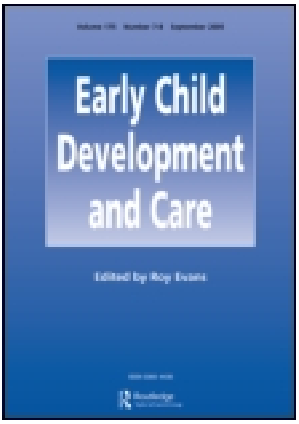

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Handclapping songs: a spontaneous platform for child development among 5–10-year-old children

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The impact of music activity on children's motor and cognitive skills has been investigated with music learning, instrument lessons and classroom music. While none have employed natural utterances, singing games or playground/street songs, these musical experiences of childhood are acknowledged as a major platform for child development. The current study isolated handclapping songs exploring the association of performance quality with classroom academic achievement and examined whether children who spontaneously engage in handclapping songs activity demonstrate improved motor or cognitive abilities. Finally, the study investigated the outcome of a two-group eight-week classroom intervention. The study found that: (1) children who were more skillful at performing handclapping songs were more efficient First Graders; (2) Second Graders who spontaneously engage in handclapping songs were advantaged in bimanual coupling patterns, verbal memory and handwriting; and (3) classroom handclapping songs training was more efficient than music appreciation classes in developing non-music skills among Second and Third Graders.

Keywords: handclapping songs; transfer effects; bimanual coupling; aural dictation; gender differences

Introduction

The last decade has produced abundant research which demonstrates that musical exposure and behaviour enhances human cognition (for reviews, see Altenmuller & Gruhn, 2002; Crncec, Wilson, & Prior, 2006; Schlaug & Bangart, 2008; Schlaug, Norton, Overy, & Winner, 2005; Wolf, 2004; Zatorre, 1998, 2003; Zatorre, Chen, & Penhune, 2007). The overriding principle is that music stimuli function in an intermediary fashion, transferring essential signals to diverse areas in the brain beyond those involving aural sensation, and subsequently expand neuroanatomical structures and functions (Fujioka, Ross, Kakigi, Pantev, & Trainor, 2006; Lappe, Herholz, Trainor, Alsop, & Schlaug, 2008; Leng & Shaw, 1991; Peretz & Zatorre, 2005; Schlaug et al., 2005; Schmithorst & Holland, 2003). Because music exposure and/or music-making extend what has been learned in one context to new contexts, for example, intellectual growth, creativity, social behaviour and scholastic proficiencies (Catterall & Rauscher, 2008; Rauscher et al., 1997; Schellenberg, 2004; Schellenberg, Nakata, Hunter, & Tamoto, 2007), the process has been referred to as the *transfer effect*

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(Rauscher & Hinton, 2006). Most researchers have assumed that transfer is maximal among children aged 3–11 because of adaptive flexibility referred to as 'neurocognitive plasticity' (Overy, 2000; Watanable, Savion-Lemieux, & Penhune, 2007). That is, the brain – and hence the mind – of children is more susceptible to environmental manipulation and therefore molds and modifies more effectively than the brain of adults (Orsmond & Miller, 1999; Rauscher, 1999; Rauscher et al., 1997; Schellenberg, 2004; Watanable et al., 2007). Nevertheless, few studies have looked at spontaneous singing games among children, while none have explored handclapping songs. Ironically, these experiences have been so widely recognised as a most natural part of childhood and a platform for child development that their associated repertoire has been designated as *childlore* (Sheehan, 1998).

Music-related cognitive transfer

Foremost, transfer effects with music have been demonstrated by employing two substantially different formats: music listening versus music instruction. Rauscher and Hinton (2006) contend there to be considerable dissimilarity and confusion between these two experiences. Although music listening can be cognitively stimulating, and therefore often called 'active listening', it is for the most part a passive form of exposure. On the other hand, while classroom music-learning may vary in content, the processes are more active, including vocal singing, rhythmic body accompaniment, instrument playing, notation learning, creative movement and dancing (Overy, 2000; Sulkin, 2003). Therefore, in the latter case, beyond effects related to cognitive transfer, there are also training and rehearsal procedures of the motor, auditory, visual and tactile senses (Sulkin, 2009). Hence, classroom music-making is a form of multi-sensory integration which supports routes of development that further enhance non-music skills and abilities. Second, the domain of cognitive transfer may be viewed as relatively *near* or *far* from the training domain (Hyde et al., 2009). Most common are transfer effects when there is a close resemblance between the domains (e.g. learning piano or keyboard-playing as a mechanism for increasing speed and accuracy in typing), while the effects for domains of remote resemblance are less obvious (e.g. learning to perform from music notation as a remedial tool for decoding language-based symbols).

In an attempt to understand the impact of music activity on children's skills and abilities, studies have usually implemented interventions framed by assessment of cognitive proficiencies – most popular have been those evaluating spatial-temporal reasoning. For example, Gromko and Poorman (1998) compared two groups of three–four-year-old children; 17 received classroom music lessons for six months versus 17 who did not receive any kind of intervention. The music lessons included singing, playing instruments, rhythmical games and creative movement. The results indicated that children receiving music lessons significantly improved in completing puzzles, geometric designing and mazes. Rauscher et al. (1997) offered 78 three–four-year-old children 10 months of piano studies, computer lessons, singing instruction or no intervention. The results indicated that children learning piano demonstrated significantly better scores for puzzles and branch model assembly. In her later study (Rauscher & Zupan, 2000), a group of 34 four–five-year-old children received classroom piano studies; the results again indicated that compared with a matched group, children learning piano were significantly better at completing puzzles and assembling branch models. These findings were replicated by Bilhartz, Bruhn, and Olsan (2000) among 71 four–five-year-old) children who were assigned to either classroom musical enrichment (i.e. singing, creative movement and percussion ensemble) or a non-music group; the results indicated that children participating in music significantly improved in assembling branch models. Finally, Costa-Giomi (1999, 2004) offered an older group of 35 nine-year-old children 36 months of private piano lessons; she found that intensive instrument tuition clearly improved spatial-temporal reasoning (albeit such improvement did not persist).

Other studies have gone beyond spatial-temporal tasks to measure transfer effects. For example, Hyde et al. (2009) investigated structural brain changes in young children receiving musical training relative to those who did not; they focused on behavioural changes, including four-finger motor sequences, melodic-rhythmic discrimination, object assembly, block design, progressive matrices and vocabulary/phonemic awareness. In the study, 31 six-year-old children participated; 15 children received 15 months of weekly 30-minute private piano lessons, while a matched group of 16 children received the same coverage of classroom music lessons. The results indicated that learning piano caused regional structural brain plasticity and improvements in motor and auditory musical tests; however, no differences surfaced between the groups for visual-spatial or verbal/phonemic abilities. Finally, several studies have focused on linguistic skills (Chan, Ho, & Cheung, 1998; Ho, Cheung, & Chan, 2003; Forgeard, Winner, Norton, & Schlaug, 2008; Heller & Athanasulis, 2002; Schellenberg, 2004; Standley & Hughes, 1997). These offer behavioural demonstrations in support for Music Neuroscience findings which tend to link neurostructures for language production with those for music processing/performance (such as: Koelsch et al., 2003; Peretz & Zatorre, 2005). For example, Piro and Ortiz (2009) compared 46 Second Graders who received 36 months of formal piano lessons with 57 Second Graders who had absolutely no exposure to music instruction; the study found that children studying piano had significantly better vocabulary and verbal sequencing skills. Studies highlighting reading and writing skills, such as Standley and Hughes (1997) and Register (2001), demonstrate that music interventions among four–six-year-old children result in improved pre-reading and pre-writing skills (i.e. linkage between visual symbols and letters, word recognition and spelling); more recently, Register, Darrow, Standley, and Swedberg (2007) found that music intervention significant improved literal understanding and reading comprehension among eight-year-old children. In a landmark study, Overy (2000) demonstrated that a 10-month classroom music intervention with six–eight-year-old children significantly improved reading and spelling skills above and beyond the reported national average for the UK. Together, these studies bring forward evidence for music training efficiency which demand temporal motor learning, coordination and automation proficiencies (Peretz & Zatorre, 2005); these have long ago been referred to as components of *auditory temporal reasoning* (Overy, 2003).

