Giant Steps Sydney and CHAMP Private Equity

Xylophone Project 2012

“Can the use of tuned percussion in an ensemble increase the development of socialisation skills in children and young people with autism spectrum disorder?”

Abstract
It is well established in the literature that music making can be a highly preferred activity for individuals with autism. Current research also suggests that music, as a multi-modal activity engaging regions of the brain overlapping with the human mirror neuron system, may have great potential for this population. Studies confirm that children show high levels of social engagement and communication in the music therapy setting. Recent studies also indicate that while children with autism can have difficulty attending to stimuli on demand, they show excellent attention to desired stimuli. They also found that there were difficulties in orienting when the cue was social, but not when the cue was non-social. This suggests that the use of desired stimuli (tuned percussion and music) is playing to a strength of autism, whilst playing in a socially-cued ensemble is focusing on a core deficit. This paper aims to combine the use of motivating resources and activities, with tracking the gradual social progress of students with moderate-severe autism and intellectual disability.

Introduction
In 2011, Giant Steps Sydney applied for a funding grant to CHAMP Equity, with the aim of setting up a program for students using tuned percussion instruments. The reasoning for using tuned percussion was to provide motivating opportunities to work on the social foundation skills in an ensemble format. An assessment tool was developed, outlining the specific music and social skills addressed in sessions, and students were assessed at the beginning of the 40-week program, and at the conclusion. 56 students aged 4-17 were included in the research, all with a primary diagnosis of moderate-severe autism. The program was implemented by a team of four Registered Music Therapists as part of the regular music therapy program delivered to all students across the school.

Music Therapy has been an integral part of the Giant Steps program since its inception, therefore the school enjoys a strong musical culture at every level and stage of the day. Active and receptive music have long been used at the school to encourage positive social interactions with others and to enhance the curriculum content. The team of four music therapists work collaboratively with teachers, speech therapists and occupational therapists in order to focus on both individual and group outcomes for students.

1 From Music Making to Speaking: Engaging the Mirror Neuron System in Autism - Catherine Y. Wana, Krystal Demainea, Lauryn Zipsea,b, Andrea Norton, and Gottfried Schlauga, April 2010
For this project, the music therapy team developed an assessment scale directly targeting the social and musical skills required to participate in a group ensemble format. Over the course of the 40 weeks, the aims of the program were:

- To increase participation and social awareness through group music making
- To further develop student skills in the areas of imitation, joint attention, turn-taking, adjusting behaviour to coordinate with others, social referencing and taking direction from a group leader

**Literature Review**

In reviewing the research literature, it was found that the use of music therapy and music interventions with individuals with autism was well justified. Music has been shown to activate cortical reward centers and children with ASD have been suggested/shown to be uniquely attracted to music. In a randomised, controlled study, it was highlighted that “other studies report that autistic children not only perform poorly on imitation tasks, but that they do not alternate the roles of initiation and imitation in turn-taking readily.” They also found that improvisational music therapy was more effective at facilitating joint attention behaviours, non-verbal social communication skills, and more and lengthier events of eye contact and turn-taking.

In regards to the specific use of tuned percussion in music therapy programs, Hollander and Juhrs found that autistic children responded well to an Orff approach because of its emphasis on rhythmic speech and movement and its capacity for motivating group participation. Dorita Berger also wrote that “the playing of designated tones on the metallophone or xylophone required visual attention and eye-hand coordination. It therefore contributes important visual and physical feedforward and feedback planning information to the brain.”

When comparing Improvisational Music Therapy with play sessions, Kim, Wigram & Gold found that children with ASD demonstrated more instances of emotional expression and social engagement when in music therapy sessions than in play sessions. Furthermore, when the music therapist placed demands on the child (using a directive style), the children’s response rate increased. Perhaps the most interesting finding was that the children were more responsive to directives when in music than in play. Leading an ensemble requires a music therapist to be directive at times, and this backs up the use of both child-directed and therapist-directed styles of intervention.

A controlled research study by Edgerton supported the claim that improvisational music therapy can increase autistic children’s communicative behaviours, and suggested that generalisation of skills to other settings does occur. Finally, a review completed by Sanders et al. looking at studies on attention function, cognitive flexibility, and inhibition found that while children with autism can have difficulty attending to stimuli on demand, they show excellent attention to desired stimuli. They also found that there were difficulties in orienting when the cue was social, but not when the cue was

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2 “Intensely pleasurable responses to music correlate with activity in brain regions implicated in reward and emotion” - Blood and Zatorre, 2001
5 “Music Therapy, Sensory Integration and the Autistic Child” - Dorita Berger; JKP (2002)
6 “Emotional, motivational and interpersonal responsiveness of children with autism in improvisational music therapy” - Kim, Wigram, & Gold (2009)
non-social. This suggests that the used of desired stimuli (tuned percussion and music) is playing to a strength of autism, whilst introducing the format of a directed ensemble is focusing on a core deficit of autism in a motivating context.

