

Full-Length Article

Clinical Music Study Quality Assessment Scale (Musiquas) : Systematic Reviews & Meta-analysisArtur Jaschke^{1,2}, Laura HP Eggermont¹, Sylka Uhlig^{1,3}, Erik JA Scherder¹¹ Department of Clinical Neuropsychology, VU University Amsterdam, Amsterdam, The Netherlands² Department of Music Therapy, ArtEZ University of the Arts, Enschede, The Netherlands³ HAN University of Applied Sciences, Nijmegen, The Netherlands**Abstract**

Publications in scientific journals have extensively used assessment scales to address methodological quality. So far there is no scale which assesses the quality of studies in the vast amount of music related sciences.

The clinical music study quality assessment scale (Musiquas) addresses this issue providing a 10-point rating scale. Studies are assessed on four general categories: Selection, Control criteria, Exposure and Outcome.

Musiquas is based on the *Newcastle-Ottawa Scale (NOS) for assessing the quality of studies in meta-analyses* and attuned by the authors to fit the demand of quality assessment in the wide array of clinical music studies.

A three round Delphi procedure as well as open online commentaries contributed to the creation of the assessment scale presented here.

Conclusively, this scale will contribute to higher quality methodologies in systematic reviews and meta analyses in music sciences and intervention research.

Keywords: *quality assessment scale, meta analysis and systematic review, experimental music study, observational music study, checklist, NOS*

multilingual abstract | mmd.iammonline.com

Introduction

“In medicine, systematic reviews and meta-analyses form the core of a movement to ensure that medical treatments are based on the best available empirical data”

Borenstein et al., 2009: p xxiii

Systematic reviews (SR) and meta-analyses (MA) are a central part in the ever-growing field of science. Reviews allow to stay ‘up to date’ with the most recent developments across multiple studies. Furthermore, they contribute to findings concerning a common research question and allow insights into the effectiveness of interventions [1, 2]. Additionally, systematic reviews and meta-analyses play a role in the design and planning of future study protocols and therefore synthesise all available evidence and knowledge of a research topic [3, 4]. As argued by Thompson and Pocock [5] as well as Chalmers [4], there are certain advantages and disadvantages to systematic reviews and meta-analyses. On the one hand, SR

and MA summarise and identify research directions. On the other hand, they can leave behind a wasteland, while potential interventions could have blossomed into a successful therapeutic or educational tool [3-5]. Recently, Sihvonen and colleagues [6], have presented a thorough systematic review on the effectiveness of music based interventions in neurorehabilitation. Even though, the inclusion criteria have been selected carefully, the quality of included studies has not been assessed with a standardised tool. Quality control therefore, improves the character of the included studies in terms of bias, identification of methodological flaws and the sensitivity of controls [4, 6, 7]. To ensure the highest standard of empirical data in SR or MA, the Cochrane Collaboration has developed a strict inclusion, exclusion and decision-making protocol, which includes the quality assessment of studies after inclusion into the final review [9]. The Cochrane protocol assesses the quality of studies with the *Newcastle-Ottawa Scale (NOS) for assessing the quality of studies in meta-analyses* and allows an additional assurance about the soundness of added studies into a review. Even though, multiple systematic reviews and meta-analyses have presented elegant findings in music-related intervention studies, the assessment of the final selection of studies has not been cross checked beyond initial selection criteria [6, 10-15]. In light of this argument, using a standardised tool to assess included studies beyond the point of inclusion criteria, assures the highest quality of included studies. Only recently [16, 17], quality assessment tools such as the Assessment of Multiple SysTemAticReviews, have found their way into reviews.

PRODUCTION NOTES: Address correspondence to:

Artur Jaschke, E-mail: a.c.jaschke@vu.nl | COI statement: The author declared that no financial support was given for the writing of this article. The author has no conflict of interest to declare.