Childlore: handclapping songs

For the most part, the music interventions in the above-mentioned studies have been based on explicit formal musical training, designed and applied by a classroom music educator within an institutional framework, following criteria and guidelines found within a Music Education National Curriculum. Further, the materials employed are Western Classical Art Music from the standard repertoire for guided listening, as well as commercially available educational songs, rhymes and music pieces composed by adults for children. Unfortunately, no study has yet employed children's natural spontaneous musical utterances, singing games or playground street songs. Ironically, music education literature long ago pointed to these musical experiences as a natural part of childhood and a platform for child development; these musical repertoire and performance behaviours are based on implicit learning between the children, who informally teach each other. Both music education and ethnomusicological literature describe children's singing games as a natural psychomotor activity (Riddell, 1990) that serve to train physical, cognitive and mental skills (Sheehan, 1998). Moreover, singing games appear to be a universal musical phenomenon among children of all societies, cultures and religions. In her musicological study of Israeli childlore, Sulkin (2003) mapped out several subtypes found within the genre. Akin to Obuo (1996), she found singing games to be the most informally learned of all children's music, and appear to represent an underlying knowledge of children's cultural society. It is interesting to note that Riddell cited archeological evidence for singing games dating back to ancient Egypt as early as 2000 BC; the survival of the genre seems to be well documented among North American, European, Asian and even African cultures. Sulkin (Brodsky & Sulkin, 2005; Sulkin, 2003, 2009; Sulkin & Brodsky, 2007) concluded that such a long existence of the genre must raise questions about its purpose, with evolutionary function and human developmental lines in mind.

A broad perspective would view two main categories of children's singing games. Foremost, there are songs written by adults for children, with educational value that teach and strengthen academic, verbal and motor abilities. These songs are usually performed in the classroom accompanied by body movements illustrating the text content; they are taught by rote through mirror imitation of an adult (such as a teacher or parent). The second category involves songs created by children from their own verbal utterances and rhythmic improvisations, fortified by motives and motivic variations of familiar folk tunes (Riddell, 1990). These songs are usually performed as background to play activities such as ball throwing, rope jumping and social games; they are learned through imitation of other children (such as classmates, friends or siblings). Sulkin (2003) verified that the environments where these are performed include the school yard before/after classes and during mid-day recess as well as on school buses. Among other issues, she documented a specific subcategory of childlore, referred to as 'handclapping songs'.

Viewed as an enjoyable game-like activity performed in pairs or threesomes, handclapping songs are accompanied with regular movement sequences and percussive clatter (Sulkin, 2003). While little research has focused on this phenomenon, a few published reports of a musicological nature can be found. For example, Merrill (1988) and Sheehan (1998) investigated gender and anthropological aspects of handclapping songs among ethnic groups in America. Riddell (1990) analysed singing games (some labelled 'handclapping songs') created by American children. Obuo (1996) described Ghanaian singing games and handclapping songs. Sulkin (2003) surveyed handclapping songs among Israeli children focusing on specific motor and social aspects. Ntsihlele (2007) documented African children's games of which some were 'handclapping songs'. Most recently, Dorovolomo (2009) explored the games that playschool children on the Fiji Islands (South Pacific) engage in during recess, some of which are verbal rhythmic 'hand-action' games. Together, these point to common characteristics of handclapping songs: (1) simple song structures, melodic lines limited to narrow ranges, and use of duple metre; (2) texts of gibberish/nonsense syllables or descriptive of everyday childhood; and (3) regular movement sequences and rhythmic body percussion employed as temporal ostinati. For the most part, regardless of geography, culture or religion, handclapping songs tend to engage girls between five and 10 years of age; they begin to participate actively from about age six, but then lose interest at about age nine. Sulkin (Brodsky & Sulkin, 2005; Sulkin, 2003, 2009; Sulkin & Brodsky, 2007) raised the question whether the appearance and engagement in handclapping songs at such a specific time frame is just a matter of socialisation or rather that this period relates to a 'window' supporting optimal development. Handclapping songs – which serve as a vehicle to support physiological, emotional, social and cognitive maturation at a most critical and opportune stage of child development – put into operation three transactions that are cardinal for such development to take place. These are:

(1) Sensory-motor transactions: Handclapping songs involve simultaneous seeing, hearing, touching and motor experience – a sensory integration of sorts. The movement sequences are executed by the arms, hands and palms. While few connote these movements as interlimb coupling or coordination (de Poel, Peper, & Beek, 2008; Janssen, Beuting, Meulenbroek, & Steenbergen, 2009), we refer to these functional motor transactions and configurations as *bimanual coupling* (Brodsky & Sulkin, 2005; Sulkin, 2003, 2009; Sulkin & Brodsky, 2007). In addition, handclapping songs require eye–ear–hand coordination, accurate synchronisation and automation.
(2) Social transactions: Handclapping songs require cooperation, mutual attention and consideration between two or more partners. They channel unspoken communication and transfer unconscious messages through touch, body posture and voice intonation (Sheehan, 1998; Sulkin, 2003, 2009). While previous studies have demonstrated that motor skills are an indiscernible measure of social status and self-confidence among school-age children (Pellegrini, Kato, Blatchford, & Baines, 2002, 2004; Yazdi-Ogev, 1995), some researchers (Merrill, 1988; Riddell, 1990; Sulkin, 2003) feel that children who perform handclapping songs have had more extensive social interactions.
(3) Verbal/linguistic transactions: Handclapping songs demand a verbal rhythmic order. Some of texts are complex and contain a considerably large number of words. Thus, handclapping songs facilitate procedures leading to memorising long strings. Further, the synchronisation of verbal and movement sequences demands integration of language and motor production systems (Sulkin, 2009).

Despite the awareness about singing games in general, and handclapping songs in particular, their influence and contribution to children's development has not yet been examined. While few investigations have included singing games among other music activities as components in research-based intervention packages (e.g. Gromko & Poorman, 1998; Overy, 2000; Rauscher & Zupan, 2000), it is exactly for this reason that the effects of handclapping songs cannot been evaluated. The main objective of the current study, then, is to isolate handclapping songs and examine the association of performance quality with academic achievement (Study 1). This is especially cogent, as other studies (Casey, Pezaris, & Nutta, 1992; Crow, Crow, Done, & Leask, 1998) found hand skills to predict academic ability. Further, it would seem warranted to explore whether children who *spontaneously* perform handclapping songs activity in the school yard during recess demonstrate enhanced abilities in non-music motor and cognitive tasks compared with children who do not engage in this activity (Study 2). Finally, the current study investigates the outcome effects of a two-group eight-week classroom intervention programme comparing handclapping songs training (HCST) with a standard music appreciation guided listening curriculum (MAGL) (Study 3).

Study 1

Methods

Participants

(1) Elementary school children. The parents of 24 children in a First Grade class in central Israel were contacted and asked to sign a 'Consent to Participate' form. Six children who refused to participate in video-recording were dropped; video-recording is seen as the ecologically valid method for gathering performance data to be screened and rated by teachers serving as blind judges (Aharoni, 2001; Merrill, 1988; Obuo, 1996; Riddell, 1990; Sulkin, 2003). The final 18 participants were mostly girls (88%), aged seven (SD = 1.9), from various Jewish ethnicities in catchment areas from mid-to-upper middle-class socioeconomic levels.

