

1 **Rock drumming enhances motor and psychosocial skills of children with emotional**
2 **and behavioural difficulties.**

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1 Rock drumming enhances motor and psychosocial skills of children with emotional and
2 behavioural difficulties.

3

4 Drumming may have therapeutic and learning benefits but there exists little
5 causal evidence regarding the benefits for children with emotional and
6 behavioural difficulties (EBD) such as Autistic Spectrum Disorder- Six EBD
7 pupils (EBD Drum) and 6 peers (Peer Drum) were given 2, 30 minute rock
8 drumming lessons per week, over 5 weeks. Six matched individuals received no
9 drumming instruction (3=EBD Control; 3=Peer Control). An exploratory,
10 mixed-methods analysis was used to explore quantitative changes in skills and
11 qualitative perspectives of the teaching staff. All pupils were tested two times
12 (pretest and posttest) on drumming ability and Motor skills (Movement
13 Assessment Battery for Children, version 2). Teacher's rating of social behaviour
14 (Strength and Difficulties Questionnaire; SDQ) was tested two times (pretest and
15 retention). Significant differences in total SDQ difficulties between the four
16 groups ($\chi^2(3) = 8.210$, $p = 0.042$) and the hyperactivity subscale ($\chi^2(3) = 10.641$,
17 $p = 0.014$) were observed. The EBD Drum group had greater reductions in total
18 difficulties compared to the Peer Drum ($p = 0.009$) group and specifically greater
19 reductions in hyperactivity compared to Peer Drum ($p = 0.046$) and the EBD
20 Control ($p = 0.006$) group. In follow-up interviews, staff spoke positively about
21 changes in pupil's attitudes towards learning and social confidence. The positive
22 changes to social and behavioural skills reported in this pilot study are similar to
23 those recorded for other music modalities.

24 Keywords: educational enrichment; drumming; psychosocial; psychomotor
25 coordination; hyperactivity; behavioural difficulties; emotional difficulties;
26 neurological development.

27

1 **Music intervention for Children with emotional and behavioural difficulties**

2 A range of anecdotal evidence exists which extols the therapeutic virtues of drumming
3 and drumming groups in particular (Friedman 2000). By contrast, the empirical
4 evidence base is small but accumulating (Bungay 2010). Psychosocial therapeutic
5 benefits such as enhanced communication (Maschi et al. 2010; Maschi et al. 2012);
6 emotional processing and tension reduction (Flores et al. 2016; Maschi et al. 2010;
7 Maschi et al. 2012); group cohesion and connectedness (Blackett et al. 2005);
8 concentration, psychomotor coordination, posture (Chen et al. 2017) have been listed.
9 The published drumming intervention studies have mainly been with adolescents and in
10 particular, those ‘at risk’, a term that can encapsulate those with emotional and
11 behavioural difficulties, alienation from school, substance abuse and poor mental health
12 (Snow et al. 2010). Ringenbach and colleagues (2014a, b) reported that drumming
13 aided repetitive motor movement and coordination for individuals with Down
14 syndrome. There is still little causal evidence regarding the benefits of drumming
15 instruction at enhancing the quality of life for younger children with specific
16 educational needs and in particular within the context of mainstream education.

17 Since the 1981 Educational Act, a range of children with different emotional and
18 behavioural difficulties (EBDs) are educated within mainstream schools in the UK
19 (Darnley-Smith et al. 2003). Despite this integration, children with EBDs still
20 underachieve academically compared to those with other disabilities (Kern 2015). The
21 range of learning, emotional and interpersonal difficulties these children present can
22 often be complex, placing demands on teaching staff and class-peers. Some of these
23 children will undergo formal assessment of their health, care and educational needs in
24 addition to, or separate from, any formal diagnosis of an intellectual or behavioural
25 disorder (such as Autism Spectrum Disorders [ASD], Attention Deficient Hyperactivity

1 Disorder [ADHD] or Pervasive Developmental Disorder not Otherwise Specified
2 [PDD-NOS]).

3 Difficulty in forming and maintaining peer relationships are a particular feature
4 of children with ASD as they struggle to understand the perspective of others, in
5 addition to their poor communication skills; this is commonly referred to as *Theory of*
6 *Mind* or *mind blindness* (Frith 2003). Recently, researchers have suggested that
7 individuals with ASD lack motivation in social interaction and therefore seek fewer
8 opportunities to develop social skills (Chevallier et al. 2012). Some researchers have
9 argued that girls display less disruptive behaviours and therefore are less likely to come
10 to immediate attention and consequently are less likely to be referred for additional
11 support (Biederman et al. 2005). Molnar-Szakacs et al. (2012) argue that individuals
12 with ASD demonstrate preference for music and are able to interpret musical emotion in
13 child and adulthood.

14 In addition to these social skills, children with emotional and behavioural
15 difficulties can also have difficulty with motor control skills. Sokhadze et al. (2016)
16 suggest that approximately 80% of people with ASD also present with motor dyspraxia
17 or clumsiness. Dyspraxia can manifest as the impairment of planning, organisation and
18 execution of fine and gross motor skills. These can further impact on the child's ability
19 to perform daily activities which may result in further isolation from peers and social
20 interactions (Gallo-Lopez et al. 2012). Using the Movement Assessment Battery for
21 Children-2, Liu et al. (2013) reported that 77% of ASD children (aged between 3 and
22 16) had significant motor delays and scored significantly lower than their typically
23 developing peers.

