educational claims were located on video packaging, websites, and accompanying materials. The videos were then coded for any content matching the claims by marking each point in the video containing material that addressed the claim.

Scene changes, character changes, interactional quality, and educational domains were coded using Noldus Observer software (v.7.0). Each video in the sample ($N = 58$) was initially coded into *scenes* to parse the content into meaningful units for analysis (Goodrich *et al.*, 2009). A *scene* was defined as the physical location where action took place ($N = 6971$ total scenes). Within scenes, character changes were coded when characters entered or exited that scene ($N = 9509$ total character changes). While there was a discrete time point when the character change was noted, the coding unit was actually the length of time from the character change until the start of the next character change. Interactional quality was coded each time a character change occurred. Character change and duration of time between two character changes were used as the coding units because these events involved a potential for shared interactions, both necessary conditions for coding any type of social interaction. This coding system provided a timestamped structure for all subsequent coding of educational domains and interactions. Specifically, each scene was assigned an educational domain, and each character change was coded for interactional quality. The remainder of this section includes the descriptions of how the videos were coded across three main categories: (a) producers' educational claims, (b) video educational domain content, and (c) video interactional quality.

Educational claim coding

Claims on video packaging. The packaging of the infant-directed videos was examined for claims made about the educational content of the videos (see Fenstermacher *et al.*, 2010 this volume for a more detailed description of this

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method). Each claim was then coded for its educational domain using definitions developed by Scott-Little, Kagan, Frelow, and Reid (2008). In the present analyses, claims related to *social/emotional development* (e.g. self-esteem, prosocial behavior: '[product] introduces positive values of friendship, compromise, and respect for every being and object') and claims linked to CCI or PPI ('all of our products are designed to encourage discovery and inspire new ways for parents and little ones to interact') were examined. *Social–emotional claims* were defined as any claim made by video producers pertaining to one of nine social/emotional categories related to self (Self-esteem, Self-confidence/self-reliance, Self-awareness, Self-concept) or others (Feelings of others, Relationships with peers, Social skills with adults, Social skills with peers, and Shared peer activities/social play) (Scott-Little *et al.*, 2008). For each video, a proportion of social–emotional claims was derived by dividing the total number of claims made by the number of claims that fit one of the nine social–emotional categories listed above.

Claim-matching in video content. Each video in the sample ($N = 58$) was coded in its entirety for any content specifically matching the educational claims found on that video's packaging, website, or promotional materials. For example, if a claim stated that a particular product would 'encourage sharing', coders noted any and all visual and/or verbal occurrences of sharing behavior in the video by marking the exact timestamp at which this content occurred. This process was referred to as 'claim-matching' and was done for all videos in our sample with one or more educational claims.

Educational domain content coding

Educational domains were calculated as the proportion of total scenes (minus opening and closing credits) in each video that contained a particular type of educational domain content. Scenes were selected as the appropriate unit for coding educational domains because we were examining what kind of content was present in the programs. Specifically, based on a system adapted from Scott-Little *et al*. (2008), each scene was coded as having one or more educational domains according to the dominant type of content (Cognitive Development, General Knowledge, Physical Development and Motor Skills, Language and Communication, or Social and Emotional Development), defined as comprising 70% or more of total scene duration. In most cases, only one domain was assigned per scene according to the type of content most heavily featured in that scene. About 5% of the scenes featured two content areas with equal emphasis ($N = 328$ of 6971 scenes, 4.71%). In addition, two programs had significantly longer scenes that resulted in content that could be coded in more than two domains. It was decided that scenes would be coded with a maximum of two domains. As a result, the two programs with extended scenes were excluded from educational domain coding analyses. Thus, $N = 56$ products were used in analyses describing educational domains.

General Knowledge included a broad range of general educational content such as colors, basic math concepts (counting, naming numbers), knowledge about animals, and the seasons. *Cognitive Development* included content related to executive functioning skills such as problem-solving, pretend play, planning, and memory. *Physical and Motor Development* encompassed depictions of physical activity, dancing, and learning about sports. *Language and Communication Skills* included learning about the alphabet and depictions of reading and vocabulary development. *Social and Emotional Development* focused on self-awareness, social skills, and

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interactions with others. In addition to these five defined areas, a domain classification of 'other/unclear' was assigned to those scenes that were either less than 2 s in total duration (as content contained in such a brief segment of the video would presumably be presented too quickly for infants to process) or containing content that could not clearly be classified into any of the five educational domains (e.g. a scene consisting mainly of a decontextualized image of a toy moving across the screen). A domain classification of 'credits' was assigned during opening and closing credits. These portions of the video were not coded any further nor were they included in the overall duration calculations for each video.