However, these reflect only two studies from the extended body of meta-analyses and systematic reviews in music intervention research. These studies have used a general, non-specific assessment tool as there is no quality assessment tool tailored for music-based intervention studies. The need for quality control has led us to attune the *Newcastle-Ottawa Scale (NOS) for assessing the quality of studies in meta-analyses* specifically to clinical music studies [18]. The NOS is used as a checklist, based on a ‘star-system’ assessing studies on “the selection of the study group, the comparability of the groups and the ascertainment of either the exposure or outcome of interest for case control or cohort studies respectively” [18]. The motivation to base our *MUSIQUAS* on the NOS, is rooted in four aspects; 1) similarities in experimental and observational designs in music as well as health sciences, 2) the importance of methods and procedures, 3) its face validity and user friendliness and 4) even though it has received a great amount of critique [19], it is the most thorough and complete scale available, used in the majority of SR and MA in and outside of Cochrane reviews [20].

With *MUSIQUAS* we aim to bridge the gap between quality control assessment and higher methodological reliability in music-based intervention research.

Method

Literature review

As suggested by Streiner and Norman [21], a review of existing literature was conducted to assure no quality assessment scale for clinical music studies had been published to avoid double publication of similar scales and to ensure that a new scale is justifiable. The search has led to a thorough analysis of existing assessment scales and their use in meta-analyses/systematic reviews. Figure 1, shows the systematic approach.

The following search terms and combinations were used to identify possible assessment scales: quality assessment AND systematic review AND meta-analysis; quality assessment tool AND Music AND Healthcare AND systematic review AND meta-analysis.

Preliminary search results have not shown a quality assessment scale attuned to music studies. Nonetheless, there were five assessment tools found, which had the potential to be used in general music-based intervention studies (Table 1). After further assessment on 1) similarity between music-based and non music-based intervention designs; 2) method and procedure assessment; 3) face validity and usability and 4)

impact in existing literature, we have attuned *The Newcastle-Ottawa Scale* to music-based interventions.