24 Music has been integrated into the care offered to children and adolescents who
25 have a range of mental, emotional, behavioural and physical needs including, eating

1 disorders, post-traumatic stress disorder, cancer, terminal illnesses (for review see
2 Darnley-Smith et al. 2003) and also in the assessment of communication deficits of
3 ASD children, adolescents and young adults (Hillier et al. 2011; Wigram 1999). Hillier
4 et al. (2011) reported significant improvements in self-esteem, positive attitudes toward
5 peers and reductions in anxiety after an eight-week programme of 90-minute music
6 sessions with adolescent and young adults with ASD. Music is intuitively appealing
7 given the social interactions such encounters create through singing and musical
8 instruments (Geretsegger et al. 2014). This appears to be particularly true when music
9 instruction takes place as a group intervention (Hargreaves et al. 1997; Maschi et al.
10 2012). Sustained, long term behavioural and psychological improvements have also
11 been reported as a result of music therapy for ASD individuals specifically (Boso et al.
12 2007) particularly for those who have poor prosocial skills (Schellenberg et al. 2015).

13 Drumming could be regarded as particularly beneficial because of its; universal
14 appeal regardless of age, gender, culture, language competency and ethnicity; ability to
15 foster group identity through collective music making; accessibility to people of
16 multiple skill levels (Bittman et al. 2001; Stone 2005). In addition, rock drumming as
17 an activity is more physically demanding than playing other musical instruments
18 thereby offering a viable alternative to other high intensity physical activities (De La
19 Rue et al. 2013). Despite the wide spread adoption of music as therapy, the evidence
20 which informs the literature in the area is largely based on case-studies rather than
21 empirical examination. In addition, rock drumming, requires the gross motor
22 coordination of four limbs to create independent actions on separate elements of the
23 drum kit. To create a proficient performance, this coordinated movement also requires
24 temporal accuracy and therefore spatial awareness and attentional control.

1 The present study sought to explore whether rock drumming might benefit
2 children with emotional and behavioural difficulties (EBD) within a school setting. As
3 an exploratory pilot study, the aim was to systematically examine the influence of rock
4 drumming in terms of recognised measures of psychosocial and psychomotor skills
5 alongside ratings of drumming proficiency. Using a control group of matched (i.e.
6 attendance, age and gender) peers enabled examination of differences in the rate of
7 progression made across the five-week intervention. The inclusion of a matched EBD
8 Control group enabled examination of changes specific to the drumming intervention
9 rather than on-going educational attainment and maturation. Using a follow-up post-
10 intervention measurement permitted examination of potential short-term retention or
11 decrements in recently acquired drumming skills.

12

13 **Method**

14 *Participants*

15 Eighteen pupils (4 girls and 14 boys; aged 7 and 8) were recruited to take part in the
16 study from a single primary school in West Sussex. Nine children were identified as
17 having “emotional and behavioural difficulties” (EBD) based on the judgements of the
18 Special Educational Needs Co-ordinator (SENCO), head teacher and classroom
19 teachers. No formal diagnosis of a learning or emotional disorder had taken place for
20 these children either through clinical or educational health and care needs assessment.
21 Selection criteria used were existing, recorded, educational profiles of their strengths
22 and weaknesses (e.g., social, emotional and/or motor difficulties) and availability to
23 take part in the research project (i.e. regular school attendance and not in receipt of
24 other enrichment activities at the time of the intervention). These participants were
25 fully integrated into school classes where a classroom assistant was able to provide

1 additional support during standard lessons; no supplemental or concomitant curriculum
2 was provided to these participants. An additional nine children were recruited who had
3 no additional educational needs; they were selected based on being matched to the EBD
4 group for regular school attendance, age and gender. Each child was matched and
5 randomly assigned to one of two groups (i.e., drumming group and control group) based
6 on their EBD status (i.e., EBD Drum n=6, Peer Drum n=6, EBD Control n=3, Peer
7 Control n=3). The drum tutor was blinded to the education needs of each participant.
8 All children recruited to the study were novice drummers and had no involvement in
9 music outside of the sessions offered by the school.

10 Six staff agreed to be involved in a short follow-up interview to be conducted at
11 the conclusion of the intervention. The three classroom teachers whose pupils were
12 recruited for the study were interviewed to add further detail of changes to individual
13 participants. These teachers completed the Strengths and Difficulties Questionnaire for
14 each of their pupils involved in the study. They had no involvement in the intervention
15 and did not observe drumming sessions but were involved in the initial selection of
16 participants. A further three staff, namely, the head teacher, the SENCO and a
17 classroom assistant also participated in a follow-up interview to gain insight into the
18 feasibility of conducting such as intervention within the context of the school
19 environment. These three individuals periodically observed drumming sessions but had
20 no involvement beyond the initial recruitment of participants.

21 ***Procedure***

22 Ethical approval was sought and granted by the University Ethical Review
23 Committee prior to recruitment. Each selected pupil's parents/carers were contacted by
24 letter to attend an 'open meeting' to discuss the aims of the research project and the
25 nature of their child's involvement. After this meeting written consent from the child

1 and parent was collected. Teachers were then contacted and asked to complete an initial
2 SDQ for each of the pupils involved. The study consisted of three phases.

3 Prior to starting the drumming intervention pretest information was obtained for
4 each child. They completed the MABC-2 test battery for the evaluation of fine and
5 gross motor control and a drumming based skills test where each participant played a
6 set drumming pattern to evaluate degree of drumming motor control and rhythm.

7 Testing involved each participant rotating around 4 testing stations taking
8 approximately 20 minutes at each station, testing was staggered across the school day to
9 ensure sufficient rest between each phase of testing. Testing did not occur in the same
10 week as the drumming intervention to minimise disruption to the participant's
11 scheduled school activities.

12 The week after the last drumming lesson (posttest) and two weeks after this
13 (retention), all participants were retested on the drumming skills test (i.e. drumming
14 skills were assessed a total of three times). At the retention testing, participants also
15 completed the MABC-2 again and teachers were asked to complete a second SDQ for
16 each pupil (i.e. psychosocial and motor skills were assessed a total of two times).

17 Individual interviews were conducted with the staff, lasting between 30 and 40
18 minutes. A semi-structured interview format was employed to enable exploration of
19 similar topics regarding their opinions of the drumming intervention feasibility, their
20 experiences and observations regarding specific participants involved.