Interactional quality

A coding system adapted from Kirkorian, Pempek, Murphy, Schmidt, and Anderson (2009) to include both CCI and PPI was used to assess the type and quality of interaction for each appearance of two or more onscreen characters. The final coding scheme included two categories of interactional quality codes: CCIs and PPIs. Recall that the coding unit used to examine interactional quality represented the duration of time from the beginning of one character change to the beginning of the next character change. Each character change unit was assigned an interaction code that captured the quality or nature of an interaction type comprising 70% or more of the character change unit. In most cases, only one interaction code was assigned per character change unit. In cases where more than one type of interaction was featured with equal emphasis ($N = 223$ of 9509 character changes, 2.35%), two interaction codes could be assigned. For character change units that did not depict a caregiver and child or more than one child (e.g. a group of adults or single character), a code of 'non-interaction' was assigned. Using a character change unit as the basis for coding sometimes resulted in multiple character changes per scene. Therefore, analyses were conducted at the character change unit level as well as the individual scene level. Scene level codes were dichotomously coded for the presence or absence of each of the interactional quality codes. These two sets of codes resulted in two sets of composite variables: the proportion of *total character change units* containing each interaction type and the proportion of *total scenes* that contained at least one of a particular interaction type.

Caregiver–child interactions. CCI codes were scored for every character change that depicted adults and children onscreen together. Six different CCI codes (Active Visual, Active Visual–Verbal, Passive, Monitoring, Not Interacting, Not Codable) were available to describe the general level of adult engagement, involvement, and attention to the child during the interaction. The categories were mutually exclusive and exhaustive.

Active involvement (visual or visual/verbal) was coded when the caregiver was responsive to the child's actions and when the primary focus of the caregiver's attention was the child (e.g. the caregiver was in close proximity to and looking at the child or at a mutually shared person, object, or other item visually or verbally presented). The primary code was broken down further into two codes describing the nature of active involvement. *Active visual interactions* contained no verbal information. Instead, cues, including posture, shared focus of attention, and caregiver facial expressions, were used to determine active involvement (e.g. building a sand castle together at the beach). *Active visual/verbal involvement* was coded when the caregiver used both verbal and non-verbal behaviors to convey interest (e.g. caregiver offering hints and suggestions to child while working on a puzzle together).

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Passive involvement was coded if the interaction included passive attention to the child (e.g. not shifting gaze away from caregiver's own activity), or a general disinterest in the child or the child's activity. Disinterest was operationalized as a flat emotional tone, frequent shifting of attention away from the child, speaking with other adults without regard to the child).

Monitoring was coded when the caregiver was attentively watching what the child was doing (lengthy visual engagement versus a glance at the child for a second or two) but did not verbally or physically interact (e.g. when a coach watched children play soccer, when a caregiver watched a child petting an animal).

Not Interacting was coded when the caregiver did not interact with or look at the child and/or failed to respond when the child attempted to solicit his or her attention. This differed from passive involvement in that a non-interacting adult and child showed no awareness of, or attention to, one another during the full character change unit.

Not Codable was coded when the faces of both caregiver and child were not visible and no verbal cues were present.

Peer–peer interactions. Peer–peer codes were used to characterize onscreen children's interactions with one another. Most of the time, these interactions involved two or more children playing side by side, playing an organized game, or playing together. Six types of mutually exclusive and exhaustive categories (Cooperative Visual, Cooperative Visual–Verbal, Parallel, Other, Not Interacting, or Not Codable) were used to score the PPIs.

Cooperative activity (visual or visual/verbal) was coded when children were working together to reach a common goal or to solve a problem (e.g. working together to find a lost teddy bear). *Cooperative visual activity* was coded when characters exchanged objects or when characters were organizing games without any verbal input. *Co-operative visual/verbal activity* occurred when children verbally discussed or described what they were doing or planned to do together. For example, cooperative visual/verbal would be assigned if a group of children were talking about how to approach a problem or task, or were having a discussion with one another.

Parallel play (or *parallel activity*) refers to a developmental stage of social activity where children play adjacent to one another without interacting to create a shared activity. Children may use the same toys or materials in a similar manner; however, the participants do not attempt to influence each other's behavior (Parten, 1932). Parallel play was coded when two or more characters were engaged in a similar activity such as swimming, stretching, or dancing.

