

The University of Hull

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The Impacts of Robotics-Based Interventions on Vulnerable Youths

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Abstract

This research explores the potential impacts in terms of personal development, social bonds, employment, structure, suitability and crime reduction/prevention of a small programme run in North Lincolnshire, targeting those identified as vulnerable youths by North Lincolnshire Council.

Key findings have been identified through evaluating interviews, focus-group-style discussions and observations, drawing parallels with a thematic framework based on current research on sports-based interventions. The hypothesis that robotics-based interventions programmes can reduce crime has a complex answer that does not elude to a straight yes or no, however the main findings of this research would suggest that robotics-based interventions might have a positive impact in terms of altering the trajectory of a potential offender. A key finding is the positive impact on personal development, most notably the increase in confidence, self-esteem and engagement.

Having an informal leadership style was found to have a significant effect on the success of the programme as it was found that that the participants on the programme did not like or respond well to authority. Other significant outcomes of this research identified the courses as being most suitable for those with autism (although this is posited tentatively as there is a potential risk of stereotyping), and the most successful features to be certificates of attendance and short-term successes achieved.

Although limited by the small size of the study, the implications of this research are substantial: it provides support for the programmes and has the potential to increase the success of other similar programmes through its findings. This research therefore notes the need for larger-scale, more in-depth studies focusing on robotics-based interventions to cement the validity of these results.

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1. Introduction

Between April 2018 and March 2019 approximately 11,900 youths (10-17-year-olds) were introduced into the criminal justice system in England and Wales. Furthermore, 38.4% of children and young people (including 18-year-olds) reoffended within the same timeframe (Ministry of Justice, 2020). Although the former figure has fallen significantly from the previous year, the latter has increased. Both figures demonstrate a need to explore interventions to reduce crime.

1.1 Intervention as Crime Prevention

Intervention as crime prevention is an attempt to ensure that someone will either not offend or not continue to offend. Intervention programmes target specific risk factors in young people as a way of determining who the programme is suited for (Tonry & Farrington, 1995:2). However, there is more than one type of intervention. For instance, Brantingham and Faust (1976) identify three levels of crime prevention. Primary aims to change the conditions in the community that have potential to promote offending. Secondary is concerned with identifying individuals or groups who have the potential to offend and attempting to change that, and tertiary prevention aims to prevent recidivism and therefore targets known offenders. In addition, Nichols and Crow (2004) summarise the mechanisms of crime prevention in three categories: diversion, deterrence and pro-social development. Diversion attempts to physically divert those who might otherwise be involved in crime at a certain time to other activities and deterrence emphasises to potential offenders that they are more likely to be caught at a certain time and place if they commit an offence. The latter, pro-social development, aspires to improve individual values and skills, for example self-esteem or cognitive ability.

1.2 Raising Participant Age (RPA) Engagement Programmes

The *Education and Skills Act* (2008) outlined the duty of young people to enrol in education or training and the requirement of the local authority to act if they did not. Following this, in September 2016, the Department for Education released statutory guidance on RPA programmes, outlining how local authorities needed to provide support for vulnerable young people in accessing education and training (Department for Education, 2016:5). For the purpose of this research, the term 'vulnerable' is defined by categories provided in the RPA Engagement Programme referral form provided by North Lincolnshire Council (2018). A full list of the categories can be found in Appendix A.

North Lincolnshire Council, in funding an external company UK STEM Ltd, has run robotics-based RPA engagement programmes for three years. The programmes are aimed at those previously identified as vulnerable and take referrals from external companies. Since the categories of vulnerable people also

include those who have not offended (but display risk factors) and those who have, we can categorise this programme as secondary and tertiary according to Brantingham and Faust's (1976) classification, and also the mechanism as pro-social development by Nicols and Crow's (2004) categories. The most recent programme ran through November 2019 over six two-hour sessions twice a week, for three weeks. The sessions were run at a college in the North Lincolnshire area and catered for a maximum of ten students. Activities involved a mixture of VEX robotics and Crumble coding (UK STEM, 2019). VEX robotic kits are 'brick-based robot assembly kits' that come with a variety of different sensors, such as touch, colour and distance, and instructions to build different remote-controlled robots. There is also the option to advance to programming depending on ability (Pachidis *et al.*, 2018). The Crumble is a microcontroller that can be programmed using the Crumble software, a block coding system. External components, such as sparkles (a red-green-blue LED), can be added using crocodile clip wires and then coded to flash or light up in different colours (Cargill, 2019).