21 *Measures*

22 Each participant was given 16 drumming tasks to perform, ranging from simple
23 rhythmic patterns involving 2 limbs (i.e., left and right hand) to more complex
24 movements involving 4 limbs (i.e., left/right hand and left/right foot). Prior to the
25 pretest data collection, the drumming instructor was briefed that participants would be

1 assessed on drumming proficiency individually and consistent prompts and instructions
2 were to be used for all participants such as “ok” or “stop”. Drumming proficiency was
3 measured using four skills (i.e., *consistency*, *sticking*, *time and co-ordination*) all of
4 which were rated by the drumming tutor using video recording to aid recall and reduce
5 potential biases of *live* rating such as burden or environmental factors (Ryan et al.
6 1995). A percentage rating from 0 (i.e. unable to perform the skill) to 100 (i.e.
7 performed with expert proficiency) was used to rate individual proficiency on each skill.
8 *Consistency* was calculated from drumstick stroke height and velocity. *Sticking* was
9 measured by the ability to follow a specified order in which the hands were required to
10 play, such as right/left/right/left – known as ‘hand to hand’. *Keeping Time* was
11 established from the ability to not speed up or slow down in relation to playing the
12 required drumming pattern at a set tempo. *Coordination* was determined from the
13 ability to integrate hands and feet movements. An overall percentage score out of 100
14 was awarded for each of the 4 attributes of drumming performance for pretest, posttest
15 and retention testing.

16 A Roland HD-1 drum kit and PM-01 amplifier (Roland UK Ltd, Swansea,
17 Wales), using Vic Firth (Vic Firth, Boston, USA) 5A drumsticks was used for the
18 testing and drumming sessions. Each 30 minute drumming lesson comprised 6
19 participants and the same drum instructor.

20 Gross and fine motor skills were measured using the MABC-2 (Henderson et al.
21 2007). The MBAC-2 is a standardised performance test of age appropriate, motor skills.
22 The assessment battery 2 for 7-10 years was used. This measures three areas of motor
23 performance; manual dexterity (i.e., peg board, threading lace, drawing trail), aiming
24 and catching (i.e., two handed ball catch, throwing to target) and balance (i.e., one foot
25 on board, walking heel-to-toe, and hopping). The MABC-2 was administrated by the

1 same trained, researchers at both testing points using the recommended, standardised
2 instructions, testing order of measures and procedural corrections between formal trials.
3 One researcher administered all fine motor tasks and the other, all gross motor tasks.
4 The researchers were trained in task administration prior to the data collection with
5 performance evaluated against the MABC-2 manual instructions by the first author who
6 is an experienced test administrator, an agreement threshold of 90% was used (Lui et al.
7 2013). The measure has good test–retest reliability (Henderson et al. 2007) whilst the
8 original version has acceptable validity, evidence on version 2 is limited (Brown et al.
9 2009). Social behaviour was rated by the classroom teachers of the relevant pupils
10 using the Strengths and Difficulties Questionnaire (Goodman 1997). The SDQ consists
11 of 25 items which measure 5 subscales with 5 items for each subscale, *conduct*
12 *problems, hyperactivity, emotional symptoms, peer problems, and prosocial behaviour.*
13 Teachers are asked to rate the participant on certain behaviours using a three-point
14 Likert scale (i.e., not true, somewhat true or certainly true) in terms of the last 6 months
15 or the school year. An example item stem would be “Restless, overactive, cannot stay
16 still for long”. At the retention testing, held two weeks after the last drumming session,
17 teachers were asked to rate each participant in terms of their behaviour in the last two
18 weeks. Total scores for each subscale can be classified as normal, borderline or
19 abnormal.

20 ***Drumming Intervention***

21 The intervention phase consisted of 2, 30 minute drumming sessions per week,
22 held on 2 separate days, separated by 48 hours, for 5 weeks (i.e., a total of 10 sessions
23 or 5 hours of tuition). All sessions were held in the same, open access area of the
24 school during the afternoon study period.

1 Each drumming lesson comprised of 3 EBD Drum and 3 Peer Drum
2 participants. The drum tutor was not informed about the composition of each group of
3 6 participants he was required to teach. The 30 minute drumming lesson was divided
4 into three inter-relating sections. Section 1 was a 5-minute ‘warm up’ period comprising
5 simple ‘clapping’ and seated ‘marching’ rhythms. It also served as a refresher in terms
6 of gripping the drumsticks and orientation around the drum kit. Section 2 lasted 15
7 minutes where the drum tutor introduced new drumming patterns for the participants to
8 undertake. The rate of progression, in terms of complexity, during Section 2 was
9 tailored to the drumming ability of each group. Section 3 lasted 10 minutes where the
10 ‘learned’ drum patterns from Section 2 were performed alongside songs recorded by
11 popular artists of a similar tempo and rhythm.

12 ***Data Analysis***

13 A mixed methods, exploratory sequential (Creswell 2015) approach to
14 intervention evaluation was employed to examine the qualitative changes in social,
15 motor-control and drumming skill whilst an inductive, qualitative approach was used to
16 explore the perceptions of intervention efficacy from staff involved. Scores for the
17 drumming skills, MABC-2 and SDQ subscales were created and descriptive measures
18 for each reported. Non-parametric significance tests (Kruskall-Wallis and Mann-
19 Whitney U tests) were completed to see if there were significant differences in scores
20 for the measures. Each interviews with the staff members were conducted by the first
21 author, audio recorded and transcribed *verbatim* by an independent researcher, a
22 postgraduate psychology student. An inductive content analysis following the
23 procedures outlined by (Lune et al. 2016) was conducted separately by the independent
24 researcher and the first author. Quotations were identified and summarised to provide
25 initial codes with similar codes combined to form themes and subthemes where

1 appropriate. On completion of this coding process a final thematic diagram was made
2 to summarise the findings. The first author and independent researcher then met to
3 present their findings, agree labels for the themes and subthemes. Discrepancies were
4 resolved through discussion until agreement of identified themes was 100%.