**Social Foundation Skills**
Social foundation skills are the building blocks for expressive and receptive communication development. They include the areas of social orienting, imitating, emotional awareness and regulation, joint attention and turn taking interactions. These skills underpin the program at Giant Steps across all settings and contexts.

- **Social Orienting** - Showing awareness and giving attention to others demonstrated by changing one’s facial expression, gazing at or turning one’s body/ head towards another person.
- **Imitation and Joint Action with Others** - Joint actions involve moving in unison with other people and imitation involves copying others. Both may involve actions with and without objects.
- **Regulating Behaviour to Coordinate with Others** - Doing something in a certain way which includes starting and stopping with others as well adjusting the speed, loudness size and shape of one’s actions so as to maintain a partnership with another person.
- **Emotional Attunement and Regulation** - The experience, expression and adjustment of internal feelings and emotions in response to situations
- **Joint Attention** - Connecting with others while observing the same object/event so as to share the experience
- **Turn Taking Interactions** - Connecting with another person in a patterned way that involves attending, waiting, anticipating and responding, based upon what each person does in an interaction

**Materials and Method**
Baseline assessment data was taken over Weeks 1-2 in Term 1, 2012, and post-assessment data taken in Weeks 38-40, 2012. 59 students across the school participated in the project, accounting for 84% of the school population. Sessions took place in one of two music therapy rooms, each equipped with tuned and untuned percussion instruments. A music therapist facilitated the sessions, with the assistance of educator staff to support students as minimally as possible.

The first 3 sessions consisted of each student being introduced to the bass xylophone (Week 1), the alto xylophone (Week 2) and the soprano xylophone (Week 3). For each instrument, students were invited to explore the instrument on their own and alongside or face-to-face with the music therapist. They were shown various ways to create sound on the instrument, how to hold and manipulate the mallets, and encouraged to share their experience with the other person through social referencing, playing in turns and playing together.

An ensemble group consisted of 2-7 participants, depending on the number of students in the group and level of support required for each student.

Research has shown that simple music with clear and predictable patterns is most effective in eliciting responses to bids for joint attention in children with autism in the severe range of functioning. Based on this premise, the following activities were included:

- improvisation and experimenting with different tones and sounds on each instrument
- learning short rhythmic and melodic phrases to match a song

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- splitting the group into sections by type of xylophone and following the group to play the 'low, middle, high' song
- taking of certain keys to make the learning of ostinato rhythms more achievable for students who could not differentiate easily between keys
- playing familiar songs by taking turns with another, playing together, and varying the volume and speed
- playing along with recorded music in the same key as the selected xylophone notes

<table>
<thead>
<tr>
<th>Music Therapy Outcomes</th>
<th>Achieved</th>
</tr>
</thead>
<tbody>
<tr>
<td>MT1 Sits or stands, orienting to instrument</td>
<td>0 1 2 3</td>
</tr>
<tr>
<td>MT2 Holds two mallets correctly</td>
<td>0 1 2 3</td>
</tr>
<tr>
<td>MT3 Uses mallets to create sound on instrument</td>
<td>0 1 2 3</td>
</tr>
<tr>
<td>MT4 Imitates partner's way of playing</td>
<td>0 1 2 3</td>
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<tr>
<td>MT5 Follows group leader to start and stop</td>
<td>0 1 2 3</td>
</tr>
<tr>
<td>MT6 Follows group leader to play faster</td>
<td>0 1 2 3</td>
</tr>
<tr>
<td>MT7 Follows group leader to play slower</td>
<td>0 1 2 3</td>
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<tr>
<td>MT8 Follows group leader to play louder</td>
<td>0 1 2 3</td>
</tr>
<tr>
<td>MT9 Follows group leader to play softer</td>
<td>0 1 2 3</td>
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<tr>
<td>MT10 Sings and plays simultaneously</td>
<td>0 1 2 3</td>
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<tr>
<td>MT11 Follows group leader to maintain beat</td>
<td>0 1 2 3</td>
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<tr>
<td>MT12 Imitates rhythm of a modelled pattern</td>
<td>0 1 2 3</td>
</tr>
<tr>
<td>MT13 Imitates pitch of a modelled pattern</td>
<td>0 1 2 3</td>
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<tr>
<td>MT14 Holds a drone independently</td>
<td>0 1 2 3</td>
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<tr>
<td>MT15 Holds an ostinato independently</td>
<td>0 1 2 3</td>
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<tr>
<td>MT16 Holds a different part alongside another</td>
<td>0 1 2 3</td>
</tr>
<tr>
<td>MT17 Holds a different part independently</td>
<td>0 1 2 3</td>
</tr>
<tr>
<td>MT18 Can change from ostinato to solo improvisation</td>
<td>0 1 2 3</td>
</tr>
</tbody>
</table>

