

Syng for spædbarnet – og massér det!

En japansk og en canadisk forsker har for nylig fundet, at spædbørn på seks måneder kigger mere på deres mor, hvis hun synger, end hvis hun blot taler til sit barn. Desuden fandt forskerne, at barnet bevægede sig mindre, mens moderen sang, end når hun talte til sit barn.

Det er en almindelig opfattelse blandt spædbørnsforskere, at et barn, der bliver stærkt optaget af et sanseindtryk, samtidig er tilbøjelig til at standse sine igangværende bevægelser for at koncentrere sig om dette indtryk, så også det sidstnævnte mål tyder på, at de små spædbørn var mere opslugt af moderen, når hun sang, end når hun talte – selv om forskerne havde gjort sig umage for at sørge for, at lydene i de to situationer var lige mange og lige stærke. Der kan således efter det japansk-canadiske forskerhold næppe være tvivl om, at allerede seks måneder gamle spædbørn er udstyret med en særlig smag for rytmiske menneskelyde!

Samtidig har en amerikansk forskergruppe fundet ud af, at mødre, der hver dag masserer deres nyfødte spædbørn efter et bestemt mønster i tyve minutter, fik spædbørn, der 1) tog mere på i vægt, 2) voksede hurtigere og 3) udviste mindre følelsesmæssig uro under en let stresspåvirkning.

Ideen til dette eksperiment kom bl.a. fra indledende undersøgelser, der viste, at spædbørn under massagen udvikler flere fysiske tegn på nedsat stress tilstand, dels i form af langsommere puls, dels i form af mere "rolige" hjernebølger og endelig simpelt hen i form af mindre bevægelsesmæssig uro.

Da man herefter ville teste betydningen af en sådan daglig massage i løbet af den første måned efter fødslen, var

det nødvendigt at medtage en kontrolgruppe, der fik lige så megen "nærkontakt" med deres moder i samme tidsrum uden at få den samme massage. Derfor bad forskerne en anden gruppe af mødre om i de samme tidsrum at give deres spædbørn en tilsvarende, men meget lettere massage, som næppe har fungeret som "rigtig massage". Men hvad barnets eventuelle oplevelse af "moderkontakt" angår, kunne den anses for at være den samme i begge grupper.

Det viste sig, at der kun var den "regulære massage", der havde de omtalte positive virkninger, så forskerne er rimeligt sikre på, at det er massagen som sådan og ikke blot den medfølgende moder-kontakt, der havde de gunstige virkninger hos spædbørnenes udvikling.

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Fysiologiske studier søger forklaring på effekten af berøring

Den ro og afslapning, en mor oplever, når hun ammer sit barn, opnås også i forbindelse med massage. Dyrestudier tyder på, at både amning og massage øger udskillelsen af oxytocin

AF MARK H. THEILMANN, FYSIOTERAPEUT B.SC
FOTO CAROLINE BACLIG/POLFOTO

I et tætpakket lokale på forårets fagfestival i Odense leverede den svenske professor Kerstin Uvnäs Moberg det fysiologiske argument for massage og forklaringen på, hvorfor massage giver afspænding og ro og konsekvenserne heraf. Disse argumenter er nu udkommet på dansk i bogform fra Akademisk Forlag. Og det er næsten ikke til at få armene ned, når man under læsningen genkender de reaktioner, vi oplever hos patienter og os selv som følge af massage, især når de så prisværdigt letlæseligt og medrivende bliver sat ind i en fysiologisk forklaringsramme.

I fem dele tager Moberg os med gennem sin forsknings forhistorie, den grundlæggende fysiologi, oxytocins virkning, berøringen som væsentligste udløser af oxytocin og til sidst andre stimuli til øget oxytocinudskillelse i organismen. Baggrunden for Mobergs forskning og denne bog ligger mere end 20 år tilbage, hvor hun undrede sig over den ændring, hun kunne observere hos sig selv og hos andre mødre, når de ammede deres børn. Fra at være almindeligt oppe på mærkerne faldt mødrene til ro og gik ind i en tæt kontakt med det diende barn. Hvorfor nu

det? spurgte hendes indre forsker. Og det har hun så lige siden arbejdet med at finde et kvalificeret bud på.