(2) Teachers-blind judges. Three elementary school teachers served as blind judges; they were recruited from educational workshops. The teachers were roughly 31 years old (SD = 7.37), with an average of seven years of teaching experience (SD = 3.85); they were educators (music, sports and homeroom) employed in different elementary schools. Each teacher received a music CD as a compensatory gesture.

(3) Homeroom teacher. A 40-year-old woman with 12 years of teaching experience.

Materials and equipment

(1) Handclapping songs. Two handclapping songs in Hebrew were employed: 'Amina' (gibberish) and 'Kushie Katan' (Little Black Dog).[1] These were chosen from a list of songs defined as the 'core repertoire' of Israeli childlore (Sulkin, 2003).

(2) Video-recording and screening equipment. We used a 30-TRV (Sony) digital video camera to record handclapping performances, and an IBM laptop with Windows Media Player to display the recorded performances to the judges.

Evaluation measures

(1) Handclapping performance quality (HCPQ). We developed this measure to define and evaluate handclapping songs performance. The HCPQ takes on board four parameters considered to be principle component factors of handclapping songs performance: Movement, Language, Socialisation and Music (Merrill, 1988; Obuo, 1996; Riddell, 1990; Seham, 1998; Sulkin, 2003). Based on a natural hierarchy (and hence the factors are weighted accordingly), the model emphasises Movement sequences as the central performance constituent, followed by Language, Social and Music facets; each factor features several subcomponents (as outlined previously in peripheral studies by Aharoni, 2001; Bently, 1966; Dill & Wintrob, 1999; Dromi, 1996; Gordon, 1965, 1971; Hozler, 1996, 1997; Ravid & Tolchinsky, 2002). The Movement factor features three subcomponents: knowledge of the movement

sequences, accuracy of movement performance and movement fluency. The Language factor features two subcomponents: knowledge of the textual content and verbal fluency. The Socialisation factor features three subcomponents: coordination and support of a partner, patience and tolerance. The Music factor features four subcomponents: knowledge of melody/rhyme rhythmic line, musical and rhythmic accuracy, musical fluency and up-tempo performance. The HCPQ scores handclapping performance quality on a four-point Likert scale (1 = weak; 4 = excellent), with a total score calculated through summation of the four weighted principal factors: Movement (40%), Language (25%), Socialisation (20%) and Music (15%).

(2) Academic behaviour and classroom social skills (ABCs). We developed the ABCs from the official Ministry of Education curricular guidelines, as interpreted by three independent First Grade class teachers from three elementary schools in central Tel Aviv; the teachers were roughly 33 years old (SD = 5.5) with eight years (SD = 2.5) of teaching experience. The ABCs is based on two parameters (featuring five subcomponents): Academic Skills (reading, writing and mathematics) and Social Skills (dominance and integration). The ABCs scores academic behaviour and social skills on a four-point Likert scale (1 = weak; 4 = excellent), with a total score calculated through summation of two weighted parameters: Academic Skills (75%) and Social Skills (25%).

Procedure

Two weeks into the elementary school year, two handclapping songs were taught to a class of 24 children seated at tables in the presence of the Homeroom Teacher. The songs were taught by rote via live demonstration (the second author). In total, there were three 20-minute sessions, once a week, during a three-week period. In the first two sessions, the songs were demonstrated and the children practiced in pairs; the entire third session was dedicated to video-recording. Approximately eight months thereafter (i.e. two weeks before the end of the school year), two evaluation processes ensued: the Homeroom Teacher evaluated the achievements of all 18 children by employing ABCs; and the video-recorded performances of the children were viewed by three judges (blind to the goals of the study) to assess performance quality by employing the HPCQ. Prior to these evaluations, both the Homeroom Teacher and the blind judges attended a 60-minute tutorial outlining rating procedures and scoring forms.

Results

Initially, comparisons between HCPQ scores of the judges and an expert (the second author) were done in an effort to validate scoring procedures. The analysis revealed no significant differences for the HCPQ total score (Judges: M = 13.19, SD = 3.47; Expert: M = 12.97, SD = 3.97) as well as for three of the four factors: Language (Judges: M = 3.28, SD = 0.75; Expert: M = 3.31, SD = 0.86), Socialisation (Judges: M = 2.99, SD = 0.66; Expert: M = 3.14, SD = 0.82) and Music (Judges: M = 3.16, SD = 1.15; Expert: M = 2.92, SD = 1.02). However, statistical differences surfaced for the Movement factor (Judges: M = 3.15, SD = 0.95; Expert: M = 2.88, SD = 1.15; t = 2.38, df = 17, $p < .05$) – the expert scored in a more conservative manner. Then, a correlation analysis was employed as a measure of inter-judge reliability (see Table 1). As can be observed from the table, the findings demonstrate positive correlations

Table 1. Study 1 – correlation matrix: HCPQ total scores.

	Judge 2	Judge 3	Expert
Judge 1	0.90*	0.83*	0.90*
Judge 2	—	0.93*	0.92*
Judge 3	—	—	0.89*

*$p < 0.05$.

of the HCPQ total score among the judges as well as between the judges and the expert. Taken together, the above findings seem to imply that the HCPQ is a reliable instrument for educational personnel after having received one 60-minute tutorial (albeit there is a tendency to score movement performance higher than done by an expert).

Next, ABCs scores were tallied; the total score was $M = 2.93$ (SD = 0.80). Ratings for Academic Skills ($M = 3.18$, SD = 0.73) were higher than for Social Skills ($M = 2.69$, SD = 0.78), and these differences were statistically significant ($t = 2.44$, df = 17, $p < .05$). The subcomponents were mathematics ($M = 3.00$, SD = 1.00), writing ($M = 3.16$, SD = 1.20), reading ($M = 3.38$, SD = 0.90), social dominance ($M = 2.55$, SD = 0.80) and social integration ($M = 2.81$, SD = 0.78). Subsequently, a correlation analysis was employed to evaluate the association of the ABCs with HCPQ scores (see Table 2). As can be observed from the table, significant positive associations surfaced for 'reading' with 'movement' and 'music' as well as for 'writing' with all four *HCPQ* factors. Nevertheless, no significant associations were seen for social components on either measure. Finally, significant positive correlations surfaced for total scores; the potency of this relationship is roughly 31% ($r = 0.56$).

Discussion

Study 1 explored the association between handclapping songs performance quality and classroom skills in an effort to highlight the possibility that such associations might enable one to *forecast* specific scholastic achievements and developmental outcomes that are necessary in the First Grade. General associations of this type have

Table 2. Study 1 – correlation matrix: ABCs scores with HCPQ scores.

	Teacher–Judges HCPQ				
Homeroom Teacher ABCs	Movement	Language	Social	Music	Total
Academic skills:					
Mathematics	−.14	−.03	−.20	−.08	−.13
Reading	.56*	.44	.46	.49*	.52*
Writing	.76*	.71*	.68*	.76*	.75*
Social skills:					
Dependence	.20	.22	.14	.21	.20
Integration	.28	.15	.23	.24	.25
Total score	.57*	.54*	.46	.57*	.56*

*$p < .05$.

already been documented for children's playground and school yard games (Pellegrini et al., 2002, 2004); these activities predicted unique and significant variance in children's end-of-year teacher's ratings, beyond predictions based on beginning-of-year evaluations (Pellegrini & Bohn, 2005). The results of the current study show that elementary school children who were more skilful at performing handclapping songs (at the onset of the school year) were also more efficient learners. Hence, the ability to perform handclapping songs may have some predictive facility in indicating scholastic achievements (in the First Grade). The results point out that the most compelling areas of association are 'reading' and 'writing'. Considering that handclapping songs involve aural-temporal processes, then, we might assume that the most efficient application of such competencies would be aural dictation.