1.3 Robotics Activities: Are They Justified?

Why offer robotics over a different programme? To answer this, we need to look at the social and educational aspects of robotics, such as the skills can be gained. These skills will be discussed in the context of robotics within schools. Robotics has the potential to benefit as a useful 'tool' to develop 'essential life skills', such as cognitive skills, personal development and teamwork (Alimisis, 2013:69). Furthermore, a study by Kandlhofer and Steinbauer (2016) found that robotics activities had significant positive impacts on technical skills and social aspects or soft skills, including teamwork and social skills. In contradiction, a systematic review by Benitti (2012) found that the results overall were actually inconclusive, as for every study that showed significant increases in skills, there were studies that showed no significant change, and concluded that more research was needed. However, it is worth pointing out here that no negative impacts were mentioned. Interestingly, both Johnson (2003) and Lindh and Holgersson (2007) put emphasis on the need for the teacher to have the knowledge, confidence and enthusiasm to teach robotics. We might conclude from this that the delivery of the sessions also plays an important part in to what extent skills are gained.

1.4 Aims and Objectives

This research seeks to explore the hypothesis that robotics-based intervention programmes are an effective form of crime prevention. Furthermore, three research questions will be addressed: the impacts of the programme on vulnerable people; the suitability of the courses for certain groups of people; the features of the programme that have a notable impact. A literature review evaluates the current research

on sports-based interventions and provides a thematic framework to draw parallels with primary data collected through interviews, focus-group-style discussions and observations.

2. A Review of the Literature

This chapter outlines where intervention fits within developmental life-course (DLC) theories before exploring existing forms of intervention. Research on using robotics-based interventions is extremely limited, so this review will aim to explore themes within sports-based programmes in the UK.

2.1 Developmental and Life-Course Theories

In the 1990s, DLC theories gained traction as the result of a large number of longitudinal studies that were published and sought to explain the offending of individuals over their lifetime (Farrington, 2003, 2010). The types of offending that these theories relate to are the 'most common crimes of theft, burglary, robbery, violence, vandalism, minor fraud and drug use' and generally apply to 'lower class urban males in Western industrialised societies' (Farrington, 2003:223). There are two fundamental parts of a DLC theory – trajectories, which show long-term patterns of behaviour, and transitions, which happen around certain life events. Depending on how one adapts to transitions, their trajectory can be influenced. DLC theories are predominantly concerned with the age-crime curve, which predicts how offending changes over time according to age, and how persistent offending in adult life can be predicted by the early onset of antisocial behaviours. The relevance of the age-crime relationship has been disputed, however: Hirschi and Gottfredson (1983) argue that although there is a correlation between age and crime, it is not a useful one. Furthermore, some theories also examine how certain life events, such as marriage, can lead to desistance in offending and therefore a change in trajectory (Sampson and Laub, 1992; Farrington, 2010). To gain a deeper understanding of DLC theories, and to identify some of the antisocial behaviours that can predict offending (risk factors), it is appropriate to look more closely at specific theories.

One of the best-known DLC theories is Moffitt's (1993) theory of dual taxonomy. This identified two possible trajectories and theories for antisocial behaviour: the adolescence-limited (AL) and the life-course-persistent (LCP). Those who embark on the adolescence-limited trajectory of offending are marked by their inconsistency in anti-social behaviour and are influenced heavily by the behaviour of their peers, who display consistent anti-social behaviours. This 'mimicry' is motivated by a difference in maturity levels: their biological maturity is higher than their social maturity (Moffitt, 1993:685). Their behaviour is then reinforced as it is seen by them as a statement of independence. After a while, this behaviour desists, as does the difference in maturity levels.

In contrast, LCP offenders show an initial difference in neuropsychological health that expresses itself through infancy in a show of 'temperament, developmental milestones, and cognitive abilities' (Moffitt, 1993:684). In addition, environmental factors such as schools, homes and neighbourhoods have the potential to make this problem worse if they are disadvantaged. Over time, antisocial behaviour is

learnt. Moffitt adds that problems with language and reasoning cause academic failure, leading to fewer skills and therefore job prospects.

We might see here how the use of intervention as a form of crime prevention fits in. At the point where the trajectory begins to take on the form of an LCP offender, there is potential to change the trajectory a transition – the event being some form of intervention. It is also possible to begin to identify risk factors, such as disadvantaged schools, homes or neighbourhoods, that might predict an LCP offender and therefore also warrant intervention. It is interesting to note that the risk factors mentioned by Moffitt are partly addressed in the vulnerable categories provided by the RPA engagement form, such as Families Initiative (North Lincolnshire Council, 2008). In order to expand on possible risk factors, we can look at other theories: according to Farrington (2010), DLC theories lie on a spectrum of psychological to sociological. Moffitt's theory of dual taxonomy lies at the psychological end of this, and it is therefore appropriate to look at another theory that encompasses more of a sociological ideal.

Thornberry (2005) offers a different explanation of offending and antisocial behaviour: interactional theory. Unlike Moffitt's theory, this model suggests that the onset of offending can occur over a period of time and some people may start offending later than others. However, they are similar in those who exhibit antisocial behaviours as a toddler are more likely to become life-persistent offenders, and the predictors of this are also the same. But as the age that offending starts changes, so do the causal factors. For example, those who are 'late bloomers' (Ibid, 2005:171) start offending at stages later than mid-adolescent and poor performance in schools, low cognitive abilities and job instability are risk factors. We can see here where intervention fits into this theory: at the onset of factors that are likely to lead to offending and antisocial behaviour. In addition, the RPA engagement form reflects these factors: NEETs, poor school attenders (below 50%) or those who have attended a 'substantial period in alternative provision' (North Lincolnshire Council, 2018).