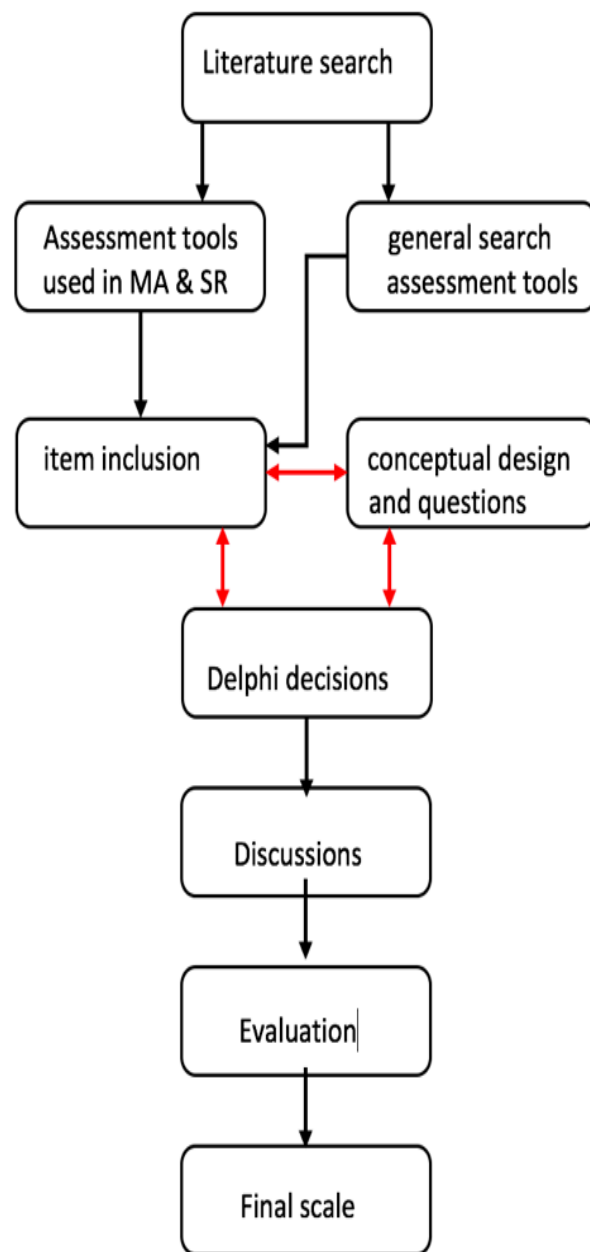


Figure 1: Systematic approach in creating the final scale

Tool	Output	Authors	Year	Description
OQAQ	Journal of Clinical Epidemiology	Oxman & Guyatt	1991	Validation of an index of quality of review articles
QUADAS	BMC Research Methodology	Whiting, Ruitjes, Reisma, Bossuyt & Kleijnen	2003	a tool for the quality assessment of studies of diagnostic accuracy included in systematic reviews
AMSTAR	BMC Research Methodology	Shea, Grimshaw, Boers, Andersson, Hamel, Porter, Tugwell, Moher & Bouter	2007	a measurement tool to assess the methodological quality of systematic reviews
QUOROM	BMC Systematic Reviews in Health Care: Meta-Analysis in Context, 2 nd Edition	Dubé & Moher Edited by: Egger & Smith	2008	Assessing quality and susceptibility to bias
NOS	Published online	Wells, Shea, O'Connell, Peterson, Welch, Losos, & Tugwel	2009	for assessing the quality of (non)randomised studies in meta-analyses

Table 1: Search results of quality assessment scales found in general health and human research sciences.

Procedure

A preliminary analysis of included sections in the NOS was conducted and identified four main categories; Selection, Control Criteria, Exposure and Outcome. These main groups were assessed on importance for the quality of clinical music studies and cross checked against the literature and identified assessment tools by the researchers through discussion, a panel of experts and consulting a third party [22, 23].

Disagreements were resolved through a *proactive debate* approach among the authors, to deliver, generate and analyse the problem and to solve the questions at hand. As both the panel of experts and the authors shared a common interest in the assessment of the quality of music-based intervention studies, the expression of concerns as well as understanding the issues involved and their consequences was paramount in the resolution process. Compromises and cooperative agreements were discussed openly and with scientific and personal integrity at the centre of the debate.

Delphi procedure – general features

Experts from the fields of music-based interventions as well as related fields were approached by the authors. Nine experts agreed to serve as members of the Delphi panel. The Delphi procedure is a structured communication technique designed to reach a consensus on one or more questions presented to a panel of experts [22, 23]. The Delphi panel experts remained anonymous throughout the whole process. Mediators, in this case the authors, have provided summaries after each round to the panel members. These summaries were evaluated and returned by each panel member individually, indicating which

item to include or exclude. The panel members did not communicate with each other directly, to minimise bias. It is believed that the process of ‘blind’ evaluation by anonymous panel members throughout three rounds, with a mediating body amalgamating the information, will narrow down possible results. In turn, these results were more reliable when originating from a structured group of individuals rather than from an unstructured group. The initial scale included 37 items distributed across four main categories; Selection, Control Criteria, Exposure and Outcome. These reflected methodologies used in experimental and observational music-based intervention studies. Overall, items showing methodological flaws were excluded by the Delphi panel and the authors, whereby disagreement was resolved through discussion. As suggested by Linstone and Turoff [22, 23], all four authors were not part of the Delphi panel to ensure adequate monitoring, structuring of workflow, feedback and to free panel members from possible biases towards their selection. The Delphi panel was able to offer suggestions on including items, which were not yet represented in the scale.

Additionally, the authors reported their decision-making processes on the included/excluded items back to the panel.

Panel members were at all stages informed and asked whether the authors decisions were supported.

The inclusion was finalized by the authors based on all information, feedback and input of the Delphi panel. The final scale is a result of the whole extended Delphi process as is shown in figure 2.