Nonetheless, even our best explanations for finding such developmental proficiencies are speculative by nature. On the one hand, handclapping songs performance quality may predict academic skills. On the other hand, specific children with enhanced developmental characteristics may naturally – in a self-selected fashion – engage in handclapping songs performance activity, which through the promotion of practice and rehearsal, reinforce academic skills and outcomes even further. In contemplation of both possibilities, we recruit and test children who spontaneously engage in handclapping songs outside of formal educational interactions in their ecologically natural school yard setting.

Study 2

Methods

Participants

(1) Elementary school children. At the onset of the school year, 24 children in a Second Grade class in central Israel self-reported engagement in school yard handclapping songs activity during recess to their homeroom teacher. Thereafter, on three occasions, over a period of one month, the second author (not yet introduced to the class) observed the children in the school yard. Self-reports were confirmed for six children, reflecting 25% of the class. We note that this is the documented proportion of children who spontaneously engage in handclapping songs activity in their natural environment (Riddell, 1990; Sulkin, 2003). Of these six children (hereafter referred to as 'Group I'), one was dropped as the parents withheld their signed 'Consent to Participate' form. A second group of children from the same classroom who self-reported not to engage in handclapping songs were recruited; self-reports were also confirmed for six children (hereafter referred to as 'Group II'). One child of this latter group was dropped for similar reasons as in Group I. It should be pointed out that several children who claimed that they *occasionally* played handclapping songs games during recess playtime were not taken on board. The final sample of 10 Second Grade children from various Jewish ethnicities in catchment areas from mid-to-upper middle-class socioeconomic levels was evenly split between two groups: Group I was mostly girls (80%) who were eight years old (SD = 1.90) and Group II was all boys who were eight-and-a-half years old (SD = 2.20).

(2) Teachers-blind judges. Three elementary school Homeroom Teachers recruited from educational workshops served as blind judges. The teachers were roughly 31 years old (SD = 3.21), with an average six years of teaching experience (SD = 2.65);

they taught at different elementary schools. Each received a music CD as a compensatory gesture.

Materials

(1) Bimanual rhythmic patting task (Bi-Pat). This motor task requires highly synchronous coordinated hand movements in which each hand is required to perform an independent rhythmic string – hence conceived of as a form of *bimanual coupling.* Previous studies (Hyde et al., 2009; Karni et al., 1995) found that improvements in planning and execution of bimanual sequential finger movements as a result of motor learning positively correlated to functional enhancement and anatomical expansion of motor and auditory brain regions. Moreover, several studies view complex bimanual tasks (conceptually similar to *Bi-Pat*), as linked to cognitive-motor development and visual-temporal perception (Getchell & Whitall, 2003; Sherwood & Brian, 2005). In the current context, we consider this skill to be a *near-transfer domain*. Adapted from Semjen and Vos (2002), *Bi-Pat* is a test-set series of four two-part rhythmic strings (one for the right hand and another for the left hand), presented as two chunks of three beats (i.e. two repeated measures in a triple metre), whereby each hand *pats* the beats in time with a metronome click (heard aloud) with either open hand (palm extended , graphically represented by either a horizontal '—' or vertical '|' line) or closed hand (palm contracted as a fist , graphically represented by a circle '●'). *Bi-Pat* items are presented on 10 × 14 cm flash cards (see Figure 1). We employed two graphic formats: horizontally sequenced or 'landscape' orientation, and vertically sequenced or 'portrait' orientation. The differences between the orientations reflect visuospatial temporal cognitive resource demand characteristics necessary for efficient perception; by intuition, we would predict higher scores for portrait orientation, as this graphic representation emulates a lower level of complexity and therefore should be less demanding. *Bi-Pat* scores are based on 'trial'; a maximum of four trials per item is permitted. Success in the first trial is scored 100, success in the second trial is scored 75 and so on; no success in the fourth trial is scored as 0.

(2) Aural dictation task. Based on the findings of Study 1, we developed an aural dictation task to assess the impact of handclapping activity on a *far-transfer domain*. Four texts (unfamiliar children's verses and short stories) were chosen from a Ministry of Education sanctioned Hebrew sourcebook for the Second Grade (Geller-Tlitman & Raisnberg, 2001). The four texts were chosen by three elementary school teachers who were blind to the goals of the study; they were roughly 33 years old (SD = 5.50), with an average eight years (SD = 4.50) of teaching experience. In an effort to control for diction and intonation (i.e. exposure qualities of the stimuli), the texts were audio-recorded (by the second author in a female voice) via a Studio B2 (Behringer) condenser microphone to a DR 1600 digital recorder (Korg). The average text length was 50 seconds (SD = 3.20).

Evaluation measure

Alef-Alef Ktav Yad handwriting evaluation. Handwriting is a complex motor language task (Dorfberger, Adi-Japha, & Karni, 2009; Shfatia, 2003); it plays a crucial

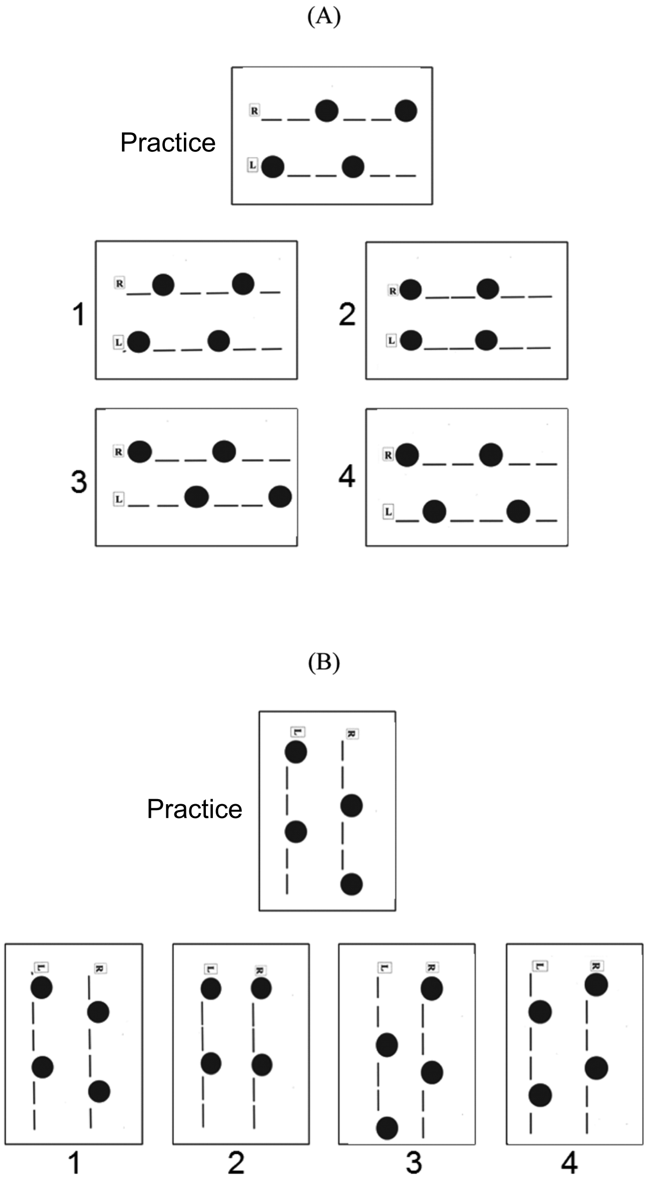

Figure 1. Studies 2 and 3 – bimanual rhythmic patting task (*Bi-Pat*) four-card series: (A) horizontally sequenced landscape orientation, and (B) vertically sequenced portrait orientation.

