Cognitive flexibility modulates maturation and music-training-related changes of neural sound discrimination

Saarikivi K¹, Putkinen V¹,², Tervaniemi M¹,³, Huotilainen M¹

1 Cognitive Brain Research Unit, Cognitive Science, Institute of Behavioral Sciences, University of Helsinki, P.O. Box 9, FI-00014, Finland; 2 Department of Music, University of Jyväskylä, P.O. Box 35, FI-40014, Finland; 3 CICERO Learning, University of Helsinki, P.O. Box 9, FI-00014, Finland

Previous research has demonstrated that musicians show superior neural sound discrimination when compared to non-musicians and that these changes emerge with accumulation of training. Our aim was to investigate whether individual differences in executive functions predict training-related changes in neural sound discrimination. We measured event-related potentials (ERPs) to sound changes coupled with tests for executive functions in musically trained and nontrained children aged 9-11 and 13-15. High performance in a set-shifting task, indexing cognitive flexibility, was linked to enhanced maturation of neural sound discrimination in both musically trained and nontrained groups. Specifically, well-performing musically trained children showed large MMN responses already in the younger age group as well as in the older age group, indicating accurate sound discrimination. In contrast, the musically trained low-performing children still showed an increase in MMN amplitude with age suggesting that they were behind in development of sound discrimination relative to their high-performing peers. In the nontrained group, in turn, only the high-performing children showed evidence of age-related increase of MMN amplitude while the low-performing children showed a small MMN with no age-related change. These latter results suggest an advantage in MMN development also for high-performing nontrained individuals. In the P3a amplitude, there was age-related increase only in the children who performed well in the set-shifting task, irrespective of music training, indicating enhanced attention-related processes in these children. Thus, the current study provides the first evidence that in children, cognitive flexibility may influence age- and training-related plasticity of neural sound discrimination.

La ricerca ha dimostrato che i musicisti hanno una discriminazione del suono superiore a livello neurale, in confronto ai non musicisti e che questi cambiamenti emergono all’aumento del training. Lo scopo degli Autori era indagare se le differenze individuali nelle funzioni esecutive sono predittive di
Children's social preferences are partially determined by the cultural knowledge they share. This study examines this influence in young children. The authors observed that children prefer other children whose favorite songs are familiar to them. Then they established that children prefer other children whose favorite songs are familiar to them, suggesting a powerful determinant of children's social preferences, both because it underpins effective communication and because it is conveyed by others through social interactions and therefore can serve as a marker of social group identity.

Adults use cultural markers to discern the structure of the social landscape. Such markers may also influence the social preferences of young children, who tend to conform to their own group and prefer others who do so. However, the forces that propel these preferences are unknown. Here, we use social preferences based on music to investigate these forces in four- and five-year-old children. First, we establish that children prefer other children whose favorite songs are familiar to them. Then we show that this effect depends on shared knowledge: children both prefer others who know songs they themselves know, and avoid others who know songs they do not know, irrespective of the target children's liking of the songs. These results suggest that young children have a remarkably selective sensitivity to shared cultural knowledge. Shared knowledge may be a powerful determinant of children's social preferences, both because it underpins effective communication and because it is conveyed by others through social interactions and therefore can serve as a marker of social group identity.
Does music training enhance literacy skills? A meta-analysis

Gordon RL¹,², Fehd HM³, McCandliss BD⁴

¹ Music Cognition Lab, Program for Music, Mind and Society, Department of Otolaryngology, Vanderbilt University Medical Center, Nashville, TN, USA; ² Vanderbilt Kennedy Center, Vanderbilt University Medical Center, Nashville, TN, USA; ³ Institute for Software Integrated Systems, School of Engineering, Vanderbilt University, Nashville, TN, USA; ⁴ Department of Psychology, Graduate School of Education, Stanford University, Stanford, CA, USA

Children's engagement in music practice is associated with enhancements in literacy-related language skills, as demonstrated by multiple reports of correlation across these two domains. Training studies have tested whether engaging in music training directly transfers benefit to children's literacy skill development. Results of such studies, however, are mixed. Interpretation of these mixed results is made more complex by the fact that a wide range of literacy-related outcome measures are used across these studies. Here, we address these challenges via a meta-analytic approach. A comprehensive literature review of peer-reviewed music training studies was built around key criteria needed to test the direct transfer hypothesis, including: (a) inclusion of music training vs. control groups; (b) inclusion of pre- vs. post-comparison measures, and (c) indication that reading instruction was held constant across groups. Thirteen studies were identified (n = 901). Two classes of outcome measures emerged with sufficient overlap to support meta-analysis: phonological awareness and reading fluency. Hours of training, age, and type of control intervention were examined as potential moderators. Results supported the hypothesis that music training leads to gains in phonological awareness skills. The effect isolated by contrasting gains in music training vs. gains in control was small relative to the large variance in these skills (d = 0.2). Interestingly, analyses revealed that transfer effects for rhyming skills tended to grow stronger with increased hours of training. In contrast, no significant aggregate transfer effect emerged for reading fluency measures, despite some studies reporting large training effects. The potential influence of other study design factors were considered, including intervention design, IQ, and SES. Results are discussed in the context of emerging findings that music training may enhance literacy development via changes in brain mechanisms that support both music and language cognition.