Other Interaction captured other types of interactions between peers that did not clearly fall into one of the above categories. Examples include affection (e.g. hugging, kissing, holding hands), standing together but not engaged in activity, or waving and yelling at the camera in unison.

Not Interacting was coded when peers were onscreen together but not interacting visually or verbally in any way (e.g. not looking at, speaking to, or otherwise acknowledging one another) and not playing or engaging in any kind of activity. The key difference distinguishing not interacting from the codes above lies in the absence of any kind of shared activity, visually or verbally presented, including playing adjacent to one another.

Not Codable was coded when the faces of both peers were not visible and no verbal content was present.

Data analysis plan

Analyses examined overall patterns of types of claims made, content matching social–emotional claims, educational domains, and onscreen interactions, as well as associations between content matched for social–emotional claims, educational domains, and interactional quality at both the overall video and individual scene levels.

Video-level analyses. Overall proportions of educational domain content (calculated as proportion of scenes assigned each domain/total scenes for each video) and interactional quality codes (calculated as proportion of character changes assigned each interaction code/total character changes for each video) were first compared at the 'video level' to assess whether the different interaction types were associated with one another as well as with the educational domain content at a broad level within videos. Correlations were examined between the relative proportions of different interaction types within videos. Next, correlations were calculated between relative proportions of active visual and visual–verbal interactions and educational domain content within videos.

Scene level co-occurrence analyses. To further describe how social–emotional content is depicted onscreen, an exploratory co-occurrence approach was adopted. These analyses were conducted with data generated at the scene-level ($N = 6691$) to test whether (1) interactional quality co-occurred with any educational domain content and whether (2) interactional quality co-occurred in scenes matched for socio-emotional claims, above or below instances expected by chance levels in the same scenes. The unit of analysis chosen for these analyses was a scene; therefore, character change units were collapsed across scenes. This strategy was selected because there could be multiple character changes within one scene and because domain content was previously coded at the scene level. By collapsing, we were able to link the kinds of social interactions that were taking place to the context of specific types of domain content. All interactional variables were dichotomous such that each interaction type was either present or not in a particular scene. Because scenes sometimes contained multiple character changes, it was possible to have both CCI active involvement and CCI passive involvement in the same scene. Each scene could then be categorized into one of four different co-occurrence patterns: both variable A and B can co-occur; A can occur while B does not, B can occur while A does not, or both variables can simultaneously not occur. Chance co-occurrence was calculated as the proportion of occurrences for one variable multiplied by the number of occurrences for another variable. Two-way contingency tables were constructed for each variable combination, using all 6971 scenes comprising the 58 videos in this sample. Two separate analyses were conducted. First, the co-occurrences between interaction types and educational domains were calculated. Next, co-occurrences between interaction types and social–emotional domain content that matched producers' specific claims were examined. The parameters obtained through a co-occurrence analysis included: (1) the probability of a co-occurrence (the proportion of scenes where both variables occur); (2) the probability of each variable occurring independently of the other variable (for each variable: the proportion of scenes in which the variable occurs); (3) the conditional probability of one variable occurring given that the other occurred (for each variable: the proportion of scenes the variable occurs when the sample space is limited to the scenes in which the other variable occurs); and (4) the expected probability of co-occurrence (the product of the two independent probabilities of occurrence for each variable). Hypothesis testing involved testing for the presence of a dependency among multiple variable combinations. When all cells had more than five cases, the traditional Pearson's Chi-Square test was used. When a cell had fewer than five cases, Fisher's exact test was conducted.

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Because we were conducting such a large number of hypothesis tests, the possibility of finding a significant relationship that is spurious (i.e. on average, a *p*-value of 0.05 indicates that statistical significance will occur by chance in 5 out of 100 comparisons) is increased. Procedures to control against that possibility often result in a larger number of false negatives (i.e. accepting the null hypothesis that no relationship is present when there actually is a significant relationship), particularly when the number of comparisons is quite large. Traditional multiple comparison tests correct for family-wise error rates while simultaneously sacrificing power, and, as such, are most appropriate for a modest number of comparisons (e.g. testing the simple main effects associated with an ANOVA framework that includes multiple factors). Because our study involved substantially more comparisons, it was necessary to choose a multiplicity correction that balanced both Type 1 and Type 2 errors, increased power, and minimized false positives. Benjamini & Hochberg's false discovery rate (1995), described as the expected proportion of false positives across all comparisons, was used.