Kerstin Uvnäs Moberg er professor i fysiologi ved Statens Landbrugsuniversitet i Uppsala og Karolinska Institutet i Stockholm, og det var ved at studere dyrestudier, hun først kom på sporet af oxytocin som den fysiologiske årsag til ro og afspænding. Studierne viste blandt andet, at oxytocin på forskellig måde indvirkede på moderdyrets interaktion med dets unger. Og det så tilmed ud som om stoffet kunne skabe en binding mellem moderen og ungerne. Herefter startede hendes arbejde med at udforske virkningerne af oxytocin hos mennesker og årsagerne til dets frigivelse. Indtil da havde den humanfysiologiske forskning fokuseret på stress-reaktioner og det såkaldte fight-or-flight system.

Oxytocin viste sig at fungere i dets modpart, et system som Moberg kalder ro-hvile-systemet eller ro-og-relations systemet.

Oxytocin er blevet identificeret som bærer af biokemisk information, der initierer og igangsætter reaktioner i kroppen, så vi slapper af og føler velvære. I modsætning til fight-or-flight systemet, som har til hensigt at mobilisere energi og skabe fokus på at bekæmpe en trussel eller flygte fra den, så er ro-hvile-systemet aktivt, når man er i sikkerhed og føler sig tryk. Her spiller berøring tilsyneladende en afgørende rolle for frigivelsen af oxytocin, berøring der opfattes og fortolkes som behagelig, uskadelig eller non-noxious af modtageren. Men meget tyder på, at også andre stimuli medfører frigivelse af oxytocin, heriblandt positiv social interaktion, sex, mad, beroligende medicin, cigaretter og alkohol.