L'impegno dei bambini nella pratica musicale è associato con un miglioramento delle capacità di linguaggio e lettura, come dimostrato da molteplici ricerche che evidenziano una relazione tra questi due domini. Gli studi sul training musicale hanno indagato se l’istruzione musicale possa trasferire direttamente questo beneficio alle capacità di lettura dei bambini, ma i risultati di tali indagini non sono univoci. L’interpretazione di questi dati è resa ancora più complessa dal fatto che è stata usata una vasta gamma di misure diverse relative alle capacità di lettura e scrittura. In questo studio gli Autori cercano di sviscerare tali dati con un approccio di meta-analisi. Gli Autori hanno costruito una revisione completa della letteratura degli studi scientifici disponibili intorno a criteri chiave necessari per testare direttamente l’ipotesi del transfer: 1) inclusione del training musicale vs gruppo di controllo; 2) inclusione delle misure pre- e post- trattamento; 3) indicazione che l’istruzione sulla lettura fosse mantenuta costante durante tutto lo studio. Sono stati identificati 13 studi (n=901). Sono emerse due classi di misure di outcome con una sovrapposizione sufficiente da permettere la meta-analisi: la consapevolezza fonologica e la fluidità di lettura. Le ore di training, l’età e il tipo di training sono stati esaminati come possibili modulatori. I risultati supportano l’idea che l’istruzione musicale possa migliorare la capacità di consapevolezza fonologica. L’effetto, isolato attraverso il confronto tra il guadagno del gruppo musicale con quello dei gruppi di controllo, era piccolo in confronto alla grande varianza in queste capacità (d=0.2). È interessante che le analisi rivelino un transfer diretto per la capacità di trovare le rime che tendeva ad aumentare con l’aumento delle ore di training. Al contrario, non si notava nessun effetto transfer aggregato per le misure di fluidità di lettura, sebbene alcuni studi riportino vasti effetti del training. È stata considerata l’influenza potenziale di altri fattori relativi al disegno di studio, quali il protocollo di intervento, il QI e lo SES (stato socio-economico). I risultati sono stati discussi nel contesto di risultati recenti sul fatto che l’istruzione musicale possa aumentare la capacità di lettura attraverso cambiamenti nei meccanismi cerebrali, che supportano sia la cognizione musicale che quella linguistica.
Disruption of Broca's Area alters higher-order chunking processing during perceptual sequence learning

Alamia A¹, Solopchuk O¹, D'Ausilio A², Van Bever V¹, Fadiga L²,³, Olivier E¹,², Zénon A¹
1 Université Catholique de Louvain, Brussels, Belgium; 2 Fondazione Istituto Italiano di Tecnologia, Genova, Italy; 3 University of Ferrara, Ferrara, Italy

Because Broca’s area is known to be involved in many cognitive functions, including language, music, and action processing, several attempts have been made to propose a unifying theory of its role that emphasizes a possible contribution to syntactic processing. Recently, we have postulated that Broca’s area might be involved in higher-order chunk processing during implicit learning of a motor sequence. Chunking is an information-processing mechanism that consists of grouping consecutive items in a sequence and is likely to be involved in all of the aforementioned cognitive processes. Demonstrating a contribution of Broca’s area to chunking during the learning of a nonmotor sequence that does not involve language could shed new light on its function. To address this issue, we used offline MRI-guided TMS in healthy volunteers to disrupt the activity of either the posterior part of Broca’s area (left Brodmann’s area [BA] 44) or a control site just before participants learned a perceptual sequence structured in distinct hierarchical levels. We found that disruption of the left BA 44 increased the processing time of stimuli representing the boundaries of higher-order chunks and modified the chunking strategy. The current results highlight the possible role of the left BA 44 in building up effector-independent representations of higher-order events in structured sequences. This might clarify the contribution of Broca’s area in processing hierarchical structures, a key mechanism in many cognitive functions, such as language and composite actions.

Dal momento che l’area di Broca è conosciuta per essere coinvolta in molte funzioni cognitive, incluse il linguaggio, la musica e l’elaborazione delle azioni, sono stati fatti molti tentativi per proporre una teoria unificante sul ruolo dell’area che enfatizzi un suo possibile contributo all’elaborazione sintattica. Recentemente, gli Autori hanno ipotizzato che l’area di Broca potrebbe essere coinvolta nel “chunking” di ordine superiore durante l’apprendimento implicito di una sequenza motoria. Il “chunking” è un meccanismo di elaborazione dell’informazione che consiste nel raggruppare un insieme di elementi consecutivi in una sequenza, e pare sia coinvolto in tutti i processi cognitivi citati sopra. Dimostrare un contributo dell’area di Broca al “chunking” durante l’apprendimento di una sequenza non motoria che non coinvolge il linguaggio potrebbe gettare nuova luce sulla sua funzione. Per farlo, gli Autori usano la TMS guidata offline dalla MRI in un gruppo di volontari sani, per interferire con l’attività della parte posteriore dell’area di Broca (l’area sinistra di Broadman BA 44) o di un sito di controllo, appena prima che i partecipanti imparino una sequenza percettiva strutturata in livelli gerarchici distinti. Gli Autori hanno trovato che l’interferenza con la BA 44 sinistra aumentava il tempo di elaborazione degli stimoli che rappresentano i confini dei “chunck” di ordine superiore e modificava la strategia di segmentazione. Tali risultati mettono in luce il possibile ruolo della BA 44 nella costruzione delle rappresentazioni indipendenti dagli effettori degli eventi di ordine superiore in sequenze strutturate. Questo potrebbe chiarire il contributo dell’area di Broca nell’elaborazione delle strutture gerarchiche, un meccanismo chiave in molte funzioni cognitive, come il linguaggio e le azioni composte.

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Editorial coordinator: Renata Brizzi
For further information: neuromusic@fondazione-mariani.org

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