role in elementary school due to implications for motor and cognitive development (Rueckriegel et al., 2008). *Alef-Alef Ktav Yad* handwriting quality diagnostic test (Erez & Prush, 1999) is a standardised and validated assessment of handwriting skill developed for the Hebrew language. Nevertheless, for ecological reasons, we made two adaptations: (1) the original version was developed for individual implementation, while we administered the assessment to all 10 children simultaneously in a classroom setting; and (2) the original diagnostic version consists of 30 subcomponents requiring over 120 minutes to complete, whereas we downsized *Alef-Alef* to an abridged set of four subcomponents (modelled on research findings from studies such as Dorfberger et al. and Rueckriegel et al.) that reduced the procedure to 30 minutes (a time frame that is much more suitable for children). The four subcomponents are Content Output, Content Errors, Kinematic Appearance and Readability. Content Output is the calculated percentage of words written in relation to the total full text heard. Content Errors is the calculated percentage of deletions, corrections and spelling mistakes in proportion to the number of words written. Kinematic Appearance is a binominal pass/fail impression of technical aspects (1 = acceptable; 2 = unacceptable), including pencil-point pressure, letter size and distance between letters or words. A 'fail' score is registered for pencil-point pressure that is overly strong (dark) or weak (light), for a letter size that is unproportionately big or small, or for an inter-letter gap or an inter-word space that is too close or too far; scores are calculated as a percentage in proportion to the number of words written. Readability is the fluency of the script, reflecting the number of words judges have to 're-read' to decipher or decode in an effort to understand the text. Readability is registered by frequency (i.e. number of words) calculated as a percentage in proportion to the number of words written. Employing guidelines of *Alef-Alef Ktav Yad*, a final compound dictation score is calculated from the content output through subtraction of content errors, unacceptable appearance and poor readability.

Procedure

All 10 children, with work sheets, 2B pencils and an eraser, sat in a quiet classroom at tables. After a short explanation and a practice trial, recorded audio tracks of the other three texts were played aloud from a stereo player (Sony *FH-B50* with two 2-way speakers) at a comfortable volume (roughly 60 dB, measured 1 m from the source). For each text on the children's worksheets, several words were missing, replaced by a black line to be filled in during the audio-recorded dictation; the children were given a minute to complete the task after the text was heard. When the worksheets were collected, each child was sent individually to an adjacent room to perform *Bi-Pat* tasks. After a practice trial, two sets of four cards (presented in a random order) were completed; orientation version sets (landscape vs. portrait) were counterbalanced by subject order and both sets were performed in succession. Each card was studied for 15 seconds and then performed twice in an exact repetition; a maximum of four trials per card was permitted until achieving success. Performance was synchronised to a metronome click (Korg MA-20) heard aloud every 1000 ms (i.e. one beat per second or 60 bpm). At a later date, we handed the dictation work sheets to three teachers serving as blind judges; they evaluated each child on the basis of criteria outlined in *Alef-Alef Ktav Yad* that they had previously learned in a tutorial session.

Results

Bi-Pat scores were entered as dependent variables in a repeated-measures analysis of variance (ANOVA), with handclapping experience as a between-group variable. There were general effects of *group* ($F_{(1,8)} = 14.9378$, $MSe = 1130.86$, $p < .01$, $\eta_{\rho}^{2} = 0.6512$) and *spatial orientation* ($F_{(1,\ 8)} = 14.4118$, $MSe = 166.02$, $p < .01$, $\eta_{\rho}^{2} = 0.6431$); no interactions between the two surfaced (see Table 3, part A). As can be observed from the table, children who spontaneously engaged in handclapping songs activity were superior in both bimanual tasks in comparison with children who did not engage in handclapping songs activity. These results indicate that

Table 3. Study 2: children who spontaneously engage in handclapping songs (Group I) versus children who do not engage in handclapping songs (Group II).

	Group I	Group II
Variable	*M* (SD)	*M* (SD)
A. *Bi-Pat*		
Landscape	81.25 (11.7)	20.00 (22.7)
Portrait	100.00 (0.00)	45.00 (44.1)
B. Aural dictation		
Content output	90.66 (6.83)	59.33 (28.7)
Content errors	2.76 (1.46)	7.88 (5.50)
Kinematic appearance	1.53 (0.36)	3.71 (2.26)
Readability	2.22 (1.09)	7.45 (5.46)
Dictation score	84.16 (6.78)	40.28 (41.2)

children in Group I were twice as efficient in portrait orientation and four times more efficient in landscape orientation as compared with children in Group II. The findings show that all children of both groups performed better when presented vertically sequenced 'portrait' orientations than horizontally sequenced 'landscape' orientations; in our minds, such a difference no doubt reflects cognitive effort.

Next, dictation scores were entered as a dependent variable into ANOVA, with handclapping experience as a between-group variable. There was a general effect of *group* ($F_{(1,\,8)} = 5.5159$, $MSe = 872.28$, $p < .05$, $\eta_\rho^2 = 0.4081$; see Table 3, part B). As can be observed from the table, children who spontaneously engaged in handclapping songs activity were superior in aural dictation skills; they completed approximately 30% more of the words, with less than half of the errors, in a more controlled style of 'penmanship', contributing to greater readability

Discussion

Study 2 explored *individual differences* among children who spontaneously engage in handclapping songs activity. While the sample is undersized, we reiterate that such a proportion (i.e. 25%) *is* considered the representative sample size for children aged 5–10 who spontaneously engage in handclapping songs activity. The study brings forth a specific focus on two tasks that rely on temporal processes, that is, bimanual rhythmic patting (a near-transfer domain) and aural dictation (a far-transfer domain); the study found advantages for both tasks among children who naturally engage in handclapping songs. First, they were superior in the timed accurate performance of eye–hand motor sequences regardless of visual perceptual orientation. Second, they were significantly more successful in aural dictation, as demonstrated by elevated control over technical aspects of handwriting (i.e. readability of penmanship), aural memory (content output, i.e. number of words written) and visual memory (content errors, i.e. spelling mistakes).

Nevertheless, aside from the small number of participants, we recognise another limitation of the study – a possible gender bias among the groups. In this regard, we have no explanation, nor are we aware of any research effort that has targeted the question: Why are handclapping songs preferred more as an activity by girls than boys? Alternatively, one might question why 'handclapping songs' is an activity avoided by boys? Some researchers (Pellegrini et al., 2002, 2004; Sutton-Smith, 1990) have documented gender differences for school yard playground modes. Accordingly, boys more often play games involving conflict (fantasised chase or competitive ball), body strength, active interference, body contact, play fighting and whole-motor activity in considerably bulky groups, and thus requiring large spaces, with well-defined outcomes such as winners and losers; on the other hand, girls more often play verbal games or choral activities of rhyme and song using body parts (feet and hands), with more in-game waiting and solitary practice, turn-taking in ordered sequences and indirect competition within well-defined stages in play, with many rules dictating each move, among a limited number of participants in smaller spaces. Playground activities that are seen primarily related to girls are hopscotch, jump rope, jacks, ball bouncing, handclapping, statues, Red-light, outdoor gymnasium (bars and swings) and chase. In general, explanations for this typology have been offered from social vantages of development rather than cognitive ones.

Finally, we acknowledge the fact that while handclapping songs performance appears to cue behavioural differences related to cognitive and motor abilities, it may also be true that children who have better motor abilities are more attracted to handclapping songs. Considering these, and bearing in mind that Study 1 did not account for baseline measures or comparative conditions, we implement a T1–T2 intervention study comparing handclapping songs to another form of music learning among a matched group of mixed-gender children.

Study 3

The purpose of the study was to investigate the outcome of an eight-week intervention programme among two Second and two Third Grade classes, each from one of the two elementary schools matched for the socioeconomic level. A 'two-group pretest–posttest intervention' paradigm was implemented in parallel weeks by the same music teacher (the second author): one group received classroom HCST, while the other received classroom MAGL. Two elementary schools 50 km apart were chosen in an effort to control for contamination effects that can come about unwontedly from the school-yard during recess playtime exposure. That is, we felt that children assigned to groups not receiving handclapping training might inadvertently learn them from the other children receiving formal training procedures.