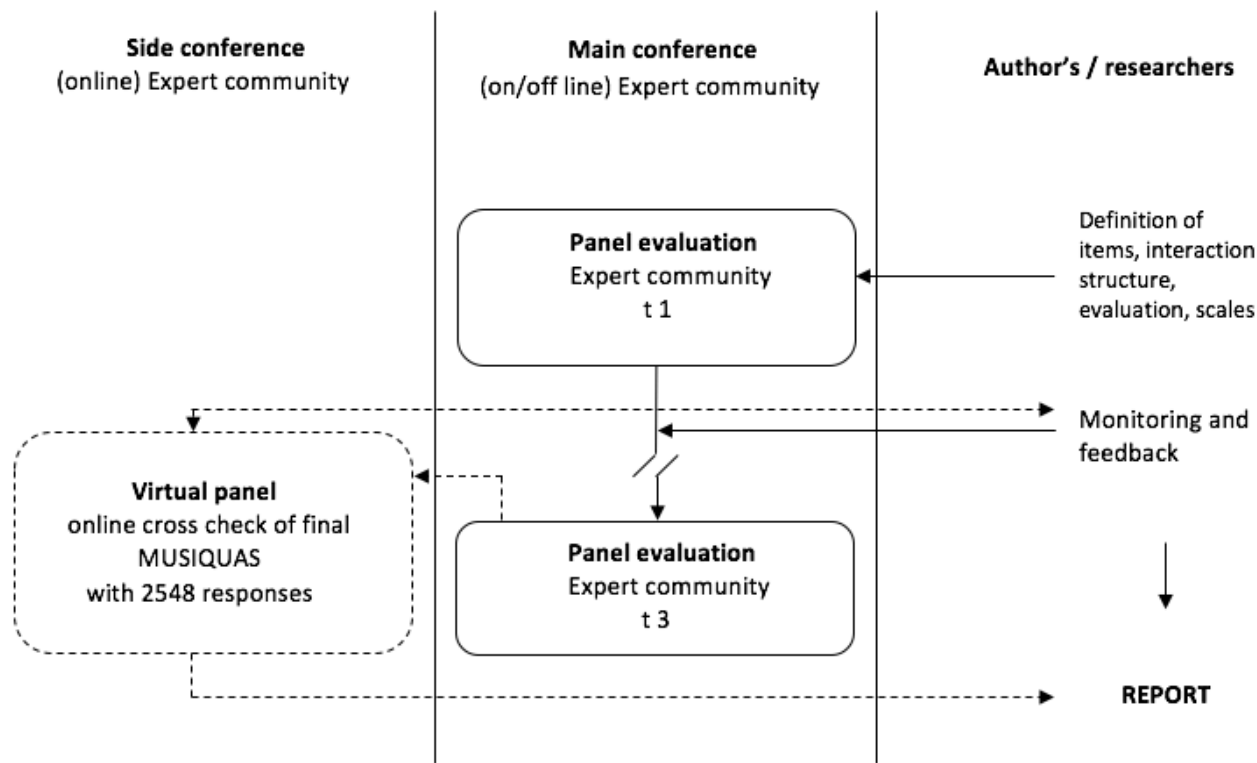


Figure 2: schematic working of the Delphi procedure following the Bolognini model [24]

Delphi procedure – 1st round

Items across the four main categories were sent out to the panel members. The category ‘Selection’ describes details on the representation of the group, e.g. *selected users, representative clinical population, representative community, representative classroom community* and description of controls, such as *classroom, clinical, public* and *no description*. Items in the ‘Exposure’ category were aimed at the *length of the interventions, specification of musicality tests* (as these give crucial information into possible near transfer and musical aptitude), *test measures and exposure of test measures*. The final group of items describes the outcome of a study. Of note, *adequacy of pre-test to post-test measures* involved different ways of measurements such as *single measures, two measures or more than two measures*, as well as *inclusion of subjects*.

Panel members were able to assess the importance of included items on a five point Likert scale (strongly agree, moderately agree, neutral, moderately disagree, strongly disagree). Individual comments on included items were encouraged during this process.