Results
The data collected from pre and post assessments was collated, with individual outcomes being compared against grade and school average outcomes. For the pre assessment, only outcomes 1-8 were measured, as students had no prior experience of activities addressing outcomes 9-18 and without the necessary skills acquired, could not participate in these until later in the program.
Case Example 1
Challenges
‘Alice’ was 16 years old at the commencement of the project and in Year 10 in the Secondary program. She attended music therapy sessions along with 4 other peers and 2 support staff. Alice struggles with tasks involving fine motor control, and disengaging attention to preferred stimuli and activities. She is very socially aware and interested in imitating other people, however she can have difficulty with imitating more detailed movements and keeping time with a beat.

Alice showed immediate interest in the large xylophones and was keen to play the instruments both individually and as part of the ensemble. She scored 1 for ‘Holds two mallets correctly’ at the pre-assessment, requiring full touch prompting to position the mallets correctly and to keep a steady controlled hold on them whilst playing. She was keen to play, but was unable to give attention to both her instrument and the group leader at the outset, finding it difficult to disengage with playing when the leader cued the group to ‘stop’, scoring a 1 for ‘Follows group leader to start and stop’. Additionally, she was unable to imitate finer details of style, scoring a 1 for ‘Follows group leader to play softer’, but enjoyed attempting imitation of other larger movements without playing precise keys on the xylophone.

Program
In order to improve Alice’s grasp on the mallets, each session would see an adult showing her how to hold them, and giving touch support where needed. Over the weeks, staff gradually faded this support and only provided touch support where needed. By the end of the program she scored a 3 for ‘Holds two mallets correctly’, with only a rare reminder via model to reposition where necessary. In learning to follow ‘stop’ and ‘go’ cues from the group leader, some adjustments were made to make the attention to two sources easier. This involved the music therapist positioning herself down low in the middle of the group and moving around on a low chair with wheels. By positioning herself at eye level and xylophone level, this reduced the distance between the two areas of focus, enabling the shift of focus to be easier. As the weeks progressed, the music therapist gradually moved further
away from student eye level to increase the distance between focus areas. Large gesture cues were offered, and most importantly, something to do with the mallets when not playing ie. Cross the mallets over each other, as the natural urge was to go back to playing if there was nothing else to do after the ‘stop’ cue. At the conclusion of the project Alice scored a 3 on ‘Follows group leader to start and stop’. Alongside this gain was an improvement in the ability to imitate finer movements, including the ability to adjust pressure and play softly. Originally this was modelled on her instrument with exaggerated facial expression and the chant ‘playing soft, little taps’ as she appeared to show comprehension of what this meant and began to follow suit in her style of playing. Again, the music therapist gradually faded these cues and expected students to imitate her style from simpler gestures and from a greater distance away. At the conclusion, Alice scored a 2 for ‘Follows group leader to play softer’, as she still required modelling and occasional support from staff seated next to her.

**Result**
The gains for Alice during the project have shown that whilst she was already a highly socially aware person, she stood to gain some skills important to participating in group activities. Being able to grasp and manipulate mallets means that she can access a wider range of instruments to play and enjoy greater confidence in her ability to produce music in different settings. Being able to shift attention between preferred objects/activities and cues from a group leader is an important skill for anyone participating in group learning and being able to imitate finer movements has the potential to make activities such as post-school dance classes more accessible and enjoyable in the long-term.