RESULTS

Descriptive analyses of types of producers' claims, educational domain content, and interactional quality patterns found in the videos were calculated. Next, an analysis of differences associated with the number of interactions across the sample was performed. Video and scene level co-occurrence analyses compared types of interactions with overall domain content (Tables 2 and 3). Finally, a scene level co-occurrence analysis was conducted to examine types of interactions as a function of producers' claims (Table 4).

Reliability

Inter-rater reliability was calculated for 14 of the 58 videos (23% of the sample). Two coders were assigned for each coding pass, a primary coder and a reliability coder. The primary coder scored all 58 videos while the reliability coder scored only the 14 videos selected to compute reliability estimates. Once reliability was established, all values were compared with one another and any discrepancies were resolved by using only the primary coder's data. Reliability estimates (kappa) were generated for character change units and scenes, yielded a kappa of 0.80, and are reported in Goodrich *et al.*, 2009. Educational domain content and interactional quality reliability estimates were 0.82 and 0.76, respectively. Coding educational claims by domain content resulted in a kappa of 0.87. Finally, coding the degree of match between claims and content yielded a kappa of 0.78.

What and How Much Social–emotional Content Is Depicted in Infant-Directed Screen Media?

Social–emotional claims found on packaging and ancillary materials

Across the sample of 58 videos, there were 686 total claims. Of these, 511 were classified into one of five broad educational domains: Social–emotional Development (15%), Language and Literacy Development (29%), Physical and Motor Development (12%), Cognitive Development (12%), and General Knowledge (32%; see Fenstermacher *et al.*, this volume, for further detail). Seventy-four claims fit one or more criteria related to social–emotional development. Of all

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social–emotional claims, just 36.49% referenced social interactions. Slightly more than a quarter of the videos (25.86%) made at least one social–emotional claim.

Social–emotional video content

Domains. A relatively small percentage of educational domain content overall was specifically targeted towards supporting social–emotional development (19.46%). To examine whether this proportion was reflective of producers' claims about social–emotional material, scenes were further analyzed for content specifically matched to social emotional claims.

Matched claims. Content matching one or more social–emotional claims occurred 507 times within 291 scenes across 15 videos. The percentage of claims that matched educational domain content overall and across all scenes was low; that is, 4.62% of claims and 4.18% of scenes matched any presented content. Whether looking across claims or across scenes, claim-matching social–emotional content occurred infrequently.

While specific content related to social–emotional claims was quite small, it was possible that onscreen characters would deliver unrelated content by embedding it within interactions or strategies related to conveying information about emotions, self-knowledge, or interacting with others. To address this issue, frequencies associated with all interactional codes were computed. Next, a co-occurrence analysis was performed to examine whether and how non-social–emotional content co-occurred within appropriate social interactions.

Interactional quality

Frequency of interaction types. Table 1 presents the frequencies of CCI and PPI relative to the number of character change units. Two-thirds of all coded character changes were assigned non-interaction codes (individual character, live animals, group of adults, and no character). CCI was depicted in 12% of character change units and PPI occurred during 26% of available character changes.

Types of CCI and PPI interactions. Within the 12% of character changes depicting adults and children together onscreen, 48% were characterized as active and involved (Active Visual or Active Visual–Verbal); 13% were coded as monitoring (i.e. passively attending to the child); 24% were coded other; and 15% were coded

Table 1. Percentage of all character changes containing each type of character configuration. Note that some character changes contained more than one type of interaction

Caregiver–child interactions	Mean (S.D.)	Peer–peer interactions	Mean (S.D.)
Monitoring	0.15 (0.43)	Parallel play	4.77 (5.39)
Passively involved	0.62 (0.99)	Cooperative visual	2.99 (4.87)
Active visual	2.81 (5.02)	Cooperative visual/verbal	3.49 (7.41)
Active visual/verbal	3.60 (11.93)	Other interaction	6.86 (7.93)
Not interacting	0.14 (0.51)	Not interacting	2.95 (3.84)
Not codable	2.00 (2.54)	Not codable	4.39 (5.21)
Total	11.42 (17.04)	Total	25.46 (17.19)

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as non-interactions. Within the 26% of character changes depicting PPIs, the majority of interactions were considered uncodable or other (43%) followed by 26% of changes that were actively engaged (Cooperative Visual or Visual–Verbal), 19% that featured parallel play, and 12% that were non-interactions.