Delphi procedure – 2nd round

Expert suggestions from the 1st round scoring 75% or higher (strongly agree) were included and kept in the assessment scale. Every item scoring less than 75% of the votes of the Delphi panel was excluded from the scale. Panel members were asked to comment on each item so far included and their opinion as to why to include or exclude particular items from the scale. Additionally, panel members suggested the combination of items under ‘umbrella terms’ e.g. *representative class room population, representative community population* and *representative clinical population* to *truly representative of the group*. This was encouraged as a long scale may have discouraged users to complete it.

Delphi procedure – 3rd round

All integrated items from the previous rounds scoring 75% or higher by all panel members were included in the final scale. Organisation of all items was finalised by the authors.

Table 2 shows the final scoring, which ranges from 1 (very poor) to 10 (outstanding). This gradation was chosen above a smaller five point Likert rating as it allows to assess included studies on a broader spectrum.

Grade	Description
10	Outstanding
9	Excellent
8	Very good
7	Good
6	Sufficient
5	Insufficient
4	Strongly Insufficient
3	Very Strongly Insufficient
2	Poor
1	Very Poor

Table 2: Rating system, reflecting overall points scored.

Additional verification

Following the Delphi procedure, Musiquas was published online for further content and face validity. The scale was uploaded between March 2012 and June 2017 [25]. 2548 online comments provided constructive feedback on all items in the four categories Selection, Control Criteria, Exposure and Outcome. Researchers could then rate the categories and the included items. The authors decided to add the online extension to the Delphi procedure as suggested by Bolognini [24], in order to test and retest face validity and usability of MUSIQUAS. The four categories, with their items, have been published separately by category. The online community was able to click on either *agree with the selection* or *disagree with the selection* within each category. Additionally, anonymous comments could be added by the online community. These were only visible to the authors to in order to minimise bias, unnecessary *spam*, *flagged online commentary* and *trolling*.

Nonetheless, countless unrelated comments needed to be meticulously removed and excluded from the final analysis of this data.

Results

Musiquas

The final scale assesses the quality of clinical music studies on 26 points divided over four main categories; Selection, Control Criteria, Exposure and Outcome. These were suggested by the authors, re-evaluated and improved by the Delphi panel and the analysis of the online data (see Figure 3 for online data).

Clinical music study quality assessment scale (Musiquas) 1st Edition

Form of intervention _____ (classroom, group or one-to-one)

Selection

Intervention group (max. one *z*)

- truly representative of the average _____ within the community *z*
- somewhat representative of the average _____ within the community *z*
- selected users (potential bias towards groups)
- no description

Selection of Controls (max. one *z*)

- classroom controls *z*
- community controls *z*
- no description

Control criteria

Cases and controls (up to two *z*)

- study controls for _____ *z*
- study controls for additional factors _____ *z*
- no description

Exposure

Administration of musical ability test (e.g. Gordon's PMMA, AMMA, IMMA or equivalent)

- Yes *z*
- No

Pre-test scores and post test score are presented and compared

- Yes _____ [please specify test(s)] *z*
- No

Same test measures used for intervention and control group

- Yes *z*
- No

Outcome

Was length of instruction/intervention long enough to show effect

- Yes *z*
- No
- No description

Assessment of outcome (max. one *z*)

- Independent blind assessment *z*
- Self report
- No description

Adequacy of pre-test to post-test measures (max. one *z*)

- all subjects accounted for *z*
- small number lost (select an adequate %) *z*
- high number lost (select an adequate %)
- no statement

Figure 3: Full Musiquas scale

Figure 3: 2548 online commentaries agreeing/disagreeing on the proposed categories

Selection, shows the quality of selected controls and if controls were part of the study at all. The described groups in a study are representative of the average within a group. Secondly, the source of the control groups is assessed. A maximum of two points can be scored in this section, whereby points are given for *representativeness* and *source of the controls* (see Figure 3)

Control criteria, assesses the quality of ‘controlled for’ factors within the studies. A maximum of two points can be awarded; one point for a single control variable and another point for any additional variable, which have to be specified on the scoring sheet. *Exposure*, judges more specific methodological aspects contributing to the quality of a study.