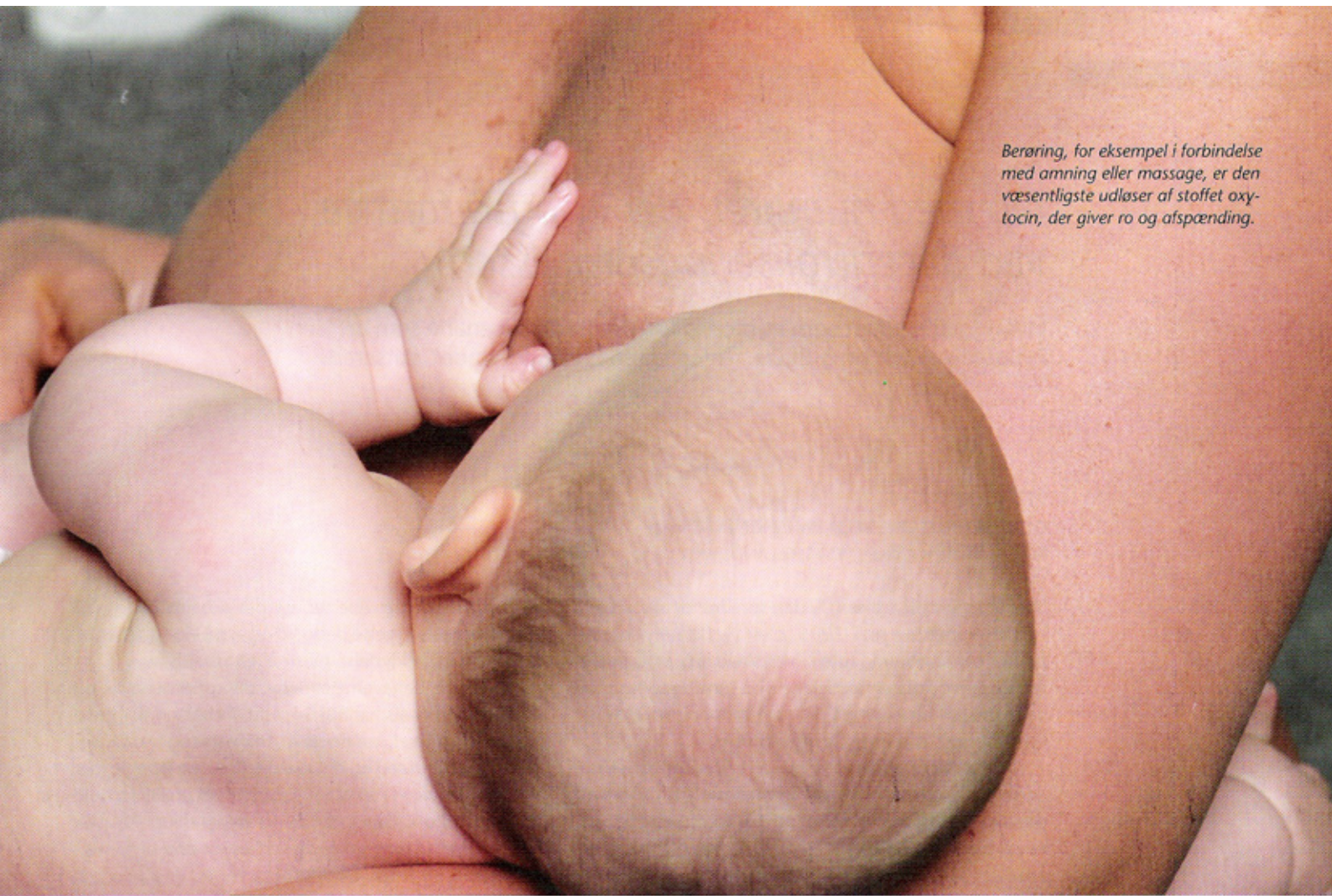
SAMME EFFEKT SOM VED AMNING

Effekterne af oxytocin har vist sig at være talrige, men de mest veldokumenterede er ifølge Moberg nedsat blodtryk, reduceret mængde af stresshormoner i blodet, forhøjet smertetærskel, bedre tarmfunktion, vækststimulation og øget social interaktion. Beviserne stammer blandt andet fra observationer af ammende kvinder, som beviseligt udskiller oxytocin til blodet under denne tætte fysiske kontakt med barnet. Her registrerede man i kontrollerede forsøg deres psykiske og fysiologiske tilstand under amning, under hvilken man gav enten en oxytocinantagonist (et stof der modvirker oxytocins virkning) eller placebo.

Placebogruppen blev ved med at føle ro og tæt kontakt med barnet samtidig med, at deres blodtryk bibeholdt et fald, mens gruppen, der fik indgivet en oxytocinantagonist, vendte tilbage til udgangspunktet for de psykologiske og fysiologiske parametre inden amningen. Men størstedelen af beviserne stammer fra forskellige typer af dyreforsøg. Så hvor stærke er beviserne for mennesker?

indgang

■ Professor Kerstin Uvnäs Moberg holdt på fagfestivalen i marts måned oplæg om den fysiologiske effekt af massage. Fysioterapeut Mark Theilmann opridser hovedtrækkene i hendes forskning og giver en anmeldelse af Kerstin Uvnäs Mobergs bog.



Berøring, for eksempel i forbindelse med amning eller massage, er den væsentligste udløser af stoffet oxytocin, der giver ro og afspænding.

FÅ STUDIER MED MENNESKER

Et litteraturstudie om oxytocin foretaget af Poulsen, Sølling og Theilmann (2005) skulle afdække om måling af oxytocin kunne bruges som effektmål af massage på mennesker. Der blev kun identificeret to små studier med mennesker, der målte oxytocinkoncentrationen som følge af massage. I forsøgene målte forskerne oxytocinudskillelse til blodet, men af etiske grunde ikke i hjernen. På dyr anvender man blandt andet mikrodialyse til måling af signalstoffer i hjernen med tydelige resultater, men da det indebærer operation i selve hjernen, er det ikke en etisk forsvarlig metode til måling hos mennesker. Studiets konklusion var, at man endnu ikke har direkte fysiologiske beviser for at massage medfører oxytocinudskillelse hos mennesker. Derfor bygger fortællingen om oxytocin som kilden til ro og afspænding hos mennesker indtil videre udelukkende på indicier. Disse er til gengæld tungtvejende og præsenteres i et klart sprog og yderst inspirerende af Moberg. Fremtiden vil forhåbentligt give mere direkte beviser for sammenhængen mellem massage og oxytocin samt dets virkning hos mennesker.

VIGTIG BOG

Mobergs bog er den første samlede præsentation af oxytocins funktion i mennesket og præsenterer egen

og andres forskning fra 1966 og frem til 2000. Den foreligger som en oversættelse af den svenske udgave fra 2000 og er således ikke blevet opdateret med den seneste forskning, desværre. Men med denne bog åbnes døren på klem ind til den nødvendige og hastigt voksende forskning, der kæder humanistisk psykologisk forskning i følelser og emotioner sammen med biologisk naturvidenskabelig forskning kaldet psyko-neuro-immuno-endokrinologi (PNEI).

Den er selvskreven til undervisningen i manuel behandling på fysioterapeutuddannelsen og et must til fysioterapeuten i en evidenshungrende verden præget af patienter med stress og udbændthed der efterspørger ro og afspænding. Giv dem en gang oxytocin.

ANDRE KILDER

Poulsen, Sølling og Theilmann (2005) (bachelorprojekt) "Oxytocin som effektmål for massage." Tilgængelig på www.ffy.dk.

Man kan læse mere og finde links til centrale og nyere artikler om oxytocin på www.psykfys.dk ■

fakta om...