**Case Example 2**
**Challenges**
At the beginning of 2012, ‘Adam’ was 6 years old and attended music therapy sessions three times a week with 3 of his peers and 2 support staff. He was involved in the Xylophone Project during one of these weekly sessions and participated in it for all 40 weeks. As an introduction to this project, he was asked to explore various ways of playing the bass xylophone individually alongside the music therapist (MT). In order to enable Adam to play with the music therapist more harmoniously, some of the keys were removed to create a pentatonic improvisation. Initially, he played the instrument correctly and was very motivated to participate as he held the two mallets correctly and hit the keys bilaterally. After a brief period of time (once he had noticed where the keys had been removed from) he became preoccupied with the holes where the keys used to be. He began to coast the mallets across the keys and post them into the holes. With this physical action came the verbalisation “see you later matey” along with other echolalic phrases as the mallets disappeared into the body of the xylophone. Once this repetitive behaviour became a part of Adam’s experience it was very difficult to discontinue it and it consequently catalysed the conclusion of his initial interaction with the xylophone.

The next opportunity that Adam had with the xylophone was in a group improvisation with his peers. The music therapist was playing the guitar and his peers were playing a combination of metallophones, bass, alto and soprano xylophones. During this session Adam was again preoccupied with the echolalia that he had established during the individual session on the bass xylophone. This time, none of the keys were removed, so instead of posting the mallets into the holes in the body of the xylophone, Adam allowed them to fall off the side of the xylophone and onto the floor instead. During this session, he also flapped his arms and ran on the spot when the music became faster. At the height of his excitement his movement accelerated to the point where he would vocalise and throw the sticks into the air. Needless to say, it was very difficult to keep him on task and playing the instrument appropriately for him was a challenge.
Program

As a result of this behaviour, it appeared that Adam needed some individual attention and structure to firstly stay on task and eventually to play a song on the xylophone with his peers. With this in mind, it was decided to do some individual improvisation sessions opposite him on a number of different xylophones without taking any of the keys off. The intention with this strategy was to give him the tools to self-regulate playing loud and fast without becoming over aroused, throwing the sticks into the air and running away. A staff member sat with him to support him at this time. When he started to run on the spot in his seat, the staff member would intervene with partial physical support on his hands to allow him to experience the proprioceptive memory of playing loud or fast without having a physical ‘explosion’. This process was slow but with repetition over many weeks this behaviour was eventually reduced and he was increasingly able to stay on task for a short improvisation.

As Adam became more accustomed to and confident with the expectations surrounding playing the xylophone, it was decided to create a visual note book to enable him and his peers to learn a musical pattern that could be over learnt with a familiar song. ‘Ram Sam Sam’ was the song that was chosen as it had a simple three chord structure and a definite rhythmic base with which to create a repetitive pattern. It also had a noticeable change within the song that could accommodate for playing fast, slow, loud, soft, and for stopping and regulating a beat to coordinate with others. Adam participated in this activity very enthusiastically. He engaged individually with both a staff member holding the visual note book to the song near him and the music therapist playing the song opposite him. He referenced the book intermittently and endeavoured to imitate the music therapist’s way of playing. As this exercise was an extension of what Adam had already experienced but in a more structured format, he still needed assistance in handling his mallets appropriately when the volume and tempo of the music changed. Partial physical support was again required to keep him regulated and contained during the more animated sections of the piece. After Adam had made some progress in this area, he played ‘Ram Sam Sam’ alongside another peer who was also playing the xylophone opposite an adult. Eventually, the whole class played this piece together. This project culminated in a group performance by the class at the end of the year in the annual Family and Friends Festival. Adam was able to play the piece independently with the group without displaying any behaviour of dysregulation.

Result

From Adam’s assessment data, he made significant gains in holding two mallets correctly, imitating a partner’s way of playing, following a group leader to start and stop, and playing slower and softer. He scored a point lower in the post assessment regarding following a group leader to play louder (even though there was a general improvement) as on the day of his assessment he was unable to perform this skill consistently without becoming dysregulated.

Even though the improvement in Adam’s abilities is attributed to his participation in the Xylophone Project, he now has the opportunity to generalise these skills across other areas. There are many other instruments that he can now play with mallets e.g. steel drum and drum kit. He is also extending his repertoire on the xylophone and has since learnt songs like Tingalao and Coconut Woman. This project has opened up his world a little bit wider.

Case Example 3

Challenges

‘Jake’ was an 11 year old boy at the start of the project and in Middle School. He attended music therapy once a week accompanied by two peers and two support staff. He loves dancing and is socially aware but by and large is difficult to engage for any length of time with instrument playing. He began the project by being able to stand and orient to the instrument, hold two mallets and
make a sound - all with verbal, gestural and modelling support. He was unable to imitate the group leader and would strike a few notes with the mallets before becoming more interested with trying to put the beaters in the holes.