Method

Participants

(1) Elementary school children. Two Second Grade and two Third Grade classes were chosen by the school principals of two elementary schools in two cities in central Israel – 31 miles apart. Each of the four homeroom teachers were introduced to the study but remained blind to the specific goals. Initially, an information letter and a 'Consent to Participate' form were sent to 113 parents; there was a response rate of 53%, accounting for 60 participants. Subsequently, nine boys were absent for post-intervention assessment and hence were dropped from the data set. Therefore, the final sample consisted of 51 children, slightly more girls (60%), who were on average eight years old (SD = 0.56); there were 25 Second Graders (HCST: $n = 13$, $M = 6$, $F = 7$; MAGL:

n = 12, M = 4, F = 8) and 26 Third Graders (HCST: n = 11, M = 5, F = 6; MAGL: n = 15, M = 5, F = 10). We point out that this 60/40 gender proportion is the average distribution of Israeli elementary schools; based on sample size, such proportions are not significantly different (p = .1690). Further, no differences in gender proportions were found for *intervention condition* (x^2 = .83, p = .36) or *grade* (x^2 = .01, p = .91). The children from both schools were from various Jewish ethnicities in similar catchment areas from mid-to-upper middle-class socioeconomic levels. Nevertheless, we do need to point out that that while there were no significant demographic differences between the groups, as can be seen in the 'Results' section (Table 4, part B), the children of the MAGL group demonstrated significantly better pre-intervention dictations scores (t = 2.09, df = 49, p < .05), which seem to be solely influenced by a significantly higher percentage of content output (t = 2.49, df = 49, p < .025); there were no differences between the MAGL children from the Second and Third Grades. Therefore, we noted the possibility that the MAGL groups might eventually exhibit characteristic cognitive advantages, perhaps caused by an enhanced learning environment (i.e. apparent differences of classroom learning, home room teachers or school standards).

(2) Teachers-blind judges. The same three teachers serving as blind judges in Study 2 participated in the current study.

Materials and evaluation measures

The materials and evaluation measures were identical to Study 2 but with additional handclapping songs and classical music pieces as stimuli.

(1) Handclapping songs. Four handclapping songs in Hebrew were employed: 'Boom-Click-Kaf' (gibberish), 'Kushie Katan' (Little Black Dog), 'La La Leo' (gibberish) and 'Zoom Zoom' (Bumble Bee). The songs were chosen from a list of songs defined as the 'core repertoire' of Israeli childlore (Sulkin, 2003).

(2) Classical music pieces. Three pieces of Western Art Music were randomly chosen from Music Education didactical manuals for the Second and Third Grades (Brand, 1999; Shahar, Glushenkof, & Sulkin, 2004; Shahar, Sulkin, Glushenkof, & Oppenheim, 1999; Strauss, 1999). The pieces were *Concerto For Violin, Strings, and Continuo* (in E Major, BWV 1042, Movement III Allegro assai) by J.S. Bach, *In the Hall of the Mountain King* (Peer Gynt Suite, No. 1, Op. 46) by E. Grieg and *Prelude No. 7* (Op. 28 in A major) by F. Chopin.

Procedure

(1) Pre-intervention (T1) assessment (Week 1). Four identical group aural dictation sessions, and 51 individual meetings administering the *Bi-Pat* tasks were implemented. The children underwent procedures as described in Study 2.

(2) Two-group eight-week intervention training (Weeks 2–9). All children received eight 20-minute classroom sessions involving either HCST or MAGL in the presence of a homeroom teacher. HCST taught four songs by rote through mirror imitation (Sessions 1–3), implemented individual practice (Sessions 4 and 5), practice in pairs (Sessions 6 and 7) and practice by threesomes (Session 8). MAGL taught three music

pieces to identify orchestral instruments, offer a historical survey and teach listening skills to enhance a basic understanding of musical structures (tempo, meter, tonality, dynamics and form) and emotional components within the music.

(3) Post-intervention (T2) assessment (Week 10). All T1 procedures were replicated.

(4) Blind judging. At a later date, the T1 and T2 dictation worksheets were handed to three teachers serving as blind judges for assessment by employing the *Alef-Alef Ktav Yad* handwriting quality diagnostic test.

Results

Bi-Pat scores were entered as dependent variables in a repeated-measures ANOVA (i.e. both T1–T2 time and spatial orientation), with intervention type and gender as between-group variables. There were general effects of *time* ($F_{(1, 47)} = 20.34$, $MSe = 435.2$, $p < .0001$, $\eta_\rho^2 = 0.3021$) and *spatial orientation* ($F_{(1, 47)} = 40.97$, $MSe = 546.6$, $p < .00001$, $\eta_\rho^2 = 0.4658$); no interactions between the two surfaced. While there were no main effects of the intervention, there was a significant interaction of *time* × *intervention* ($F_{(1, 47)} = 0.23.18$, $MSe = 435.2$, $p < .0001$, $\eta_\rho^2 = 0.3303$). No main effects for *gender* surfaced. Taken together, these findings indicate: (1) all children performed *Bi-Pat* tasks better post intervention, (2) vertically sequenced 'portrait' orientation was easier for the children than the horizontally sequenced 'landscape' orientation, and (3) children from the HCST group significantly out-performed the MAGL group post intervention (see Table 4, part A).

Next, dictation scores were entered as a dependent variable in a repeated-measures ANOVA, with intervention type and gender as between-group variables. There were general effects of *time* ($F_{(1, 47)} = 54.16$, $MSe = 201.8$, $p < .00001$, $\eta_\rho^2 = 0.5354$) and *gender* ($F_{(1, 47)} = 3.91$, $MSe = 1298.7$, $p = .054$, $\eta_\rho^2 = 0.0767$); no interactions between the two surfaced. While there were no main effects for the intervention, there was a significant interaction of *time* × *intervention* ($F_{(1, 47)} = 25.43$, $MSe = 201.8$, $p < .00001$, $\eta_\rho^2 = 0.3511$). Taken together, these findings indicate: (1) all children demonstrated

Table 4. Study 3: handclapping songs training (HCST) versus music appreciation guided listening (MAGL).

	HCST (N = 24)			MAGL (N = 27)		
	T1	T2	Outcome	T1	T2	Outcome
Variable	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)
A. *Bi-Pat*						
Landscape	44.79 (40.2)	77.87 (20.1)	33.07 (23.8)	54.63 (36.2)	53.70 (32.9)	–0.93 (18.8)
Portrait	66.93 (39.6)	90.63 (13.1)	23.70 (32.9)	79.40 (27.2)	80.19 (23.4)	0.78 (22.1)
B. Aural dictation:						
Content output	61.52 (22.3)	90.56 (15.4)	29.04 (18.5)	76.35 (20.2)	82.21 (19.7)	5.87 (13.7)
Content errors	5.54 (5.47)	4.51 (4.57)	1.03 (2.87)	4.88 (4.07)	3.55 (2.31)	1.33 (2.56)
Kinematic appearance	3.95 (4.49)	1.65 (0.99)	2.31 (3.81)	2.52 (2.24)	2.15 (1.53)	0.37 (1.01)
Readability	6.22 (7.42)	2.82 (2.47)	3.40 (5.44)	4.47 (4.55)	3.43 (2.79)	1.04 (2.55)
Dictation score	45.81 (35.0)	81.58 (22.3)	35.78 (23.3)	64.48 (28.8)	73.08 (25.0)	8.61 (17.0)

better aural dictation scores post intervention, (2) girls demonstrated overall higher post-intervention aural dictation scores than boys ($M = 72.28$, SD = 19.12, vs. $M = 57.26$, SD = 32.68), and (3) the HCST group significantly out-scored the MAGL group on post-intervention scores (see Table 4, part B).