Kerstin Uvnäs Moberg (2006)
"Afspænding, ro og berøring. Om oxytocins helbredende virkning i kroppen". Akademisk Forlag, København.





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Infants' responsiveness to maternal speech and singing

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Abstract

Infants who were 6 months of age were presented with extended audiovisual episodes of their mother's infant-directed speech or singing. Cumulative visual fixation and initial fixation of the mother's image were longer for maternal singing than for maternal speech. Moreover, movement reduction, which may signal intense engagement, accompanied visual fixation more frequently for maternal singing than for maternal speech. The stereotypy and repetitiveness of maternal singing may promote moderate arousal levels, which sustain infant attention, in contrast to the greater variability of speech, which may result in cycles of heightened arousal, gaze aversion, and re-engagement. The regular pulse of music may also enhance emotional coordination between mother and infant.

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1. Infants' responsiveness to maternal speech and singing

Maternal behavior is undoubtedly influenced by infants' interests and inclinations, which may account for prosodic differences in speech to prelinguistic infants of different ages (Kitamura, Thanavishuth, Burnham, & Luksaneeyanawin, 2002; Stern, Spieker, Barnett, & MacKain, 1983). For their part, infants are more responsive to natural maternal voices than to stimuli incorporating reduced spectral cues (Cooper & Aslin, 1994). From the earliest days of life, infants prefer their own mother's face (Bushnell, Sai, & Mullin, 1989) and voice (DeCasper & Fifer, 1980) to those of a stranger. They also prefer positive facial expressions to neutral facial expressions (Kuchuk, Vibbert, & Bornstein, 1986) and positive vocal

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expressions to neutral vocal expressions (Kitamura & Burnham, 1998; Singh, Morgan, & Best, 2002). These findings are consistent with infants' precocious interest in social stimuli that have positive valence (Trehub & Nakata, 2001–2002; Walker-Andrews, 1997). The keen interest in these social signals provides a means by which mothers can achieve some type of emotional communion with their infants.

From 4 to 7 weeks of age, if not before, infants are highly responsive to the richly intoned sounds of infant-directed (ID) speech, preferring those to the more muted tones of adult-directed (AD) speech (Cooper & Aslin, 1990; Kaplan, Goldstein, Huckleby, Owren, & Cooper, 1995; Pegg, Werker, & McLeod, 1992; Werker, Pegg, & McLeod, 1994). Although ID speech is acoustically distinct from AD speech in several respects, including heightened pitch, exaggerated pitch contours, and slow tempo (Papoušek, Bornstein, Nuzzo, Papoušek, & Symmes, 1990; Stern, Spieker, & MacKain, 1982), aspects of its pitch patterning are thought to reflect the speaker's positive affect (Kitamura & Burnham, 1998; Trainor, Austin, & Desjardins, 2000) and to induce heightened responsiveness (Fernald & Kuhl, 1987; Singh et al., 2002). The inherent attractiveness of this speech register for infant listeners may account for its widespread use across cultures (Ferguson, 1964; Grieser & Kuhl, 1988; Papoušek, Papoušek, & Symmes, 1991).

Maternal singing to infants is also ubiquitous, both within and across cultures (Trehub & Schellenberg, 1995; Trehub & Trainor, 1998). North American mothers sing frequently (i.e., several times daily) to their infants, most commonly in the course of playful interactions but also during various instrumental activities such as sleep preparation, bathing, feeding, or diaper-changing (Trehub et al., 1997). Beyond a separate genre of songs (i.e., lullabies and play songs) is a distinctive singing style, which involves high pitch, slow tempo, and other indices of heightened expressiveness or emotionality (Trainor, Clark, Huntley, & Adams, 1997; Trehub et al., 1997). Like maternal speech, maternal singing is finely tuned to the age and affective state of the listener (Bergeson & Trehub, 1999; Trehub & Trainor, 1998), except in the case of "dismissive" mothers, as classified by the Adult Attachment Interview (Milligan, Atkinson, Trehub, Benoit, & Poulton, 2003). Like other mothers, dismissive mothers sing more expressively in infants' presence than in their absence, but they are less likely to differentiate their singing style for distressed and non-distressed infants.