5

6 **Results**

7 *Changes in drumming skills performance*

8 Changes in drumming skills were assessed across the three time points and examined
9 for differences between the drumming and control groups. From Figure 1 it can be seen
10 that on average, all groups improved on all four drumming skills from pretest to posttest
11 with on average, a small decline in performance at retention seen for some drumming
12 skills but not all. For the group of interest, the EBD Drum group, greater variability in
13 drumming performance can be observed by larger standard deviation values at the final
14 retention testing. The four elements of drumming were combined to generate an
15 average total drumming score at the three time points. Non-parametric, Kruskal-Wallis
16 significance tests were completed to see if there were significant differences in scores at
17 the three time points between the groups. Group differences in average drumming
18 scores were observed at the posttest ($\chi^2_{(3)} = 8.730, p = 0.033$) and retention testing ($\chi^2_{(3)}$
19 $= 9.451, p = 0.024$). Descriptively, the Peer Drum group performed better than the EBD
20 Drum and two control groups at the posttest and retention testing whereas the EBD
21 Drum group had higher scores than the EBD Control group at posttest and retention
22 testing. Post hoc Mann Whitney U tests revealed the only significant differences in
23 average drumming skill were between the Peer Drum group and the EBD Control group
24 at posttest ($U = 9.833, p = .034$) and retention ($U = 10.417, p = .034$) testing.

1 The differences observed were not statistically significant for the three aspects of
2 movement or for the total movement score.

3

4 [insert Figure 2 here]

5

6 ***Changes in social behaviour***

7 The classroom teachers of participants completed the Strengths and Difficulties
8 Questionnaire (SDQ) each individual, pretest and at the retention testing, two weeks
9 after the drumming lessons had finished. Change scores have been calculated, these
10 values have been averaged for each group and are depicted in Figure 3. The SDQ
11 change scores demonstrate that Total Difficulties (i.e., the aggregation of subscales)
12 reduced for all children except one group, the Peer Drum child (e.g., shown as a positive
13 value). As depicted in Figure 3, the largest reduction in SDQ subscales for the EBD
14 Drum group was in hyperactivity and peer problems, with modest gains in prosocial
15 behaviour. The EBD Control group followed a similar pattern but not to the same
16 magnitude. Significant differences were observed between the four groups for total
17 difficulties scores ($\chi^2_{(3)} = 8.210, p = 0.042$) and for hyperactivity ($\chi^2_{(3)} = 10.641, p =$
18 0.014), all other change scores were not significant. The EBD Drum group had
19 significantly greater reductions in their total difficulties score compared to the Peer
20 Drum group ($U = 8.833, p = 0.009$). In terms of hyperactivity change scores, the EBD
21 Drum group had significantly greater reductions than the Peer Drum ($U = 6.833, p =$
22 0.046) and EBD Control ($U = 8.147, p = 0.006$) groups.

23

24 [insert Figure 3]

25

1 ***Teaching Staff's Perspective: Follow-up Interviews***

2 The six members of staff interviewed all expressed enthusiasm towards the
3 project and willingness for the school to be involved. Three themes to emerge from the
4 interviews with staff concerned the benefits to the school, these have been coded as (1)
5 reflecting the values of the school (2) intervention novelty (3) intervention feasibility.
6 In addition, staff also reflected on the benefits of the intervention to the EBD involved,
7 two themes emerged and have been coded as (1) improved confidence and
8 communication skills (2) improvements of attentional focus and delay of gratification.

9 *Reflecting the values of the school*

10 The staff interviewed were very positive about being involved in the project.
11 All expressed interest in finding out the results from the study as well as being involved
12 in follow-up work. “Because we are a school that takes on new initiatives and we never
13 stand still.... That’s got to be positive for the school and positive for the children
14 involved [pause] so happy to take part.” (Classroom Teacher 2)

15 *Novelty*

16 There appeared to be a general curiosity factor because of the novelty of
17 rock drumming and so staff members were interested in getting involved. In
18 particular the concept of working with children with educational and social needs
19 was appealing to the teachers. “We’ve just enjoyed being part of something for
20 the future really and hopefully it will lead to great things.” (Classroom Teacher 2)

21 *Feasibility of Intervention*

22 The classroom teachers shared their observations on how the project had
23 influenced class dynamics. All three teachers expressed the view that the withdrawal of
24 children from class had no detrimental effect to either the specific children involved,
25 class peers or to the management of the class. It was felt that the sequencing of the

1 drumming classes in the afternoon seemed to complement the structure of the school
2 timetable. A further observation from one teacher was that the children had the
3 opportunity to be in a group with children who they would ordinarily have limited
4 contact with. Children are normally grouped by ability for small group work and so it
5 was felt that the opportunity to work in a small group of mixed ability was good for
6 class cohesion.

7 *Perceived benefits for EBD children*

8 “Going in and out and watching it progress over the weeks you could see the utter
9 enjoyment that the children were experiencing... you could see the benefits they were
10 getting from that” (Head Teacher). When asked about the changes in the behaviour of
11 those involved in the drumming project, class teachers explained that the differences
12 observed were very specific and dependent upon the particular difficulties of each child.
13 In general the themes of increased confidence and communication skills and enhanced
14 attentional focus and delayed gratification were commonly cited.

15 *Improved confidence and communication skills*

16 Teachers described observing increased confidence displayed by EBD
17 pupils in relation to their interactions with school staff.