Initially, we did not consider 'grade' as a between-group variable within our analyses for the following reasons: (1) there was less than one biological year difference between the classes, and (2) there was a substantial overlapping of age groups (which is customary at this level of elementary school). Nevertheless, we could not but notice what seemed *as if* a performance difference in both near- and far-transfer domains between the grades. Moreover, when we considered that engagement in handclapping songs occurs within a specific developmental window, we felt there was all the more reason to explore differences between Second versus Third Graders. Therefore, we first conducted a post-hoc analyses (in the same fashion as described above) but with the addition of 'grade' as a between-group variable. Although no main effects were seen for the bimanual tasks, several near-significant interactions surfaced: *time* × *grade* ($F_{(1, 43)} = 2.98$, $MSe = 417.6$, $p = .091$, $\eta_\rho^2 = 0.0648$), *time* × *intervention* × *grade* ($F_{(1, 43)} = 2.96$, $MSe = 417.6$, $p = .092$, $\eta_\rho^2 = 0.0643$) and *time* × *intervention* × *version* × *grade* ($F_{(1, 43)} = 3.29$, $MSe = 180.2$, $p = .076$, $\eta_\rho^2 = 0.0710$). These findings seem to indicate that: (1) Third Graders were generally better at *Bi-Pat* tasks than Second Graders, (2) the HCST groups in both grades out-performed the MAGL groups, (3) the best improvements were for the Second Graders, and (4) Second Graders in the HCST groups performed much better with regard to vertically sequenced 'portrait' spatial orientation. No effects between the two grades surfaced for dictation scores.

In a second post-hoc exploratory effort, we looked at 'change scores'. By subtracting pre-T1 from post-T2 values, we then see *gains* or *losses* subsequent to the intervention (see Table 4). Outcomes of all three dependent variables were entered into a multivariate test of significance (MANOVA), with intervention type, gender and grade as between-group variables. There was a main effect of *intervention* (Wilks $\lambda = 0.4834$, $F_{(3, 41)} = 14.61$, $p < .00001$, $\eta_\rho^2 = 0.5165$), and a near interaction of *intervention* × *grade* (Wilks $\lambda = 0.859913$, $F_{(3, 41)} = 2.23$, $p < .099$, $\eta_\rho^2 = 0.1401$; see Table 5). As can be observed from the table, the findings indicated that the outcomes for both near- and far-transfer domains of the HCST intervention were significantly better than for the MAGL intervention, but that the best outcome seems to be among the Second Grade HCST group.

Finally, for exploratory purposes only, we conducted a similar MANOVA with change scores of the four dictation subcomponents (i.e. content output, content errors, kinematic appearance and readability), with intervention type, gender and grade as between-group variables. There was a main effect of *intervention* (Wilks $\lambda = 0.5640$, $F_{(4, 40)} = 7.73$, $p < .00001$, $\eta_\rho^2 = 0.4360$), and an interaction of *gender* × *grade* (Wilks

Table 5. Study 3: outcome measures (post-intervention change scores) by grade.

	Second Grade ($N = 25$)			Third Grade ($N = 26$)		
	Total	HCST	MAGL	Total	HCST	MAGL
Variable	*M* (SD)	*M* (SD)	*M* (SD)	*M* (SD)	*M* (SD)	*M* (SD)
Bi-Pat landscape	21.25 (27.5)	37.98 (24.7)	3.13 (17.8)	9.14 (26.0)	27.27 (22.9)	−4.17 (19.6)
Bi-Pat portrait	18.10 (35.0)	37.50 (38.5)	−2.92 (10.9)	5.29 (22.5)	7.39 (12.1)	3.75 (28.1)
Dictation score	26.69 (28.4)	42.84 (25.5)	9.19 (20.3)	16.30 (18.5)	27.43 (18.1)	8.14 (14.5)

Table 6. Study 3: outcome measures (post-intervention change scores) by gender.

	Girls (N = 31)			Boys (N = 20)		
	Total	Second Grade	Third Grade	Total	Second Grade	Third Grade
	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)
A. Dictation score by gender						
T1 pre-intervention						
Content output %	73.12 (20.5)	69.78 (25.7)	76.23 (14.2)	63.57 (24.1)	60.00 (25.6)	67.14 (24.4)
Total errors %	11.35 (6.31)	10.66 (7.05)	11.99 (5.69)	17.29 (18.6)	18.67 (15.3)	15.91 (22.1)
T2 post-intervention						
Content output %	90.48 (12.1)	88.66 (16.4)	92.19 (5.83)	79.41 (23.5)	84.00 (24.4)	74.82 (22.9)
Total errors %	7.69 (4.59)	6.62 (4.60)	8.70 (4.31)	11.17 (8.82)	10.35 (7.94)	11.99 (9.99)
B. Change score by gender						
Content output	17.37 (15.6)	18.89 (19.4)	15.96 (11.3)	15.84 (25.4)	23.99 (29.3)	7.68 (19.0)
Content errors	1.11 (2.53)	0.25 (2.44)	1.91 (2.40)	1.31 (2.99)	2.46 (3.01)	0.17 (2.63)
Kinematic appearance	1.08 (2.68)	1.82 (3.73)	0.36 (0.48)	1.59 (3.17)	1.99 (3.05)	1.89 (3.40)
Readability	1.46 (1.70)	1.98 (2.11)	0.98 (1.07)	3.21 (6.48)	3.87 (5.35)	2.55 (7.65)

$\lambda = 0.7675$, $F_{(4, 40)} = 3.03$, $p < .05$, $\eta_\rho^2 = 0.2324$). These findings again indicate that outcomes for dictation subcomponents were significantly better among the HCST groups than among the MAGL groups. However, unlike our previously mentioned findings that girls demonstrated an overall better outcome for dictation, these current results exemplify that for the most part, those effects were based on Content Output (see Table 6, part A). That is, this final analysis illustrates that while the boys benefitted more from the intervention than the girls, Second Grade boys achieved the most successful outcome of intervention (see Table 6, part B). A clear picture can now be seen, showing that Second Grade boys who at pre-intervention (T1) assessment demonstrated the lowest levels of verbal memory (i.e. percentage of words written during aural dictation) and the highest levels of impairment (i.e. percentage of content errors and unacceptable kinematic appearance, resulting in poor readability), also demonstrated the best post-intervention (T2) change in all dictation subcomponents – thus attaining an equal footing to the girls' T1 scores as well as more than having matched the scores of Third Grade boys.

Discussion

Study 3 investigated the outcome of HCST on cognitive and motor skills in both near- and far-transfer domains by employing a controlled learning environment. A two-group classroom-based intervention was implemented in an effort to replicate findings from Studies 1 and 2, thereby ruling out biases that seem to occur naturally when exploring gender-linked behaviour such as handclapping songs (i.e. characteristically seen as a 'girl' activity, mostly engaging children of the female gender). Study 3 recruited Second and Third Grade children from two elementary schools separated by 50 km in an effort to control for contamination effects; we contend that children learning handclapping songs would spontaneously practice these in the school yard during recess, hence exposing other children (including those assigned to control groups) to the songs. Therefore, each school was pre-assigned to a specific intervention group. We point out that while there were no significant demographic differences between the groups regarding gender, age, academic grade, or socioeconomic level, we did find the MAGL groups having significantly higher pre-intervention dictation scores compared with the HCST groups. Hence, in an effort to control for confounding factors (such as pedagogical style and seasonal occurrences), we implemented the interventions with the same music teacher, for an equal number of sessions, in parallel months.

Study 3 clearly found practice effects. That is, there were significant improvements of tasks measured post intervention, partially resulting from repeated exposure. Further, the study found gender biases among the children. That is, elementary school girls seem to be more advanced than boys in areas of verbal memory and handwriting penmanship skills.

