Institution: Hartpury University		
Unit of Assessment: Sport and Exercise Sciences, Leisure and Tourism		
Title of case study: Drumming as a Physical Activity Intervention to Improve Outcomes for Children with Autism Spectrum Disorder		
Period when the underpinning research was undertaken: 2016-2020		
Details of staff conducting the underpinning research from the submitting unit:		
Name(s): **Prof Stephen Draper**	**Role(s) (e.g. job title):** **Professor and Dean of Research and Knowledge Exchange**	**Period(s) employed by submitting HEI:** **2016 - current**
Period when the claimed impact occurred: 2017-2020		
Is this case study continued from a case study submitted in 2014? N		

1. Summary of the impact

Practical and cost effective therapies that positively improve daily living skills for those with autism spectrum disorder (ASD) are lacking, and drug based therapies often have undesirable side effects. This research investigated learning rock / pop drumming as a therapeutic physical activity intervention to improve behaviour, coordination, and life quality, demonstrating changes in brain structure and function. Impacts from this research included profound improvements in motor ability for daily living skills for over 200 participants and produced sustainable and self-funding drumming initiatives in both Gloucestershire special and mainstream schools. The growing adoption has created the demand for a therapeutic arm of a local drumming SME and has exported the concept and programme to other populations and other UK regions.

2. Underpinning research

Prof. Draper is a co-founder of the Clem Burke Drumming Project (CBDP), named after Clem Burke, Honorary Doctorate of Music, and member of Rock & Roll Hall of Fame and co-founding member of the band 'Blondie', who shared the vision to investigate the possible positive effects of drumming for wellbeing. CBDP is a collaborative research project between Hartpury University, Chichester University and Kings College London (KCL). Leading from Prof. Draper's research into the physiological stresses of the professional drummer, this work has evolved into investigating the benefits to wellbeing of drumming in autism spectrum disorder (ASD), building on the known benefits of physical activity, music and coordination exercise.

Project funding from the Waterloo Foundation (£133,948), enabled the CBDP to investigate the structural and functional changes in the brain when learning to drum. Within the CBDP collaboration; Hartpury has been responsible for the quantification of motor skills, coordination and wellbeing, KCL has provided the expertise and resources in brain imaging, and Chichester has specialised in psychosocial measurements. An initial magnetic resonance imaging (MRI) study, using a group of non-ASD sixth-form students who were compared with matched controls for age gender and educational cohort, demonstrated that group-drumming lessons (1.5 hours per week) significantly altered the brain structure within eight weeks [3.1]. The cerebellum grew and reshaped because of the drumming stimulus, which has important implications for the therapeutic use of drumming for a number of conditions (including ASD). Having successfully demonstrated the ability to alter the brain through drumming, researchers replicated this in a comparable ASD cohort, where changes to resting brain function and improvement in inhibitory control were seen [3.2]. Encouragingly, all ASD participants involved in this project have continued drumming beyond the end of the project having found the activity beneficial.

Alongside these MRI projects, the behavioural impacts of drumming with children with additional educational needs (including ASD) were investigated [3.3], showing improvements in both behavioural difficulties and hyperactivity compared to matched controls. Following a series of dissemination events with stakeholders (local schools, healthcare professionals, charities etc.) at Hartpury University, this work broadened to a project working with children with ASD and other educational difficulties from a large special school in Gloucestershire [3.4]. The children learned drumming at the Hartpury University campus using electronic drum kits arranged in a circle around the tutor's kit. Changes in mirror neurons seen in MRI suggest that this group setting is beneficial and improves communication [3.1]. Lessons were 30-40 minutes, twice per week for 10 weeks and included instruction as well as playing to popular music. When back in the classroom, reduced emotional and peer problems were observed and measured (using the Strengths and Difficulties scale from Goodman, 1997) in the children (10% improvement) [3.4]. Qualitative interviews of parents and teachers revealed profound changes in quality of life for the participants, whose coordination had improved [3.4]

> *'he struggled very much with a knife and fork and not being able to really cut anything. But now he's able to hold a knife and fork properly. Orientating his toothbrush, he would be able to brush both sides of his teeth, and along the inside of his teeth.' (Parent)*

Data were also drawn from the drum kits, acquired through the musical instrument digital interface (MIDI) signal, throughout the project and showed objective improvements in the children's coordination [3.4]. This work is ongoing with three of the twelve special schools in Gloucestershire.

Prior to this work, evidence of the benefits of drumming for ASD was purely anecdotal and largely based on reports from parents of ASD children seemingly helped by learning to drum. This work was the first to show that the brain structure and function can be altered quickly and demonstrably through a relatively low exposure to learning to drum [3.1] and that this can also be demonstrated in an ASD population [3.2], where it may have a profound effect on ASD children and their parents. This work has been widely disseminated through international conferences (International Association for the Scientific Study of Intellectual and Developmental Disabilities World Congress, European College of Sport Science Annual Conference, Annual meeting of International Society for Magnetic Resonance in Medicine, International Conference on Autism) and through public engagement events (e.g. Hartpury Science Hub at the Cheltenham Science Festival, with thousands of children engaging in activities related to drumming and wellbeing annually).