Points were scored on aspects of scientific measurements; *was a musical ability test administered prior to the chosen experiment (items 11 and 12)*, were *pre-test and post-test scores compared and evaluated (items 13 and 14)* and were the *same test measures used for both the intervention and control group (items 15 and 16)*.

Outcome measures the effect in the described study. It addresses, if the length of music instruction or intervention was long enough to show an effect (length can be individually specified to meet methodological needs). However, recent research suggest that interventions should generally last at least one-and-a-half years for educational interventions [26] and a minimum of 6 months in music therapy related research [27, 28]. Another point can be scored in this category for independent blind assessment, in contrast to self-reporting or the lack of a description whatsoever.

Finally, a point is scored for the adequacy of pre-test to post-test measures; *were all participants accounted for, was a small or high number lost, or is there no statement of this event within the study* (Figure 3).

Delphi procedure

All nine panel members have individually returned full questionnaires and commentaries to the mediators across the three decision rounds. The experts did not communicate with each other, to minimise bias and guarantee anonymity.

Online data

Online data was assessed on agree/disagree and was used to confirm the decisions made by the Delphi panel and the authors. The international (76 Countries) online community has agreed on more than 60% of the included items. Questions from the community were; *why is item [...] included, examples and difficulties from clinical and practical experiences with an item (e.g. what if a control cannot be selected because of the heterogeneity of the population as for example ASD?) or overall face validity and use of the scale.* The section *Exposure* however, has shown the greatest variety in comments. This may be as items included in this section still vary across music-intervention based studies.

Musiquas was piloted in two systematic reviews [29, 30]. Jaschke et al., have analysed the influence of music education on academic achievement with executive functions as sub - functions for language and mathematics in primary school children. They have included eleven studies into their systematic literature review with mixed results. However, by analysing the quality of the included studies next to the thorough inclusion and exclusion criteria, they have presented a wider overview on the reliability of the results in their review. By assigning a score to included studies, the authors allowed the interpretation of the strengths and weaknesses of their analysis beyond the point of inclusion criteria.

Study (publication date)	Musiquas rating	N instruction	N control	(R)CT
Deaé & Schwarzer (2005)	8	14	14	✓
Ho, Y. C. et al. (2003)	8	45	45	✓
Piro, J. M & Ortiz, C. (2009)	7	46	57	✓
Portowitz, A. et al. (2009)	6	45	36	✓
Gromko, J. E. (2005)	4	43	60	✓
Tsana, C. D. & Conrad, N. J. (2011)	7	26	43	✓
Schellenbera, G. E. (2004)	8	32	34	✓
Register, D. (2001)	5	25	25	✓
Jentschke, S. and Koelsch, S. (2009)	5	21	20	✓
Courey, S. J. et al. (2012)	6	37	30	✓
Rickard, N. S. et al. (2012)	7	47	37	✓
	7	38	31	✓

Table 2: excerpt from included studies in Jaschke et al’s, (2013) review, with Musiquas rating

Discussion

Quality assessment of research studies is an integral part of every meta-analysis or systematic review [8]. Medical and health science reviews have made extensive use of such assessment tools. Even though there are several similarities in experimental and observational designs, studies describing music-based interventions have made only limited use of such tools [4, 7, 8]. This can be attributed to the absence of a scale focusing on clinical music studies. We have therefore created the clinical music study quality assessment scale out of the need to assess the quality of studies in meta-analyses and reviews in music-based intervention research.