18 [EBD Drum] has blown everybody really.... his functioning is way below
19 reception children with very poor speech and language and very poor
20 understanding of safety.... I don't know whether it's a combination of
21 things, or whether it's one particular thing, one of which could be the
22 drumming or whether it's just coincidence. His confidence is now just
23 great.... we've got our class assembly on Friday in front of the whole school
24 and all the parents, and he's speaking. And he's never stood up and spoken
25 before in front of a huge audience.” (Classroom Teacher 1)

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“[EBD Drum] has been getting gradually more confident throughout the year and that’s a progressive thing, I’m sure the drumming has been another opportunity to help her grow in confidence. She is quite ... a musical person anyway, so I think it [the drumming] has helped her to develop her rhythm a bit more.” (Classroom Teacher 3)

Social competence in the EBD Drum children consistently emerged from the interviews. They seem better equipped to interact with adults in particular and articulate their needs.

Improvements of attentional focus and delay of gratification

One teacher did observe a difference in the behaviours of certain children in the EBD Drum group attributed to idiosyncrasies of their particular needs.

“it was like any other day of the week because [pause] they [Peer Drum] managed their emotions in a far better way, the excitement and enthusiasm was tempered ‘*oh it’s drumming today*’. [EBD Drum] it would be from the moment they would come in [in the morning] ‘*when is it, when is it, when is it*’ because the concept of time is so difficult for them. Someone like [EBD Drum] who is a very low level boy, it would be ‘*have I got to wait before it goes dark again before I go, is it another sleep before I go?*’ So those children, who have some obsessive behaviour, were enhanced because they knew it was that day and it was for them and they were going to do it.”

(Classroom Teacher 1)

1 In terms of the comparison group, the teachers were unable to pinpoint any
2 noticeable changes in ability or temperament over the 5 weeks but remarked that all
3 involved had enjoyed the sessions. Classroom Teacher 3 described how these children
4 had enjoyed being selected for the activity. This would suggest that there was a certain
5 degree of feeling pride at selection for involvement perhaps due to the novelty of
6 drumming.

7 “[Peer Drum] was his usual, excitable self really [pause] generally seemed
8 to have enjoyed it and responded to it, like he does everything, put 100%
9 in.” (Classroom Teacher 3)

10

11

12 **Discussion**

13 The objective of this exploratory pilot study was to assess the potential psychosocial
14 and psychomotor benefits of a drumming intervention for children with emotional and
15 behavioural difficulties within the school environment. A secondary aim was to assess
16 the feasibility of offering drumming instruction within the school day rather than as an
17 extra-curricular activity. A mixed methods approach was used to compliment the
18 exploratory nature of this pilot study to gain qualitative insight from staff alongside
19 their perceived ratings of psychosocial behaviour and the performance data from the
20 participants. The authors acknowledge the small sample size and therefore inferences
21 drawn from the data collected should be interpreted with caution. The inclusion criteria
22 for the study were developed with the school staff to reflect the manner in which school
23 staff would identify children to benefit from timetabled, enrichment activities during the
24 school year. The definition of emotional and behavioural difficulties was chosen to

1 reflect the behavioural deficits children present with and prior to potential formal health
2 and care assessment that may prompt a clinical diagnosis.

3 Whilst the benefits observed in the EBD drumming group are not dramatic, they
4 should be considered in comparison to the changes observed for those who did not
5 receive drumming lessons. In terms of drumming skills, it is evident that all groups
6 improved from pretest to posttest suggesting a learning effect for this novel task. There
7 was no significant drop in performance at the retention testing but there was greater
8 variability within each group. An examination of the posttest performance revealed that
9 the peer drumming group performed better than the EBD control for three of the four
10 skills and in terms of the total measure. Differences at retention again observed
11 between the peer drummers and the EBD control groups but for the skill of sticking and
12 the total measure. This may not appear statistically significant given the small sample
13 size but reflects a meaningful improvement in performance that in real terms would not
14 distinguish them from their peers. The inability to detect change between groups (i.e.,
15 drumming instruction versus control) may suggest that the method of scoring drumming
16 performance in this study requires further refinement. It is feasible that an impartial,
17 blinded (i.e., to the study design and participant allocation) tutor would have provided
18 inter-rater reliability (McHugh 2012). Adopting objective metrics of drumming such as
19 those employed in the Amad et al. (2016) rock drumming study would provide a more
20 sophisticated measure and remove the issue of rater bias.

21 The MABC-2 was used as an objective measure of movement competence to
22 explore if there was a transfer of the motor skills learned in drumming to wider motor
23 skills (i.e., in particular manual dexterity). Rock drumming involves the control and
24 coordination of four limbs and therefore may transfer beyond fine motor skills to gross
25 motor coordination skills. Whilst there were no significant differences in the change in

1 MABC-2 scores, there were observable improvements with both EBD groups making
2 greater gains in the short time frame than the matched peers for some but not all skills.
3 Possible reasons for this may relate to the low initial starting point of the EBD pupils
4 and their ability to respond to activities leading to an increase in motor skills. This
5 could be attributable to drumming or exposure to activities being undertaken across the
6 school curriculum. Positively, the EBD children narrowed the gap in terms of motor
7 skills to their peers. Again the choice of the MABC-2 may be examined further to see if
8 it allows for the potential benefits of drumming to general motor skills. An inspection
9 of Figure 3 also reveals greater within group change when compared to the other groups
10 (i.e. the size of the boxplots for this group). Case notes from the researchers involved in
11 data collection did suggest that at the second testing, the EBD children appeared to be
12 less timid and careful in their approach to the activities. These children were not as
13 concerned about making mistakes and displayed a greater 'gusto' when the tests began.
14 This difference in attitude demonstrates the complexity of competence testing as it
15 inadvertently measures the process as well as the product. During the parental
16 debriefing, one parent remarked that they had noticed that their child (EBD Drum) had
17 shown improvement in dexterity and strength in holding a pen in order to complete
18 homework as the intervention progressed. Therefore measures of grip strength may be a
19 useful measure to be included in any future studies.