Ratios of interactions to non-interactions. To examine whether high-quality (i.e. active visual/visual–verbal CCI, cooperative visual/visual–verbal PPI) interactions were distributed evenly across videos, the ratio of interactions to non-interactions was computed for each video (i.e. total CCI or PPI divided by total non-interaction codes). A ratio above 1.0 indicates more interactions than non-interactions while a ratio below 1.0 indicates a larger proportion of content contained no interactions. In this sample, the ratio of interactions to non-interactions ranged between 0 and 3.32; however, the majority of ratios were below 1.0. The range of ratios in the bottom quartile ranged between 0 and 0.26 ($M = 0.15$; S.D. = 0.08). Ratios in the top quartile ranged between 1.08 to 3.32 ($M = 1.74$; S.D. = 0.65). These results indicate that just 25% of all videos contained more interactions than non-interactions.

Associations Among Interaction Types

First-order correlations between interaction types were calculated at the video level. Overall, CCI and PPI were moderately and negatively related ($r\,(58) = -0.32$, $p < 0.05$). No other significant associations were found between CCI and PPI codes: active CCI and active PPI ($r(58) = -0.034$, $p = 0.80$), passive CCI and parallel play ($r(58) = 0.06$, $p = 0.67$), and active and passive interactions within CCI ($r(58) = 0.07$, $p = 0.56$) or PPI ($r(58) = -0.11$, $p = 0.41$). These results suggest that CCI and PPI interactions may be orthogonal to one another; that is, some videos predominantly displayed CCIs while others predominantly displayed PPIs.

Associations Between Educational Domain Content and Onscreen Interactions

Video level associations

Correlations were computed at the video level between the percentage of scenes containing different educational domains and percentage of active onscreen interactions (Table 2). Because cognitive development material comprised such a

Table 2. Associations of educational domain content with onscreen interactions

Presentational strategy	Educational domain (percent of scenes)			
	General knowledge	Language and communication	Social and emotional development	Physical development and motor skills
Percentage of CCI that was active (visual and visual verbal)	−0.155	−0.017	0.510**	−0.020
Percentage of PPI that was cooperative (visual and visual verbal)	0.041	−0.334*	0.190	0.242

Note: Video-level analyses examined associations between the percentage of scenes assigned each type of educational domain and the percentage of all CCI active interactions and all PPI cooperative interactions.
**Correlation is significant at the 0.01 level (two-tailed).
*Correlation is significant at the 0.05 level (two-tailed).

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small portion of overall domain content (i.e. less than 5% of all scenes), we did not compute correlations for the cognitive domain. Very few of the educational domains were significantly correlated with onscreen interactions. Only the presence of social–emotional domain content was positively correlated with active CCI. Conversely, PPIs were not positively associated with specific domain content. Scenes featuring language and literacy domain content rarely contained character change units that depicted cooperative PPI. These findings indicate that the majority of language and literacy domain content was presented outside of an interactive context.

We predicted that developmentally appropriate CCI and PPI would be significantly related to the presence of social–emotional domain content. These predictions held only for CCI; that is, cooperative PPI was unrelated to the presence of social–emotional domain content. As a result, cooperative PPI was more likely to be presented in contexts independent of, or tangential to, social–emotional themes (Table 2).

Which Interactional Strategies Were More Likely to Co-Occur at the Scene Level?

Table 3 features scene-level co-occurrences between high-quality CCI and PPI (i.e. active and cooperative, respectively) representing Social–emotional, Language and Literacy, Physical and Motor, and General Knowledge domain content. Because cognitive development material comprised less than 5% of all scenes, we did not compute co-occurences for this domain. High-quality CCI co-occurred more frequently with social–emotional content (35%) and least frequently with language and literacy (8%), physical (8%), and general knowledge (6%) domain content. High-quality PPI was more likely to co-occur with physical (40%) and social–emotional domain content (43%) and less frequently with general knowledge (10%) or language and literacy (8%) domain content.

Onscreen interactions in scenes matching for social–emotional claim content

The total number of social–emotional claims made by video producers was modestly associated ($r(\mathrm{df} = 54) = 0.35$, $p < 0.01$) with the overall percentage of social–emotional domain content shown in the videos; however, these claims were unrelated to the proportion of CCI and PPI presented in the videos. This finding indicates that even when social–emotional claims were made, they were infrequently tied to high-quality interactions between children and caregivers or peers.