3. References to the research

3.1. Bruchhage, M.M.K., Amad, A., **Draper, S.B.** *et al.* (2020). Drum training induces long-term plasticity in the cerebellum and connected cortical thickness. *Nature: Scientific Reports,* **10,** 10116. DOI: 10.1038/s41598-020-65877-2

3.2. Cahart, M-S., Amad, A., **Draper, S.**, *et al.* (2021). The Effect of Learning to Drum on Behaviour and Brain Function in Autistic Adolescents. International Conference on Autism 2021 accepted (Dec 2020). Available on request.

3.3. Lowry, R.G., Hale, B.J., **Draper, S.B**., *et al.* (2019). Rock drumming enhances motor and psychosocial skills of children with emotional and behavioural difficulties. *International Journal of Developmental Disabilities*, 65:3, 152-161. DOI: 10.1080/20473869.2018.1429041

3.4. **Draper, S.**, Lowry, R.G., Marino, L., *et al.* (2020). The effects of a rock drumming intervention on children with additional educational needs. European College of Sport Science Conference 2020. ISBN 978-3-9818414-3-5. Available on request.

4. Details of the impact

The research demonstrating the beneficial effects of drumming on young people with ASD has benefited the individuals taking part, has enabled Schools to offer a beneficial intervention and created a new revenue stream for a drumming SME. Successful public engagement with the research means that it is now being taken up in other settings for other conditions.

Benefits to young people involved

Approximately one person in 100 is on the autism spectrum, suggesting that in Gloucestershire, where the project was based, 8,580 people may be on the autism spectrum, including about 1,200 children. There were profound changes for the 200 individuals engaged in this project. The local special school that participated in our behavioural study [3.4] is the largest in the region and one of the largest in the UK (providing for over 300 children). The school saw changes in the children involved including benefits beyond the drumming lessons [5.1].

There was a reduction in peer and behavioural problems [3.3, 3.4] and parents saw profound changes in coordination and the ability to perform real life skills (e.g. brushing teeth and eating with cutlery) [3.4]. These children performed for their parents, carers and other pupils for the first time in their school lives [5.2], a classroom teacher noted,

> *'I loved it though, I cried. I was very, very proud of them. Watching them do something like that.' (Teacher, Milestone School)*

Therefore drumming also provided a vehicle that greatly improved self-esteem and confidence,

> *'Pupil self-confidence demonstrated significant improvement, which had an impact on their learning and engagement in other areas'* [5.1]

One non-verbal ASD child, now attends his drumming lessons in the school hall without his one to one classroom assistant and sings to the songs he has learned:

> *'One particular child, who is largely non-verbal, sang to the songs and was able to remember lyrics; he was even heard singing to himself during other lessons – an incredible achievement!'* [5.1]

Benefits to Schools

Such were the benefits to the children involved; the school has self-funded the drumming tutor to continue to provide these lessons,

> *'As a result of the positive changes we saw in the children involved, the school has supported continued drumming lessons for our pupils'* [5.1]

There are twelve special schools in Gloucestershire, three are now running the drumming intervention and the other nine have committed to implement it as soon as conditions allow [5.3].

> *'I am pleased to confirm our wholehearted support for your project and our wish to take part as soon as you are able to proceed and present restrictions allow'*
>
> *(Chair, Gloucestershire Association of Special Schools' Heads [5.3])*

In addition to reaching all of the Gloucestershire Special Schools, drumming has also been adopted by a large local mainstream secondary school for those children with specific emotional and behavioural difficulties. This adoption has occurred as a direct result of dissemination of the research described (Hartpury University stakeholder event). This programme was self-funding using individual pupil premium and has already reached 100 children in the school [5.4]. The School observed that self-confidence improved in the children involved to the extent they used the drum sets to teach their peers the drumming they had learned. They also noted that the drumming was useful to calm children experiencing

difficulties in the school day. The children were due to perform at an end of year (June 2020) music festival headlined by Coldplay. Sadly, COVID-19, meant this was not able to take place.

The public dissemination of results as described above has also led to engagement with the CBDP and the adoption of drumming interventions beyond the region, across England. This includes working with special schools and communities in London, Liverpool, Bedfordshire and Wiltshire [5.5].

Impact on SME

Inspire Drums is a small business (SME) located in Gloucestershire that was primarily engaged in private and one to one drumming lessons in mainstream schools. The owner of Inspire Drums became involved through dissemination of this work via the Hartpury Science Hub at the Cheltenham Science Festival. Inspire Drums have collaborated with Hartpury University in delivering the drumming interventions to special schools in Gloucestershire. As a result of the research findings showing the efficacy of drumming and the profound changes seen in the children engaging in drumming, Inspire Drums has grown from a company of one tutor to now employing five four? [5.6] to service the demand for drumming to assist children with ASD and other developmental difficulties. This expansion benefits this small business, creates more capacity to provide drumming to those who will benefit and expands the knowledge of drumming tutors of the needs of this population. Uptake from ASD pupils has increased in private lessons as well as the school projects described here.