20 Perhaps the most consistent findings were the SDQ results and the supporting
21 qualitative comments made by the teachers and support staff. Significant, positive
22 changes in hyperactivity and total difficulties were observed for the EBD Drum group
23 in comparison to the other groups. Teachers described positive changes in the
24 attentional control and delayed gratification of those EBD children who had participated
25 in the drumming. Children learn to control their immediate needs through effort control

1 but this is often reported as deficient in children with ASD (Faja et al. 2013). There
2 were also descriptive positive changes in peer problems and prosocial scores. These
3 findings are corroborated by the views of the classroom teachers who discussed the
4 confidence, enthusiasm and social engagement of the pupils involved. The teachers
5 viewed the drumming intervention as enabling those children with EBD to become
6 more vocal and seek to communicate with teachers and support staff in a positive way
7 that had not previously been undertaken. An examination of the film footage of the
8 drumming sessions clearly demonstrated the social nature of group drumming described
9 by Hargreaves et al. (1997). The children responded positively to the music selection,
10 the tutor's instruction and feedback and to the presence and encouragement of the other
11 group members. The positive changes in social and behavioural skills observed by
12 teachers is similar to that reported by other researchers for different music modalities
13 (Boso et al. 2007; Geretsegger et al. 2014; Hargreaves et al. 1997; Schellenberg et al.
14 2015).

15 The study employed a small sample size and therefore inferences drawn from the
16 results of the study should be done with caution. There is a need for a larger, replication
17 of the study with consideration given to the selection of measures used to assess
18 intervention effectiveness. The measure MABC-2 was used to assess the transfer of
19 drumming to standardised tests of gross and fine motor skills. The challenge of using
20 standardised measures to assess change is that they may fail to capture the diversity and
21 meaningful change that occur with EBDs participants. Spooner et al. (2015) discussed
22 the need for more studies with specialist groups but acknowledge the difficulty
23 researchers face in demonstrating learning or communication breakthroughs. The use
24 of the SDQ and the teacher interviews provided greater scope to capture such small and
25 idiosyncratic changes. The design of this study means that it cannot be determined

1 whether these changes are specifically due to drumming or whether learning a different
2 novel skill would have similar effects. Ideally, a future study would include, not only a
3 control group that can enable determination of change over and above maturation, but
4 also an alternative intervention group which would address if change has occurred
5 dependent upon the enrichment activity undertaken. This type of design does not
6 however control for participant reactivity or the Hawthorne Effect (Paradis et al. 2017).
7 The changes observed may have arisen as a result of selection to the drumming
8 intervention or the staff's enthusiasm for the objectives of the study. Future research
9 should consider if more embedded and observational methods would counter the
10 potential influence of reactivity, manipulation or deception. In relation to this issue is
11 one of participant recruitment. In this pilot study, to control for the amount of
12 drumming instruction delivered, it was decided to select participants with a good
13 attendance record. This pragmatic decision has a consequence of exclusion of potential
14 participants who may have presented with greater emotional, behavioural and
15 educational difficulties. Sinclair et al. (2005) reported that EBD adolescents are at
16 greater risk of poor attendance and consequently non-completion of formal education
17 than typically developing peers.

18 The constellation of disorders and symptoms clustered under the term EBDs
19 appear to be more common in boys than in girls (Mitchell et al. 2007). The demands
20 presented by EBD boys may be distinct to their female peers. They appear to be more
21 prone to hyperactivity in the classroom, and find gross and fine motor movements
22 challenging. This can consequently lead them to engage in seeming anti-social displays
23 of frustration, more so than their female peers (Berk 2013; Lune et al. 2016). In future
24 studies, researchers need to consider gender in terms of the design and sample
25 composition but perhaps also in terms of the outcome variables measured.

1 *Applications to Habilitation*

2 A secondary aim of this study was to assess the feasibility of such interventions
3 within the school working life. School staff interviewed were very positive regarding
4 the intervention and indicated that it was feasible in terms of future delivery within the
5 school curriculum. In terms of the tutor, timing of the sessions, location and the number
6 of sessions, the staff felt that the right balance had been struck. During study planning,
7 the research team and the teachers were concerned about potential disruption that might
8 be caused to EBD children who used the open access space for specialised teaching and
9 therapy. Despite initial reservations regarding potential disruption, the mere presence of
10 the drumming sessions led to an observable change in one child's behaviour, a child
11 who had not participated in the study:

12 “She's so nervous and doesn't like change, typical autistic child, and it's
13 taken ages for her to get used to noise in the hall you know.... She wanted
14 to have a go and wasn't frightened of it.” (SENCO)

15

16 *Conclusions*

17 To assess the impact of the drumming intervention upon pupil's psychosocial and
18 psycho-motor skills, this pilot study used a number of established measures from the
19 developmental psychology literature. In terms of observable differences, the most
20 notable changes were in regards to psychosocial skills. A reduction in hyperactivity and
21 peer problems, with modest gains in prosocial behaviour, were evident following the
22 five week drumming intervention. These findings were supported by the teacher's
23 observations. A secondary aim of the study was to assess the feasibility of conducting
24 such an intervention within the normal working practices of a school. The
25 overwhelming opinion of the staff interviewed was that the 5 week drumming

1 programme, comprising two 30-minute lessons, was deliverable and complemented
 2 rather than detracted from the ongoing enrichment activities of the school. As part of
 3 the research team’s reflections, further consideration and refinement of the measures
 4 selected to evaluate impact is required. Further consideration regarding the optimal
 5 assessment of drumming performance is needed; possibly using competency ratings
 6 accrued over the intervention period, rather than demonstration of ability at one-single
 7 time point. Inclusion of other measures, such as grip strength in light of comments
 8 passed by a parent and the inclusion of parental ratings of their child’s behaviour may
 9 yield further insights. Research conducted in the school environment is a working
 10 collaboration between researchers, staff and parents and without this buy-in valuable
 11 insights will be missed and progress impeded.