Even though a quality assessment scale is desperately needed in music intervention reviews and meta-analyses, there are possible limitations to MUSIQUAS. Our scale approaches music-based interventions from a broader perspective. It combines clinical, class-room and community music interventions in one assessment scale. Arguably, this could be seen as counterproductive in the creation of a specialised scale. However, MUSIQUAS focuses on the *music in music-based interventions*, combining the different approaches of such interventions under the umbrella of quality assessment in music studies. Furthermore, it is uncertain if MUSIQUAS will be used at all. This, however, is difficult to argue as there is no music-based quality assessment tool as of yet. Against this backdrop, a recent systematic review on the analysis of assessment tools in MA and SR has concluded that, even though there are different general tools,

there is a current lack of specialised assessment tools for different types of studies, e.g. clinical or educational music interventions and designs [2]. Therefore, we see MUSIQUAS as the first step in bridging this gap.

As MUSIQUAS is in no means complete, further peer assessment will contribute to the development of this scale. Additionally, researchers in music-based intervention research have to be stimulated to use quality control tools and be aware of the benefits of quality assessment in SR or MA [9, 20].

Therefore, *MUSIQUAS* will contribute towards a standardisation of experimental and observational designs in music-based intervention research. It will support such research to withstand the harsh critique of policy makers, government funded research or insurance companies and to unify diverse methodological questions, leading to higher quality and well-founded results.