Although naive listeners readily distinguish ID singing from non-ID singing (Trehub et al., 1997; Trehub, Unyk, & Trainor, 1993), the differences in singing style are subtle compared to the dramatic differences between ID speech and AD speech. For example, exaggerated pitch contours, which are considered the hallmark of ID speech (Katz, Cohn, & Moore, 1996; Papoušek, 1992), are precluded in singing because they would violate the defining features of the tunes. As a result, performers must rely on small, expressive changes in vocal quality, pitch level, and timing to achieve their social-emotional goals. In contrast to the three- or four-semitone rise in the pitch level of ID speech relative to AD speech (Fernald & Simon, 1984), ID singing is approximately one semitone higher than typical informal singing (Trehub et al., 1993, 1997). The result is higher pitched ID speech than ID singing, which reverses the usual situation of higher pitched non-ID singing than non-ID speech (Bergeson & Trehub, 2002).

The small but perceptible differences between ID and non-ID singing achieve their intended effect. Just as infants are more attentive to ID than to AD speech (Cooper & Aslin, 1990; Grieser & Kuhl, 1988; Werker & McLeod, 1989), so are they more attentive to ID singing than to non-ID singing, both in the newborn period (Masataka, 1999) and at 6 months of age (Trainor, 1996). The specific cues that underlie differential responsiveness to ID and non-ID speech and singing are unclear, but, as noted, those associated with positive emotion (e.g., high pitch, voice quality) have been implicated (Kitamura & Burnham, 1998; Singh et al., 2002; Trainor et al., 1997). The acoustic salience of ID speech, especially its wide pitch range, high pitch, and distinctive contours, is presumed to lessen the impact of background

noise (Fernald, 1991). Emotional intentions are also thought to be more emotionally transparent in ID than in AD speech (Fernald, 1989, 1991; but see Trainor et al., 2000), which may contribute to successful emotional communication between mother and infant. Mothers' inclination to pose frequent questions to their prelinguistic infants leads to a high incidence of terminal pitch rises, which are especially effective in recruiting attention (Cruttenden, 1994; Stern et al., 1982). In the case of sung materials, infants exhibit greater attention to higher than to lower pitched renditions of the same song by the same singer (O'Neill, Trainor, & Trehub, 2001; Trainor & Zacharias, 1998).

ID speech and singing are thought to regulate arousal as well as attention (Trehub & Trainor, 1998), but there has been little documentation of the presumed arousal consequences. In recent years, however, music is being used increasingly to reduce the dangerously high arousal levels of infants in neonatal intensive care units (Cassidy & Standley, 1995). Maternal singing also modulates the arousal levels of healthy, non-distressed infants, as reflected in salivary cortisol changes (Shenfield, Trehub, & Nakata, 2003). Maternal speech has similar effects on infant arousal, but the effects are more sustained for maternal singing (Shenfield, Trehub, & Nakata, 2002).

The consequences of maternal speech and singing are presumed to be similar in the sense of enhancing infant attention, averting distress, and fostering interpersonal bonds (Trehub & Trainor, 1998). Nevertheless, differences in their acoustic properties may promote somewhat distinctive patterns of attention and engagement. Not only is ID speech higher in its overall pitch level than ID singing, it also incorporates considerably greater fluctuations in pitch and timing (Bergeson & Trehub, 2002). For example, the acoustic features of specific maternal utterances to prelinguistic infants can vary substantially from one occasion to another (Bergeson & Trehub, 2002), but repeated performances of songs to infants are relatively uniform in their tempo (roughly two syllables per second), rhythm, and dynamic range (Bergeson & Trehub, 2002). Fundamental frequency, which corresponds to perceived pitch, varies almost continuously over a wide range in speech but not in music, which incorporates small discrete steps and a much slower rate of change (Patel, Peretz, Tramo, & Labreque, 1998; Vos & Troost, 1989). Moreover, speech to infants is peppered with arousing exclamations (*Wow!*) and non-vocal (e.g., hand clapping, finger snapping) or non-verbal (e.g., clicks) sounds. Thus, ID singing has much less in common with playful or arousing ID speech than it does with soothing ID speech.

ID speech, by virtue of its higher pitch level and greater variability, may be especially effective in recruiting attention, but it may be less effective than ID singing in sustaining infant attention. One possible consequence of infants' heightened pleasure and arousal to playful ID speech is difficulty maintaining that state for extended periods. Infants may disengage from the pleasurable source of stimulation from time to time, re-engaging once their arousal level has moderated (Tronick & Gianino, 1986). The repetitive, lulling properties of ID singing may foster more moderate arousal levels, which facilitate longer bouts of infant engagement. Accordingly, we predicted that infants would show more sustained attention to extended episodes of maternal singing than to comparable episodes of maternal speech.