12

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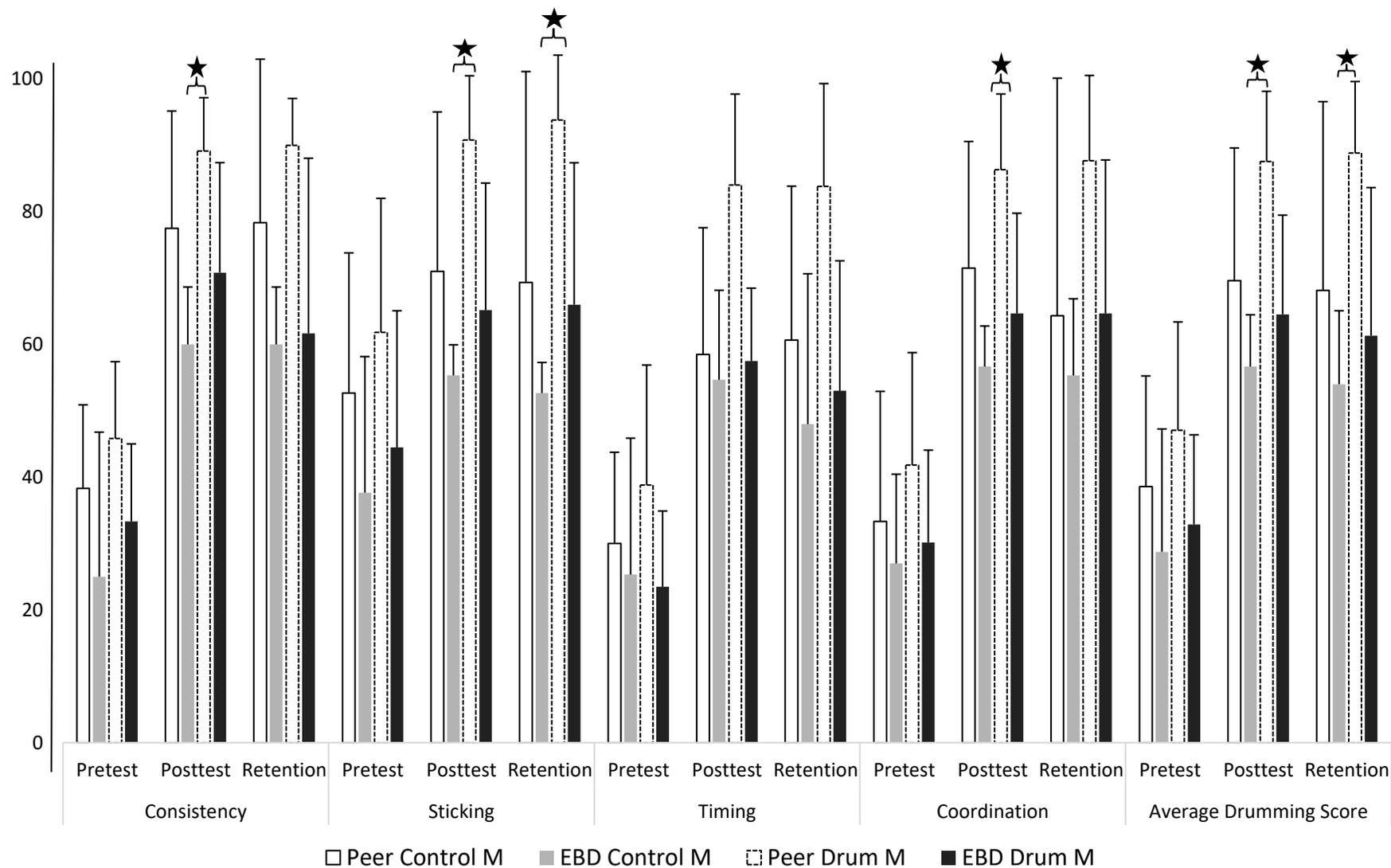


Figure 1. Pretest, Posttest and Retention Drumming Performance Scores for participants in the drumming intervention and control conditions. Significant non-parametric paired comparisons are denoted by a ★.