The next set of analyses examined when and how different interactional strategies were used in videos where producers made social–emotional claims. Table 4 presents these co-occurrences. Both active and passive PPI were equally represented within scenes matched to at least one social–emotional claim. Active PPI occurred five times more frequently than predicted by chance in scenes matching at least one social–emotional claim (i.e. cooperative visual: 19%; cooperative visual–verbal: 22%). This high-quality PPI co-occurred most frequently in scenes supporting social skills with adults (43%) and social skills with peers (63%). Passive PPI co-occurred in approximately 81% of scenes containing social–emotional content. Specific passive PPI categories included parallel play (21%), non-interactions (11%), other interactions (31%), and uncodable (18%). The majority of scenes devoted to feelings of others depicted parallel play (48%) whereas active PPI co-occurred in just 31% of scenes. Overall, these results indicate that videos with social interaction claims meet those claims just as often through passive interactions as through active interactions with peers (Table 4).

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Table 3. Scene-level co-occurrences between high-quality interactions and educational domains

	General knowledge		Language development		Social emotional development		Physical development	
	Actual ♯ of within-scene co-occurrences (expected ♯)	% scenes containing interaction type	Actual ♯ of within-scene co-occurrences (expected ♯)	% scenes containing interaction type	Actual ♯ of within-scene co-occurrences (expected ♯)	% scenes containing interaction type	Actual ♯ of within-scene co-occurrences (expected ♯)	% scenes containing interaction type
Active visual CCI	**49 (92)**$^{-}$	**3.34**	68 (71)	7.61	**68 (20)**$^{+}$	**21.56**	14 (18)	5.57
Active visual–verbal CCI	34 (34)	2.40	5 (27)$^{-}$	**0.77**	**49 (8)**$^{+}$	**13.30**	4 (6)	2.41
Cooperative visual PPI	**64 (109)**$^{-}$	**4.40**	**43 (85)**$^{-}$	**5.14**	**70 (24)**$^{+}$	**23.95**	**91 (21)**$^{+}$	**34.40**
Cooperative visual-verbal PPI	85 (62)	5.73	**28 (49)**$^{-}$	**2.82**	**42 (14)**$^{+}$	**19.38**	16 (12)	6.06

$^{+}$Co-occurrence significantly greater than predicted by chance, $p<0.05$. $^{-}$Co-occurrence significantly less than predicted by chance, $p<0.05$. Bold indicates co-occurrence differs from chance.

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Table 4. Scene-level co-occurrences between matched social emotional claims and interactional content

Interactional quality	Social–emotional claims related to others											
	Any social emotional claim		Feelings of others		Relationships with peers		Social skills with adults		Social skills with peers		Shared peer activities/ social play	
	Actual ♯ of within-scene co-occurrences (expected ♯)	% scenes containing interaction type	Actual ♯ of within-scene co-occurrences (expected ♯)	% scenes containing interaction type	Actual ♯ of within-scene co-occurrences (expected ♯)	% scenes containing interaction type	Actual ♯ of within-scene co-occurrences (expected ♯)	% scenes containing interaction type	Actual ♯ of within-scene co-occurrences (expected ♯)	% scenes containing interaction type	Actual ♯ of within-scene co-occurrences (expected ♯)	% scenes containing interaction type
CCI												
Active visual	**15 (7)**$^+$	**7.11**	0 (1)	0	2 (1)	4.35	**12 (3)**$^+$	**12.37**	0 (2)	0	**9 (3)**$^+$	**8.82**
Active visual–verbal	**9 (3)**$^+$	**4.27**	1 (0)	3.23	3 (1)	6.52	**7 (1)**$^+$	**7.22**	**7 (1)**$^+$	**9.21**	**6 (1)**$^+$	**5.88**
Passive	**7 (2)**$^+$	**3.32**	0 (0)	0	1 (0)	2.17	**6 (1)**$^+$	**6.19**	0 (1)	0	**5 (1)**$^+$	**4.90**
Monitoring	3 (1)	1.42	0 (0)	0	0 (0)	0	**3 (0)**$^+$	**3.09**	0 (0)	0	**3 (0)**$^+$	**2.94**
Not interacting	0 (3)	0	0 (0)	0	0 (1)	0	0 (1)	0	0 (1)	0	0 (1)	0
Uncodable	**23 (5)**$^+$	**10.90**	3 (1)	9.68	4 (1)	8.70	**16 (2)**$^+$	**16.50**	**8 (2)**$^+$	**10.53**	**20 (2)**$^+$	**19.61**
PPI												
Cooperative visual	**41 (8)**$^+$	**19.43**	4 (1)	12.90	5 (2)	10.87	**19 (4)**$^+$	**19.59**	**25 (3)**$^+$	**32.90**	**30 (4)**$^+$	**19.43**
Cooperative visual–verbal	**46 (8)**$^+$	**21.80**	**6 (1)**$^+$	**19.36**	**17 (2)**$^+$	**36.96**	**25 (4)**$^+$	**25.77**	**23 (3)**$^+$	**30.26**	**31 (4)**$^+$	**30.39**
Parallel play	**44 (9)**$^+$	**20.85**	**15 (1)**$^+$	**48.39**	**11 (2)**$^+$	**23.91**	**15 (4)**$^+$	**15.46**	**29 (3)**$^+$	**38.16**	**15 (5)**$^+$	**14.71**
Other interaction	**66 (13)**$^+$	**31.28**	**13 (2)**$^+$	**41.94**	**29 (3)**$^+$	**63.04**	**24 (6)**$^+$	**24.74**	**35 (5)**$^+$	**46.05**	**24 (6)**$^+$	**23.53**
Not interacting	**23 (6)**$^+$	**10.90**	**9 (1)**$^+$	**29.03**	**5 (1)**$^+$	**10.87**	**8 (3)**$^+$	**8.25**	**17 (2)**$^+$	**22.37**	**9 (3)**$^+$	**8.82**
uncodable	**37 (11)**$^+$	**17.54**	**8 (2)**$^+$	**25.81**	**9 (2)**$^+$	**19.57**	**11 (5)**$^+$	**11.34**	**20 (4)**$^+$	**26.32**	**22 (5)**$^+$	**21.57**