> '*The impact on our business is has also been profound. Working with your project has generated a new demand for drumming tuition generally and specialist drumming tuition in particular. Consequently, the business has grown from one tutor to four and we have created an entire 'therapy' arm of the company offering. This expansion has created a pool of tutors who are learning from us about the challenges and practicalities of delivering drumming to different populations*'
>
> (Phil Jones, Inspire Drums [5.6])

Public engagement leads to impact on other conditions

The nature of the changes seen in the brain through the research are likely to benefit other populations. As a result of successful engagement activities, researchers were approached by a care home in the city of Gloucester to provide drumming tuition and monitor dementia patient responses [5.7]. This work was due to begin in April 2020 but postponed due to COVID-19 restrictions. However, we have two care homes committed to this project once the pandemic allows this to happen. Others in the County are working with Hartpury to use drumming to assist with recovery from brain trauma and The National Star College, (a specialist further education college for people with physical disabilities, acquired brain injuries and associated learning difficulties) has also committed to join the Project and include drumming in 2021 [5.8]. The Bedfordshire Clinical Commissioning Group also plans to expand drumming provision beyond the special school environment to:

> *'Include interventions with vulnerable young people in a range of settings outside typical educational provision, this may include for children who are electively home educated, children at risk of criminal and/or sexual exploitation and children displaying challenging behaviours.'*
>
> *(Joint Commissioning Manager [5.5])*

As well as a wide range of public engagement events, findings were further communicated through stakeholder roundtable and research communication events at Hartpury University. The partnerships made through these events directly enabled the behavioural studies to take place [3.4, 5.1, 5.3] and for the impacts described here to take place. The ongoing work of CBDP is to build on its previous research findings highlighting the physical demands of drumming to enhance health and wellbeing through drumming. This was translated to the drumming audience and public through the individual University communication channels and

by the CBDP website, social media channels and contacts [5.8]. The experimental work of the project has also resulted in high profile drummers acting as advocates for the Project [most notably Clem Burke himself, Mark Richardson (Skunk Anansie / Feeder) and Rob Rolfe (Enter Shikari)]. Consequently, this work has worldwide reach (the CBDP website has been accessed from 106 countries in 2019-20) and has altered media and public perception of the benefits of drumming. Rhythm Magazine is the premier drumming magazine in the UK and they have covered the CBDP on multiple occasions, most recently noting:

> '*Latest research from the project has made connections between learning to play the drums and changing the brain's structure and function, something which has resulted in enhanced behaviour in a school and home environment among individuals experiencing autism.'* [5.9]

High profile drummers and advocates for the project have described the impact of this research on the perceptions of drumming in the drumming community and the public [5.10]

> *'My hope is that drumming becomes an essential part of the well-being program of every school, care home, hospital and prison. After all, if it works for one of us it can work for all of us.'*
>
> *(*Mark Richardson, Drummer, Skunk Anansie [5.10]*)*

> *'The research that you have done, especially relating to the fitness of drummers and the positive impacts on the brain have changed perceptions of drumming.*'
>
> (Rob Rolfe, Drummer, Enter Shikari [5.10])

5. Sources to corroborate the impact

5.1. Testimonials from three Gloucestershire special schools engaged in drumming (Lynn Dance (OBE) CEO Sand Academies Trust; Diane Taylor, Head Teacher The Milestone School; Howard Esson, Lead Teacher in Extra Curricular Leaning, Heart of the Forest School; Annette Fiderman, Head Teacher, Paternoster School)

5.2. YouTube video of drumming intervention with The Milestone School https://www.youtube.com/watch?v=PRptXHG_eF0

5.3. Letter of intent from all Gloucestershire Special Schools, Signed by Pete Hales, Chair Gloucestershire Association of Secondary Head Teachers (GASSH)

5.4. Testimonial from Suzie Buckley Head of Music and Will Morgan Head Teacher, Cotteswold School

5.5. Letters from Abbot's Lea School, Liverpool(signed by Sara Mursic, Head of Autism Research and Development) and Bedfordshire NHS Clinical Commissioning Group (signed by Laura Park, Joint Commissioning Manager)

5.6. Testimonial from Phil Jones, Founder and CEO, Inspire Drums

5.7 Letter from Hannah Knaggs, Activities Coordinator, Buckland Care

5.8. .Letter of endorsement from National Star College, signed by Paul Tarling, Enrichment and Community Engagement Coordinator)

5.9. Rhythm Magazine article

5.10. Testimonials from Clem Burke (Blondie), Mark Richardson (Skunk Anansie) and Rob Rolfe (Enter Shikari)