Adjustments and Results
By the end of the year, Jake was able to independently use the mallets to create a sound on the instrument and more importantly was able to play for longer durations. To aid this, a piece of material was put over the holes and then gradually faded as Jake became more focused in his playing. Also improved was his ability to imitate his partner’s way of playing, moving from requiring touch support to verbal, gestural and/or modelling. Two further skills were developed over the duration of the project and these were the ability to follow the group leader to play both faster and louder.

At the beginning of the project Jake was unwilling to look at the group leader to imitate but this progressed to him being able to accept and follow the leader with a touch support. This showed that his listening skills as well as his ability to adjust his behaviour to coordinate with others had improved over the year. He was also able to participate in this activity for a longer period of time which in conjunction with other strategies outside the music room were designed to improve his levels of patience for waiting and participating.

Discussion
Benefits
One of the key benefits to each student having their own instrument was that it greatly reduced the amount of waiting time. Children and adolescents with autism frequently have difficulty with waiting for unknown periods of time and delaying gratification when an object or activity is highly motivating. Having an instrument each meant that students were able to spend more time in sessions actively engaged in music making. In addition, having a choice of instruments to play gave students the opportunity to express preferences in socially appropriate ways, and give a sense of mastery over their environment and the manner in which they would contribute to the group.

During the course of the project, students and staff experienced great moments of joy and shared excitement, providing many opportunities to engage in joint attention and shared emotional attunement with others. These moments served to heighten the awareness of peers during group playing, leading them to share the discovery of new instruments and new sounds together, and recognising that the sound of the instruments playing together was harmonious and pleasing to listen to. As the weeks progressed, students were observed approaching their instrument with greater confidence and willingly sharing their musical space with peers and adults. The process of helping to set up the group and pack away at the conclusion of sessions offered opportunities to engage students in tasks that involved complementary social actions. For example, picking up a xylophone together and moving it to its position for playing, and electing a student to distribute mallets to each group member.

It is of note that whilst each music therapist following general guidelines regarding activities for the xylophones, the program could not remain standard for all students due to the fact that each music therapist practises in a slightly different style, and that activities were constantly being reviewed and adapted to enable the highest level of participation and success from each individual student.

Challenges
The project was not without its challenges. For some students, the constant seeking for novelty meant that music therapists needed to constantly vary activities in order to avoid a drop in
motivation levels. Several students had great difficulty grasping narrow objects and manipulating them toward a directed target. To a person without these challenges, the xylophone may appear to be a very simple instrument to play. However, the playing of a xylophone involves the use of many faculties at once: grasping the mallets and maintaining that grasp, directing the object toward the xylophone keys, moving them in a manner that will produce sound. Then another level of skill is required to differentiate between keys and select which one/s to strike and when. And as a member of a group ensemble one has to distinguish the sound of their own instrument in the midst of other instruments around them, and shift attention between their instrument and the cues being given by the group leader. For some students, the greatest development was the satisfaction of holding and manipulating the mallets to create sound on these beautiful instruments and sharing that achievement with others. To accommodate these developments in students of different ages and heights, some xylophones needed to be lifted up off the floor on xylophone stands with wheels, whilst others could remain on the floor.

Other challenges included rigidity around the instruments, removing tone bars and repeatedly packing away the mallets in the designated holes. Some students would use the mallets in non-functional ways (from a musical perspective) eg. lining them up, posting them in the gaps between tone bars and throwing them. As the program progressed, less of these behaviours were observed as students became more engaged in musically functional playing of their instruments. Finally, regulating the volume level of the group needed strategies to prevent students forming negative memories of their time in music groups. Music therapists would limit the number of instruments distributed at one time, vary the type of mallets used (harder/softer), provide headphones for students struggling with noise levels and build in the teaching of how to play louder and softer from an early stage in order to help students modulate volume for themselves.

**Summary**
The Xylophone Project was deemed a success both in terms of individual gains over the 12 months, but also in terms of its ability to bring a motivating force to social ensemble formats in music therapy sessions. Great gains were particularly seen in the areas of imitation and following direction, both essential skills for participating in group activities. By engaging the mirror neuron system as well as the whole body, the experience was as much social as it was musical. Additionally, as video footage was viewed by staff and parents, and performances were given at the end of year concert, the successes were able to be shared with the whole school community. The flow-on effect of this continues to be that students are seen in the light of their abilities and achievements, rather than their challenges and disabilities.

**Acknowledgments**
The success of this project was made possible by:

**The Music Therapy Team 2012 were:**
Bronte Arns        Vanessa Lucas        Catherine Haining        Johanna Haire

Music Therapy is a research-based practice and profession in which music is used to actively support people as they strive to improve their health and wellbeing.