$^+$Co-occurrence significantly greater than predicted by chance, $p<0.05$. $^-$Co-occurrence significantly less than predicted by chance $p<0.05$. Bold indicates co-occurrence differs from chance.

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While high-quality CCI co-occurred less frequently than high-quality PPI in scenes matching at least one social–emotional claim, they were 2–3 times more likely to co-occur than would be predicted by chance (i.e. about 11% of scenes). The majority of these high-quality CCIs were present in scenes that featured content targeting social skills with adults (20%) and with peers (9%). Passive CCI accounted for seven and monitoring CCI accounted for three claim-matched scenes, resulting in no significant associations between these lower-quality CCIs and scenes matched for social emotional claims. Although the proportion of all scenes depicting any social–emotional content was quite low, when this content did occur, it was most often depicted through active CCI strategies (Table 4).

Finally, we examined the co-occurrence between social–emotional content matched to social–emotional claims and the depictions of two or more characters onscreen who did not interact or who engaged in an encounter that was 'uncodable' (i.e. the actors' faces could not be seen and voices could not be heard or because the character change unit was presented for fewer than two seconds). Uncodable interactions were found in approximately 11% (CCI) and 18% (PPI) of scenes containing social–emotional content and between 11% (CCI) and 26% (PPI) of scenes that specifically matched one or more social interaction claims. CCI non-interactions (caregivers and children presented onscreen together in the absence of an interactive context) never co-occurred in scenes that matched producers' social–emotional claims. PPI non-interactions were more frequent in scenes matched to producers' claims: 8%–29% of scenes matched for interactive social claims related to others and 11% of scenes matched for any social–emotional claim.

DISCUSSION

The purpose of this study was to examine the interactional quality of social relationships depicted in infant and toddler videos. Our analyses indicated that infant-directed videos rarely use social interactions between caregiver and child or between peers when delivering educational content. Even when producers claim to explicitly target social–emotional content, correlations between these claims and content are modest at best. Moreover, other types of domain content (especially language) that is best learned through high-quality face-to-face social interactions rarely co-occurred with those interactions. The results suggest that producers of infant-directed media are not applying developmental principles or research evidence in ways that take full advantage of developmentally appropriate interaction strategies to present their content.

The research evidence associated with face-to-face exchanges is quite clear: infants and toddlers learn best through high-quality CCI and PPI (e.g. Vygotsky, 1978). This evidence is substantial and has existed for a considerable period of time. During the genesis of the infant-directed screen media explosion, the political and social climates in the United States were singularly focused on the importance of the first 3 years of a child's life (e.g. Carnegie Task Force on Meeting the Needs of Young children, 1994), circumstances that make the dearth of interactions found in these programs particularly surprising. Recent research also demonstrates that the presence of high-quality interactions onscreen are causally linked to positive changes in the ways that viewing caregivers interact with their own children (Pempek *et al.*, in press).

Social–emotional claims comprised only 17% of the 686 claims made by producers. Even when these claims were made, the videos contained, at best,

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moderate levels of onscreen interactions with only 4% of all scenes matched to social–emotional claims. While a substantial portion of the CCI presented in these videos was characterized as active, these high-quality interactions still accounted for less than half of all coded CCI. Moreover, CCI of all types made up only a small fraction of onscreen interactions, occurring in just 12% of all character changes and 10% of scenes across the total video sample.