Instead of the unfamiliar speech and singing excerpts in typical preference studies (e.g., Cooper & Aslin, 1990; Pegg, Werker, & McLeod, 1992; Werker & McLeod, 1989), we chose extended samples of speech or singing produced by mothers of the infants to be tested. Moreover, we selected audiovisual stimuli rather than the unimodal stimuli of typical preference studies with speech (Cooper & Aslin, 1990; Fernald, 1985) and singing (O'Neill, Trainor, & Trehub, 2001; Trainor, 1996) because of earlier and greater responsiveness to multimodal or multidimensional stimuli than to more impoverished stimuli (Gogate, Walker-Andrews, & Bahrick, 2001; Walker-Andrews, 1997). Audiovisual stimuli also

precluded differential responsiveness resulting from potential differences in maternal touch across speech and singing contexts.

In principle, a within-subject design seems ideal for comparisons of responsiveness to maternal speech and singing, but pilot-testing revealed pronounced order effects favoring the first stimulus, which made that option unworkable. Finally, in addition to conventional measures of looking time, we monitored infant body movement. In general, reductions in infant body movement are correlated with heart rate deceleration and other measures of infant attention (Casey & Richards, 1991; Field, Healy, & LeBlanc, 1989). In particular, increases in visual attention are typically accompanied by decreases in movement (Bacher & Robertson, 2001). For the aforementioned reasons, we predicted greater visual attention and lesser body movement in response to maternal singing than to maternal speech.

2. Method

2.1. Participants

The participants were 43 middle-class mothers and their healthy, full-term infants who were 5.5–6.5 months of age ($M = 5$ months, 25 days). Data from other infants were excluded because of (1) parents' non-compliance with the test protocol ($n = 3$) and (2) infant fussing exceeding 30 s ($n = 3$). Infants were randomly assigned to a 4-min maternal speaking episode ($n = 21$) or a 4-min maternal singing episode ($n = 22$).

2.2. Apparatus and materials

During an initial visit to the laboratory, maternal speech and singing to infants were recorded in a double-walled sound-attenuating chamber (Industrial Acoustics). The mother placed her infant in a form-fitting seat and kneeled facing the infant. Separate audio recordings were made by means of a Sony PC-62 reel microphone connected to a Sony TCD-D7 digital tape recorder. Two digital-8 video cameras (Sony DCR-TRV510 and Sony DCR-TRV315) captured (1) a frontal image of the mother's head and upper body and (2) a lateral image of mother and infant. For the speaking episode, mothers were instructed to interact with their infants as they normally did at home but to refrain from singing. For the singing episode, mothers were asked to sing songs that they usually sang to their infants at home. When the mother indicated that she was ready to begin, the experimenter left the room and began recording.

Audio signals were edited by means of SoundEdit16 (Version 2, Macromedia, San Francisco) software (on a Radius 81/110 computer) to minimize infant vocalizations. When infants vocalized in the absence of maternal vocalizations, the sound was muted during that segment. When infant and mother vocalized simultaneously, the intensity was reduced to approximately 10% of the original level during that segment. The intensity was gradually decreased during the preceding 20 ms and increased during the subsequent 20 ms to minimize abrupt intensity changes. Amplitude levels were also adjusted to a constant level across stimuli by means of the sound editing software. Signals incorporating a frontal image of each mother were transferred to a Power Macintosh G3/350 computer by means of EditDV Unplugged (Version 1.6.1, DigitalOrigin, City, CA, USA). The original sound track was replaced with the edited audio track after synchronizing the timing with the video track by means of the video-editing software. The resulting audiovisual stimuli were transferred to digital-8 tape on a Sony DCR-TRV510 digital video camera. Test

stimuli generated by the procedure consisted of 4-min audiovisual segments of singing or speaking from each mother.

In their second visit to the laboratory, approximately one week later, each infant was tested in a quiet room. Infants sat on their mother's lap approximately 80 cm from a 17-in. Panasonic CT-1939 v video monitor at eye level. A Sony DCR-TRV 510 digital-8 video camera controlled the playback of audiovisual stimuli, and a hidden Sony CCD-TR500 Hi8 video camera recorded a frontal view of the infant.

2.3. Procedure

The mother was instructed to refrain from interacting with her infant, who remained on her lap throughout the test session. When the infant was quiet and facing directly ahead, the experimenter (concealed behind a screen) initiated the designated audiovisual episode, which continued for 4 min. The infant's behavior was captured on videotape for subsequent scoring.