References

- Borenstein, M., Hedges, L. V., Higgins, J. P. T. & Rothstein, H. R. (2009), *Introduction to Meta-Analysis*, Wiley and sons publications: Chichester
- Zeng, X., Zhang, Y., Kwong, S.W.J., Zhang, C., Li, C., Sun, F., Niu, Y. & Du, L. (2014), The methodological quality assessment tools for preclinical and clinical studies, systematic reviews and meta-analysis, and clinical practice guideline: a systematic review, *Journal of Evidence-based medicine*, 8: 2 - 10
- Ioannidis, J.P.A. and Lau, J. (1998), Can quality of clinical trials and meta analyses be quantified? *The Lancet*, 352, 590
- Chalmers, I. (2007), The lethal consequences of failing to make use of all relevant evidence about the effects of medical treatments: the need for systematic reviews. In P. Rothwell (ed.), *Treating Individuals*. Ed. London: *Lancet*: 37 – 58
- Thompson, S. G. and Pocock, S.J. (1991), Can meta analyses be trusted?, *The Lancet*, 338, 1127-1130
- Sihvonen, A. J., Särkämö, T., Leo, V., Tervaniemi, M., Altenmüller, E. & Soynila, S., (2017), Music-based interventions in neurological rehabilitation, *The Lancet Neurology*, 17: 1-13
- Deeks, J.J., Dinnes, J., D'Amico, R., Sowden, A.J., Sakarovitch, C., Song, F., et al. (2003), Evaluating non-randomised intervention studies, *Health Technological Assessment*, 7(27), iii-x, 1-173
- Sanderson, S., Tatt, I.D. and Higgins, J.P.T. (2007), Tools for assessing quality and susceptibility to bias in observational studies in epidemiology: a systematic review and annotated bibliography, *International Journal of Epidemiology*, 36, 666-676
- Cochrane Collaboration (2013), *Cochrane Library and tools*, retrieved from the world wide web on 27th September 2017: www.cochranelibrary.com.
- Vaughn, K. (2000), Music and Mathematics: Modest support for the Oft-claimed relationship, *Journal of Aesthetic Education*, 34(3/4), 149-166
- Hetland, L. and Winner, E. (2004), Cognitive transfer from arts education, in E. Eisner and M Day (eds.), *Handbook on research and policy in art education*, National Art Education Association
- Chanda, M.L. and Levitin, D. J., (2013), Feature Review; The Neurochemistry of Music, *Trends in Cognitive Sciences*, 17(4), 179 – 193
- Platz, F and Kopiez, R. (2012), When the eye listens: A Meta-Analysis of how audio-visual presentation enhances the appreciation of Music performance, *Music Perception*, 30(1)
- Sala, G., & Gobet, F., (2017), When the music's over. Does music skill transfer to children's and young adolescents' cognitive and academic skills? A meta-analysis, *Educational Research Review*, Vol 20,55-67
- Standley, J. M. (2008), Does Music Instruction Help Children learn to read? Evidence of a meta-analysis, *Applications of research in music education*, 27(1), 17-32
- Leubner, D & Hinterberger, T., *Reviewing the Effectiveness of Musci Interventions in Treating Depression*, *Frontiers in Psychology*, Published online 07 July 2017
- Kamioka, H., Tsutani, K., Yamada, M., Park, H., Okuizumi, H., Tsuruoka, K., et al. (2014). Effectiveness of music therapy: a summary of systematic reviews based on randomized controlled trials of music interventions. *Patient Prefer Adherence*. 8: 727
- Wells, G.A., Shea, B., O'Connell, D., Peterson, J., Welch, V., Losos, M. and Tugwel, P. (2009), *Newcastle-Ottawa Scale (NOS) for assessing the quality of nonrandomised studies in meta-analyses*, published online: http://www.ohri.ca/programs/clinical_epidemiology/oxford.asp
- Stang, A. (2010), *Critical Evaluation of the Newcastle-Ottawa scale for the assessment of the quality of nonrandomized studies in meta-analyses*, *European Journal of Epidemiology*, 25, 603-605
- Higgins, J.P.T. and Green, S. eds. (2013), *Cochrane handbook for systematic reviews for interventions*, version 5.1.2 [updated March 2017], The Cochrane Collaboration, 2017, Available online from www.cochrane-handbook.org
- Streiner, D.L. and Norman, G.R. (2008), *Health Measurement scales: A practical guide to their development and use*, 4th Edition, Oxford and New York: Oxford University Press
- Linstone, H.A. & Turoff, M., (1975), *The Delphi Method: Techniques and Applications*, New Jersey Institute of Technology
- Linstone, H.A. & Turoff, M., (2002), *The Delphi Method: Techniques and Applications Revisited*, New Jersey Institute of Technology
- Maurizio Bolognini (2001), *Democrazia elettronica. Metodo Delphi e politiche pubbliche (Electronic Democracy. Delphi Method and Public Policy-Making)* (in Italian), Rome: Carocci Editore,
- Jaschke, A.C. and Eggermont, L.H.C. (2012), *Music study and intervention quality assessment scale (Musiquas)*, published online 1st March 2012, http://vu.nl/academia.edu/ArturCJaschke/Papers/1616348/Music_study_and_intervention_quality_assessment_scale_Musiquas_1st_Edition
- Kraus and White-Schwoch (2017), *Neurobiology of Everyday Communication: what we have learned from Music*, *The Neuroscientist*, Vol. 23(3) 287–298
- Geretsegger, M., Elefant, C., Mössler, K. A. & Gold, C., (2014), *Music therapy for people with autism spectrum disorders*, *Cochrane Database of Systematic Reviews*
- Kühlmann, A. Y. R., Etnel, J. R. G., Roos-Hesselink, J. W., Jeekel, J., Bogers, A. J. J. C., & Takkenberg, J. J. M. (2016). Systematic review and meta-analysis of music interventions in hypertension treatment: a quest for answers. *BMC Cardiovascular Disorders*, 16, 69.
- Jaschke, A.C., Eggermont, L.H.P., Honing, H.J. & Scherder E.J.A., (2013), *Music intervention and its effect on intellectual abilities in children: a systematic review*, *Reviews in the Neurosciences*, 23
- Uhlig, S, Jaschke, A.C. and Scherder E.J.A (2013.), *Effects of music on emotion regulation: a systematic review*, *The 3rd International Conference on Music & Emotion, Jyväskylä, Finland*

Biographical Statements

Artur C Jaschke is associate professor in music-based therapies and interventions and visiting fellow in Cognitive Neuroscience in Music

Laura Eggermont works as Associate Professor Clinical Neuropsychology

Sylka Uhlig is a Board certified Music Therapist and Senior Research Fellow Music Therapy and Neuropsychology.

Erik Scherder is Professor and head of Department of Clinical Neuropsychology.