Nevertheless, Study 3 found unequivocal transfer effects for both near- and far-transfer domains: HCST was significantly more effective in developing bimanual coupling, verbal memory and writing proficiencies. Moreover, HCST was more effective for Second Graders concerning a far-transfer domain involving verbal memory and handwriting. Specifically, boys who demonstrated poorly developed skills seemed to have gained the most from HCST and practice procedures, who after only eight sessions were able to 'close the gap'. This, by itself, is an interesting find given that Beringer and Ruthberg (1992) did not find six–eight-year-old boys to benefit more than girls from motor sequence training, and that Dorfberger et al. (2009) only found gender advantages of motor training procedures among males aged more than 12.

General discussion

Singing games and handclapping songs are universal among children of all societies. Archeological evidence of singing games has been found in ancient Egypt, and survival of the genre is documented for African, Asian, European and North American cultures. This long-range existence raises the question: Do singing games have a functional purpose? One possible answer is that they serve evolutionary purposes in child development since their performance constitutes a natural sensory-motor training that seems to contribute to movement, language, cognitive and social skills. Handclapping songs, an activity mostly involving children between ages six and nine, may be especially potent in providing acquisitions during a highly specific and opportune window of development. Handclapping songs are learned by rote, sung *a cappella*, accompanied only with sequential ostinato of rhythmic body percussion and performed in pairs or small groups. By 10 years of age, these songs have been discarded, replaced by rope jumping games or other activities such as ball play.

It has long been accepted that music learning and instrument training, structured by a requisite curriculum, can lead to improvements in non-music areas of human performance – in domains which are both near and far from the learned music domain (Pascual-Leone, 2005). However, it is prudent to question whether *spontaneous* music activity, such as singing games and handclapping songs, have an impact on child development. Handclapping songs are composed by children in an ecologically natural environment, whereby children simultaneously chant, sing and produce percussive body sounds – all linked together in a sequence of rhythmic body movements. The current investigation, then, explored handclapping songs as a platform facilitating the acquisition of specific cognitive, motor and social skills.

The investigation required the in-house construction of several measures, including those evaluating handclapping performance quality (HCPQ), academic behaviour and social skills (ABCs) and bimanual rhythmic coupling (*Bi-Pat*). Further, a handwriting quality diagnostic test *Alef-Alef Ktav Yad* was adapted in an effort to align it for use in an educational setting. All of these were initially tested and subsequently demonstrated to be content valid. Nevertheless, we recognise the fact that there is a need for more in-depth psychometric testing and reliability studies.

The current investigation implemented three studies. Study 1 questioned the relationship of handclapping songs performance quality with academic achievements and social skills. The research sought to position the performance of handclapping songs among developmental markers indicative of academic readiness for the First Grade. Most specifically, handclapping song performance scores seem to be somewhat predictive of classroom competences. Study 2 investigated differences in non-music motor and cognitive task performance among children who naturally and spontaneously perform handclapping songs in the school yard during recess. The results clearly indicated that those who engage in this activity demonstrate advanced perceptual and temporal processes in synchronised bimanual coupling (a near-transfer domain) as well as improved verbal memory and handwriting abilities (a far-transfer domain). Study 3 explored the outcome of a two-group intervention implemented at two elementary schools. The findings point to improved efficiency of children participating in the HCST compared with children receiving the MAGL program. Further, the study indicted that the HCST intervention was most beneficial for the Second Graders, and that those who gained the most from the eight-week HCST intervention were the Second Grade boys.

While the current study did not set out to explore developmental differences between the genders, we are not blind to the gender biases that surfaced – especially considering the characteristic (and socially accepted) view that handclapping songs are a ‘girl’ activity. Concerning motor performance abilities, Dorfberger et al. (2009) questioned whether apparent differences between the genders exist already in infancy, or whether they are established during childhood neurodevelopment? Several possible explanations are offered: First, certain biologically based central nervous system factors may cause males to have a real advantage in acquiring cognitive, motor and social skills. Second, the nature of the task requirements may play a role; for example, there are male advantages in navigation and mental rotation (i.e. tasks requiring spatial manipulation), while female advantages are seen in handwriting (i.e. language skills). A third explanation relates to task complexity; for example, there are male advantages in simple motor tasks such as index finger tapping (especially for speed), while females are better in tasks requiring more complex motor planning abilities such as pegboard tasks, handwriting and mirror drawing; however, such ‘gender-related advantages may disappear or shift as a function of practice’ (Dorfberger et al., 2009, p. 166). Finally, a fourth vantage highlights the potential for motor learning and the level of motor experience in task acquisition; that is, males and females differ in the rate of improvement in task performance even when an identical training experience is afforded, and this, then, is an indication for neurological differences between the genders.

With the above in mind, we take a tangential turn and pull into the overall picture facts indicating the incidence of learning disabilities, which tend to be far less favourable for boys, who outnumber girls 2:1 in this regard (see Child Trends Data Bank), and are even higher when considering *dyslexia*, for which boys outnumber girls 4:1 (Miles, Haslum, & Wheeler, 1998). Recently, Beringer, Nielsen, Abbott, Wijsman, and Raskind (2008) replicated gender differences in writing among typically developing children; they found that boys were more impaired in handwriting and composing than girls, and men who were more impaired in these skills were also more impaired in spelling than women. These above findings might be interpreted as neurodevelopmental advantages in favour of girls. In the light of the current findings, then, our overriding question is: Is it possible that among other factors, such gender biases are strengthened by self-regulated and controlled neuromotor rehearsal and training? After all, those who engage in handclapping songs activity between the ages six and nine are predominately female.

Finally, we would like to conclude by placing handclapping songs activity into a more applied context of neuropsychological developmental and intervention. Pascual-Leone, Amedi, Fregni, and Merabet (2005) point out that neuroplasticity essentially means that an innate characteristic of the human brain is its ability to reorganise itself. One transaction which has demonstrated such structural and functional changes is that involving hand patterns such as bimanual coupling (Monaghan, Metcalf, & Ruxton, 1998). It would seem warranted, then, to view handclapping songs activity as a natural ecological and opportune format to affect neurophysiological behaviours and cognitive skills. Impairment of fine motor abilities (such as handwriting skills) can be mediated by a variety of motor performance components, visual-motor integration, bilateral motor integration, motor planning proprioception and sustained attention (Rueckriegel et al., 2008). We contend that all of these can be found in handclapping songs activity. Our suggestion is based on a premise that while the timing for such changes is paramount, engagement in handclapping songs clearly appears as the most potent time window which, like other music-related activities, has been seen to affect cortical changes through an intensity of rehearsal and performance experiences (e.g., see, Elbert, Pantev, Weinbruch, Rockstroh, & Taub, 1995; Kelly & Garavan, 2005; Pantev et al., 1998; Schlaug, Jancke, Huang, Staiger, & Steinmetz, 1995). We point out that many researchers (such as Christman, 1993; Pascaul-Leon et al., 2005) have found complex repetition of bimanual sequences to trigger changes in sensory-motor cortices. Most specifically, Bishop (1990, 2005) showed that hand skills are one among the indicators of hemispheric function and specialisation, and the relevance of such associations is in both directions: of advantage as well as of impairment.

While the current study presents only preliminary findings (in the sense that this is the first exploration on handclapping songs, and obviously further investigations as well as replication studies are needed), we would argue that handclapping songs might be considered as a critical marker when assessing development (and developmental disabilities). Further, we would tend to suggest that handclapping songs activity be taken on board as an intervention with young children in the First and Second Grades – especially boys – as a platform for developmental remediation.

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Note

1. A short video demonstration of three handclapping songs described in this paper can be found at: http://cmsprod.bgu.ac.il/humsos/departments/art/staff/Warren.htm
   'Zoom Zoom' (Bumble Bee), 'Boom Kaf' (gibberish) and 'Kushie Katan' (Little Black Dog).

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