3. Results

Videotapes of infants were transferred to a Power Macintosh G3/350 computer via EditDV Unplugged video-editing software. Two trained observers who were unaware of the hypotheses or the conditions of testing coded onset and offset times for visual fixations and instances of minimal body movement by means of frame-by-frame viewing of soundless videotapes. Minimal body movement was defined as the absence of movement other than that of wrists and fingers. When scoring body movement, the videotapes were played first at a reduced speed, or frame-rate, to locate portions for frame-by-frame evaluation. Coders generated a transcription for each target behavior (visual fixation, minimal body movement) by recording onset and offset in units of a frame (1/30 s). Two additional observers coded visual fixations and minimal body movement independently for over 15% of infants selected randomly from the sample. Reliability checks were interspersed randomly throughout the coding process. Inter-observer agreement ranged from .85 to .94 ($M = .91$) for infant gaze and .88 to .97 ($M = .92$) for minimal body movement.

Transcripts of gaze and minimal body movement were converted to the following dependent measures—overall duration of visual fixation, duration of initial fixation, and fixation coupled with minimal body movement. Because a number of infants lost interest in the stimuli during the fourth minute of maternal speech ($n = 5$) or singing ($n = 2$), data analysis was restricted to the first 3 min. Cumulative looking, initial fixation, and fixation coupled with minimal body movement were subjected to 2×2 (gender by vocal style) analysis of variance. Gender was included as a factor because of claims of greater social interest on the part of infant girls (e.g., McClure, 2000) and more parental talk to infant girls than to boys (e.g., Kitamura et al., 2002). There was a main effect of vocal style (speech versus singing) for all dependent measures (see Fig. 1). Cumulative looking times were greater for maternal singing ($M = 141.44$ s, S.D. = 29.80) than for maternal speech ($M = 121.08$ s, S.D. = 32.97), $F(1, 39) = 4.31, p < .05$. Initial fixation times (i.e., duration of first look) were also greater for singing ($M = 26.22$ s, S.D. = 4.82) than for speech ($M = 11.66$ s, S.D. = 9.33), $F(1, 39) = 7.12, p < .02$. There was no effect of gender and no gender by vocal style interaction on any measure of visual fixation. Finally, fixation accompanied by minimal body movement was significantly greater for maternal singing ($M = 90.81$ s, S.D. = 42.08) than for maternal speech ($M = 64.50$, S.D. = 42.18 s), $F(1, 39) = 4.49, p < .05$.

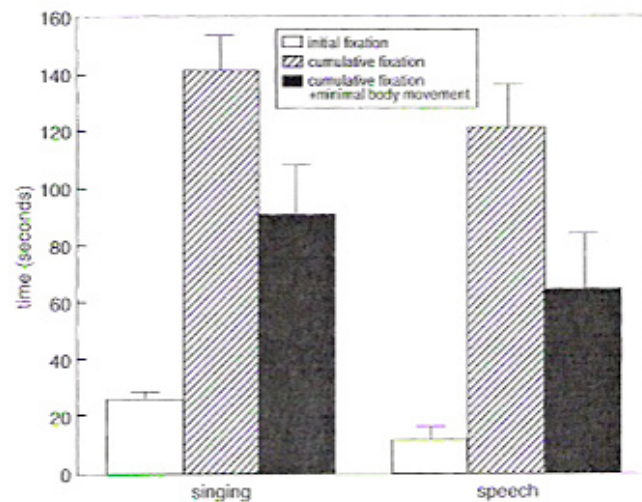


Fig. 1. Initial fixation, cumulative fixation, and cumulative fixation with minimal body movement as a function of maternal speech and singing. Error bars indicate standard error.

4. Discussion

The principal goal of the present investigation was to compare the attentional consequences of extended episodes of maternal speaking and singing for infant listeners. The results revealed that infants exhibited more sustained attention to audiovisual presentations of maternal singing than to maternal speech, as reflected in greater overall fixation, greater initial fixation, and greater fixation accompanied by minimal body movement.

The use of audiovisual stimuli undoubtedly contributed to infants' high level of interest in the materials. On average, infants looked at audiovisual displays of singing for 141.44 s, which represented 78.6% of the available time (180 s). By contrast, they looked at comparable displays of speaking for 121.08 s, or 67.3% of the time. Their very first look at the monitor during the maternal singing episode was approximately 26 s long, which was more than twice as long as the very first look during the maternal speech episode. Clearly, infants were highly attentive to both maternal signals, but they were considerably more engaged by singing than by speech. Pronounced movement reduction, which occurred in the context of maternal singing, is likely to reflect intense engagement (Bacher & Robertson, 2001), which is consistent with reported correlations between movement reduction and other attentional measures (Casey & Richards, 1991; Field et al., 1989). It may also reflect the calming or relaxing consequences of maternal singing, which is consistent with more sustained arousal reduction by maternal singing than by speech (Shenfield et al., 2002).