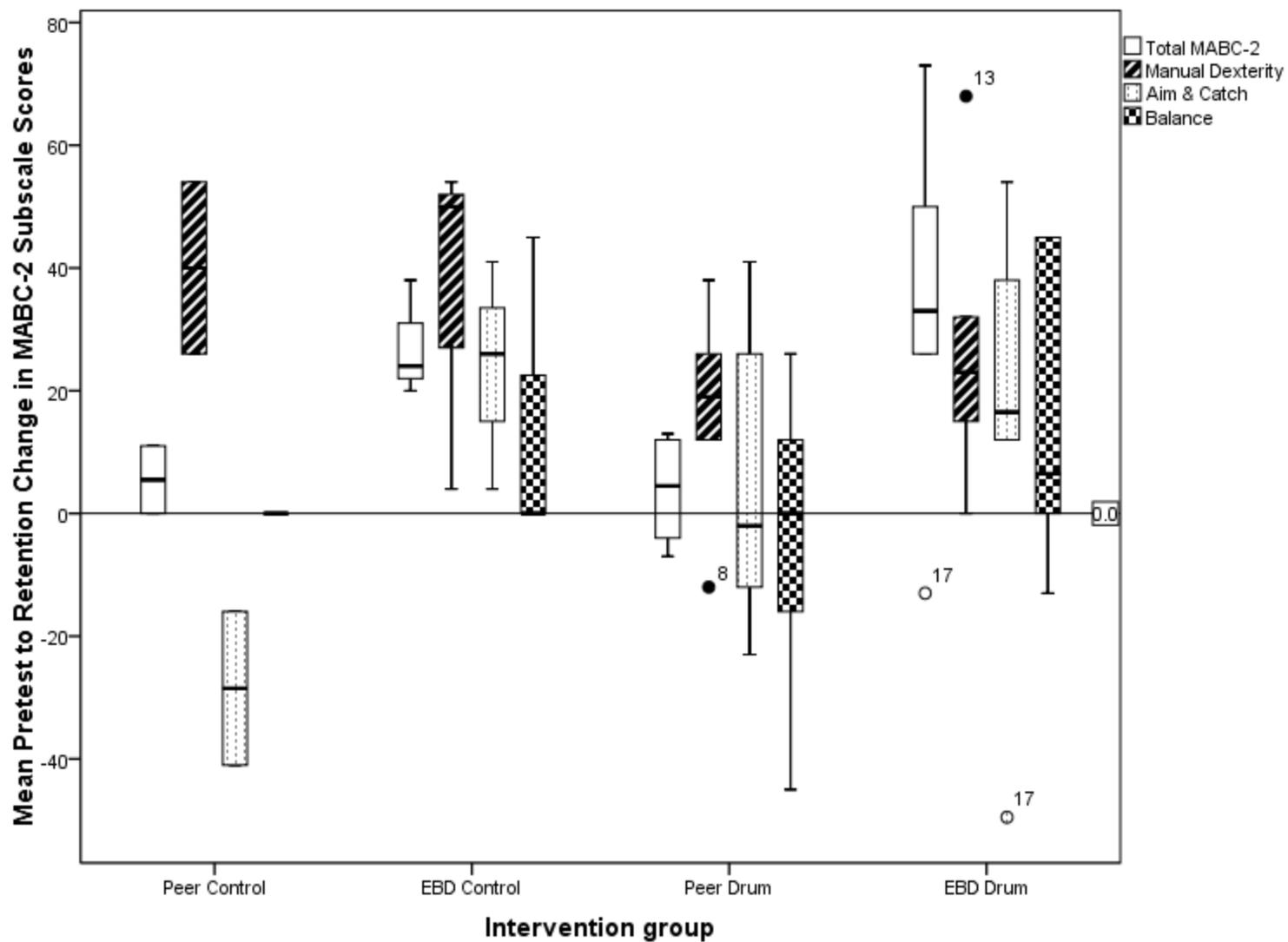


Figure 2. Pretest to Retention changes in MABC-2 subscale scores for participants in the drumming intervention and control conditions.

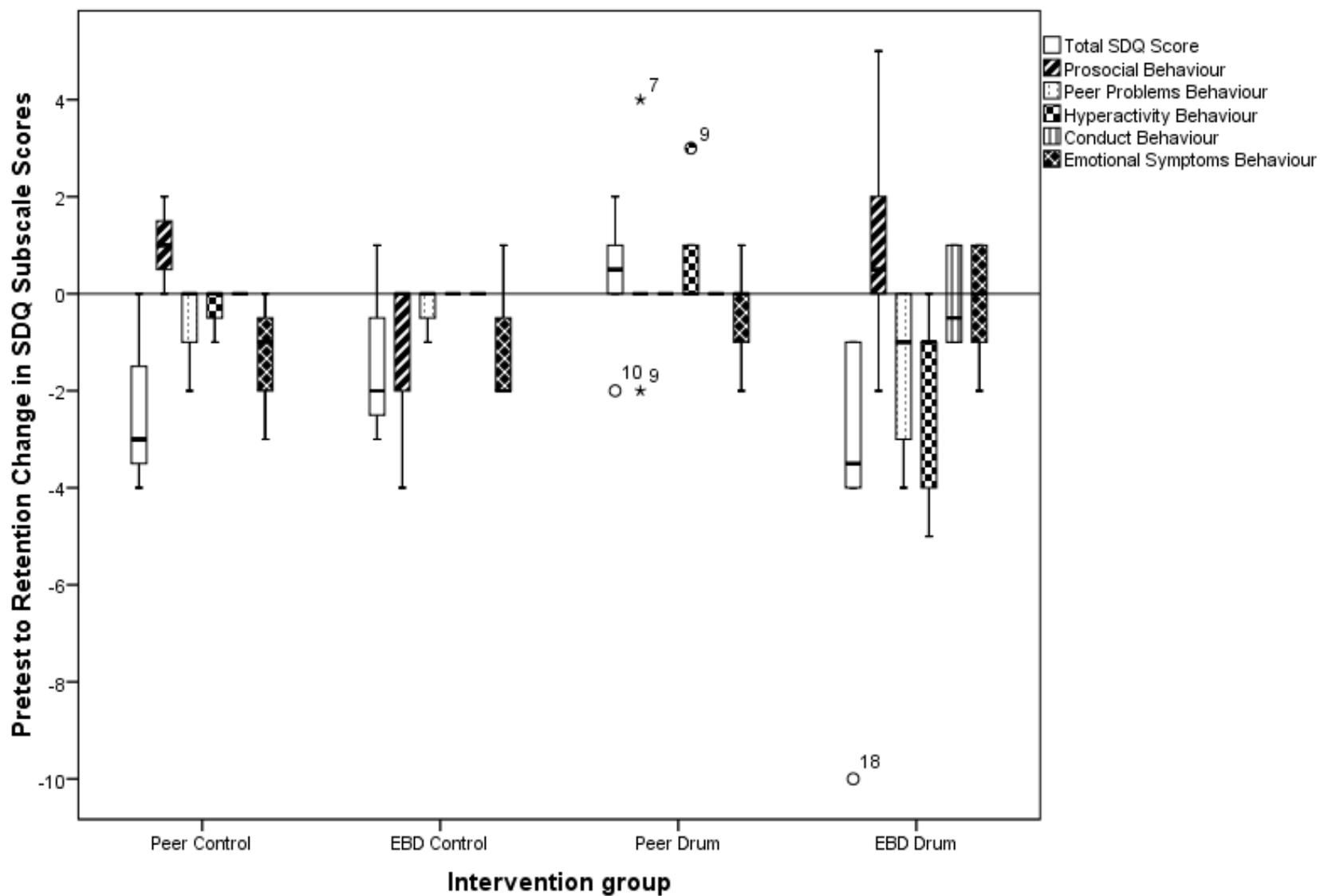


Figure 3. Pretest to Retention change in teacher ratings of SDQ test scores for participants in the drumming intervention and control conditions.