Infants and toddlers between birth and 3 years of age are undergoing a peak time of social–emotional and socio-cognitive development (e.g. Vygotsky, 1978), making them particularly primed to pay attention to and engage with other people in their environments. Depictions of onscreen characters, particularly those whose faces can be seen and who are actively engaged with one another, are likely to garner more infant attention. Indeed, research on learning via observation of third-party exchanges indicates that actively engaged onscreen interactions between characters represent a particularly effective means for successfully conveying educational content to infants and toddlers (e.g. Akhtar, 2005; Akhtar *et al.*, 2001; Linebarger & Walker, 2005; O'Doherty *et al.*, 2010). In contrast, content that is presented in a decontextualized way with few or no onscreen characters to engage the audience may make it particularly challenging for infants and toddlers to learn effectively. Videos whose purpose is to support infant and toddler learning should utilize onscreen characters who are actively engaged with one another to present educational content. Not only was the overall level of social–emotional content presented in these videos surprisingly low, the inclusion of high-quality interactions was also scarce. Just 25% of the videos in the sample depicted more interactions than non-interactions, and two-thirds of character changes (i.e. scenes when characters were present, left the scene, or entered the scene) across the 58 videos featured an individual character or no character at all. Such results indicate that the majority of infant-directed videos present content in ways that ignore the vital importance of social interaction in social and cognitive development. As a whole, these results demonstrate that the under-representation of social–emotional content in infant-directed videos persists even when producers of these videos indicate that they are targeting such content.

Infant-directed videos also tended to be highly thematic; the most frequent educational content domains were general knowledge (49.40 %) and language and literacy development (28.75%; see Fenstermacher *et al.*, 2010, this volume). While some of the content presented in these areas may be more or less developmentally appropriate for infants and toddlers (e.g. learning about colors or labels for objects versus learning about going to a museum or how to read), neither language development nor general knowledge content showed strong associations with onscreen interactions, suggesting once again that interactional strategies are not used to teach content. In fact, language content was negatively associated with onscreen interactions, suggesting that videos designed to 'teach' language concepts to infants and toddlers do so in the relative absence of onscreen interactions.

Producers of infant-directed media make claims emphasizing developmental benefits associated with social–emotional content, presumably demonstrating an awareness of the importance of such content to early childhood development. The degree of mismatch between these claims and presented content suggests that errors are made when this awareness is translated into specific content. Part of the translational problem may lie in how information is communicated between the developmental science community and the producers who make media content for infants and toddlers, between the producers and the parental

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consumers of this content, and between the developmental science community and the parental consumers. Recent empirical research (e.g. Deloache *et al.*, 2010; Robb, Richert, & Wartella, 2009; Richert, Robb, Fender, & Wartella, 2010) suggests that certain vocabulary-focused infant and toddler videos do not present content in ways that are optimally beneficial or easily understood by infants and toddlers. These experimental findings coupled with the negative association between language content and onscreen interactions described above suggest that a straightforward and potentially simple shift from the use of decontextualized methods of content presentation to a more interactive format (e.g. participatory verbal cues like those used in Dora the Explorer) may be a crucial learning element missing from such infant and toddler videos (see Fender, Richert, Robb, Wartella, 2010; Vaala *et al.*, 2010). Encouraging producers to take advantage of existing research regarding how infants learn best in live situations, how these learning principles can be used to deliver media content, and whether such strategies have supported learning from media represents the first of many steps towards the creation of high-quality developmentally appropriate content that facilitates learning by their young audience.

A caveat to the current research is that, as developmental researchers, we are well aware of the importance of interactions and social context for young children. It is possible that caregivers do not view content presented through CCI or PPI as 'educational' and, as a result, do not purchase products that mention social–emotional goals or content. Instead, the analysis of producer claims indicates a strong emphasis on content more traditionally linked with 'learning' including vocabulary, the alphabet, colors, and numbers (Fenstermacher *et al.*, this volume). Producers of infant and toddler media may simply be catering to caregivers' interests in downplaying social–emotional content in favor of other types of educational material. Until additional empirical research examines the relations between video structure and developmental outcomes, it is hoped that producers of infant and toddler media will create content using existing research as well as compare existing and new content to the codes described here and elsewhere (Fenstermacher *et al.*, this volume; Vaala *et al.*, 2010). Although much remains to be learned about the specific practices that can help very young children learn from videos, our recommendations represent the best practices available based on the current state of knowledge in the field.

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