Because the presentation of audiovisual materials was not contingent on infant looking, the spoken or sung materials remained audible when infants looked away from the mother's on-screen image. Nevertheless, the visual display provided access to the coordinated visual gestures that accompanied maternal speech or singing. As noted, maternal speech and singing generated different patterns of responsiveness, involving more sustained regard of mothers' image in the case of singing. At about 6 months of age, infants become increasingly interested in their environment (Legerstee, Pomerleau, Malcuit, & Feider,

1987), which encourages mothers to follow rather than re-direct their infant's focus of attention and to talk about objects and events in view (Adamson & Bakeman, 1991; Morikawa, Shand, & Kosawa, 1988; Tomasello & Farrar, 1986). It is possible, then, that instances of gaze aversion in such contexts are not a reflection of boredom but are typical of mother-infant interactions involving speech.

From previous research, we know that maternal singing is much more stereotyped than is maternal speech. For example, mothers' songs are performed at a nearly identical pitch level and tempo on different occasions, in contrast to maternal utterances, which are highly variable in those respects (Bergeson & Trehub, 2002). Greater moment-to-moment variability in acoustic features may account for heightened attention to ID than to AD speech (Fernald, 1991), but it cannot account for the present finding of greater attention to ID singing than to ID speech. Instead, infants may attend preferentially to the more emotive auditory stimulus, just as they attend preferentially to emotive speech over emotionally neutral speech (Kitamura & Burnham, 1998; Singh et al., 2002). Emotional expressiveness may also underlie infants' enhanced attention to ID over non-ID singing in the newborn period (Masataka, 1999) and at 6 months of age (Trainor, 1996; Trainor et al., 1997). Similarly, it may account for 6-month-olds' greater visual attentiveness during ID singing than during ID speech. The variability of maternal speech may lead to cycles of increased arousal, gaze aversion to reduce arousal, and re-engagement with the stimulus. According to Stifter and Moyer (1991), gaze aversion is an effective means of regulating arousal in a way that preserves involvement with an arousing stimulus.

Music is generally acknowledged as a vehicle for conveying emotion (Juslin & Sloboda, 2001; Krumhansl, 1997; Panksepp, 1995). Although ID speech also conveys emotion (Fernald, 1991; Papoušek, 1992), it may be less effective in this regard than ID music, especially for prelinguistic infants who can access the form but not the content of verbal messages. In the case of songs, fixed words and tunes enable singers to focus on expressive aspects of their performance. Speakers, by contrast, generate message content along with prosodic form. Moreover, maternal singers' small repertoire (Trehub et al., 1997) and their ritualized performing style (Bergeson & Trehub, 2002) may make infants' listening experience highly comforting as well as pleasurable. Finally, the presence of a regular pulse, or beat, in music may facilitate the coordination of emotion between mother and infant, just as it promotes coordinated movement and feelings in group music-making and listening (Benzon, 2001; Trehub, 2003). Brown (2003) portrays music as "the ideal synchronization device," which may have evolved "to coordinate action and promote cohesion at the group level" (p. 16).

It is useful to distinguish between *communication* in a literal sense, which is best accomplished by spoken exchanges between individuals who share a language or communication code, and *emotional communion*, which may be achieved more readily by music (Brown, 2000; Peretz, 2001). For infants who have no access to conventional means of communication, maternal speech transmits affective information through prosodic and paralinguistic channels (Fernald, 1991; Papoušek, 1992). Vocal music may be especially effective in exploiting these channels. The success of music in regulating arousal is notable in the case of premature infants who have life-threatening problems (Cassidy & Standley, 1995; Lorch, Lorch, Diefendorf, & Earl, 1994) and even for healthy 6-month-olds (Shenfield et al., 2003).

Differential looking patterns to maternal speech and singing may have implications for infant learning. Visual fixation patterns are thought to reflect patterns of information processing, with short visual fixations linked to efficient learning (e.g., Colombo, Mitchell, Coldren, & Freese, 1991; Jankowski, Rose, & Feldman, 2001). To date, however, research in this domain has been limited to non-social stimuli. One intriguing possibility is that maternal speech and singing have different but equally important strengths, with maternal singing enhancing interpersonal ties, and maternal speech optimizing the extraction of

information from the environment. Finally, it remains to be determined whether the relations between fixation patterns and learning that have been observed in non-social contexts prevail in social contexts involving maternal speaking and singing.

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