2.3 Existing Forms of Intervention: A Closer Look

Although different types of intervention programme exist, such as performing arts (Brown & Nicklin, 2019), sports-based interventions will be reviewed here because the area has been well-researched and there are potential parallels that can be drawn with robotics activities.

Nichols and Crow (2004) draw on the classifications of crime prevention proposed by Brantingham and Faust (1976) and the mechanisms they themselves propose – identified in the introduction of this research – to highlight examples of sports programmes in the UK. The robotics courses run by North Lincolnshire Council can be identified as secondary and tertiary programmes that focus on pro-social development. The example that Nichols and Crow (2004) offer for this category of programme is Fairbridge, a charity-run

programme that works with 14-25-year-olds referred by external agencies. The programme consists of a three-day residential as part of a week-long course, followed by a six-month plan that aims to improve skills in life and work. Tertiary pro-social examples include Derby Positive Futures, West Yorkshire Sports Counselling (WYSC) and Hafotty Wen 14 Peaks. Derby Positive Futures was one of the 24 Positive Futures programmes and took referrals from the Youth Offending Team. The programme involved 'one-to-one sports counselling' with varying time scales, eventually leading to paid work (Ibid, 2004:273). WYSC ran from 1993 to 1996 and consisted of a 12-week programme of one-to-one sports activity sessions (Nichols, 2007) and Hafotty Wen 14 Peaks programme was a 24-hour walk through North Wales (plus training days) run for high-risk offenders. These could be both open- and closed- group (closed only allowing for a known group of people, open allowed access for any probationers) (Ibid, 2007).

2.3.1 Personal Development

A common theme in the current research is the change in personal development. For example, an improvement that comes from sports programmes is an increase in physical fitness (Nichols, 1997; Bailey, 2005; Fraser-Thomas *et al.*, 2005; Lubans *et al.*, 2012). Physical health benefits are well-documented and contribute to a whole range of problems, such as preventing obesity or improving blood pressure (Janssen and LeBlanc, 2010) and have also been attributed to an increase in self-esteem (Nichols, 2007:10). In contradiction, Fraser-Thomas *et al.* (2005) note the potential negative impacts of physical activity, such as sporting injuries and potential eating disorders.

An improvement in self-esteem has frequently been noted as an impact of sports programmes (Nichols, 1997; Bailey, 2005; Fraser-Thomas *et al.*, 2005; Morgan *et al.*, 2019). A study by Sandford *et al.* (2008) found that teachers saw an increase in levels of self-esteem in students that attended either the HSBC/Outbound Project or the Sky Living for Sports projects. In addition, Lubans *et al.* (2012) deduced that outdoor adventure programmes, sport and skills-based programmes and physical fitness programmes were all associated with improvements in self-esteem and wellbeing. However, Fraser-Thomas *et al.* (2005:26) also commented on the potential negative impacts of the programmes in terms of a drop in self-esteem exacerbated by feeling pressured into winning, a sense of isolation from teammates and a lack of self-confidence.

Whether or not sports-based programmes result in improvements in cognitive abilities has been contested. Fraser-Thomas *et al.* (2005), in their review of the literature, conclude that there is a positive correlation between cognitive development and participation in sports activities. Bailey (2005), although agreeing a positive relationship has been suggested, stipulates that there this is outweighed by the studies that have found no or limited relationships. In addition, he surmises that this means that it is not possible to tell the difference between a causal relationship or a correlation.

2.3.2 Social Bonds

A number of social bonds are developed as a result of being involved in sports-based interventions. A study by Moreau *et al.* (2018) highlights the significance of social bonds by assessing the bonds made during the secondary, pro-social focused programme DesÉquilibries. Moreau *et al.* (2018: 7) found that some of the most important perceived aspects were being in a 'supportive climate', teamwork and peer support. In addition, Sandford *et al.* (2006) place emphasis on the social processes underpinning a programme being key rather than the activity itself.

Further social bonds are those within a community that create a sense of belonging. This was identified by Sandford *et al.* (2006) as an important part of any intervention programme design. It was also acknowledged in a study by Kelly (2011), which evaluated the programme Positive Futures through interviews with those at various levels within the programme, from managers to participants. Social bonds related to creating a 'better community and better people in those communities' but also crime prevention through giving youths a more 'positive role' in the community (Ibid, 2005:136). An emphasis is placed on the need for programmes to be accessible to participants no matter their gender, finances, culture or ability (Morgan *et al.*, 2018). This theme of 'sport for all' was the most commonly mentioned theme in Kelly's (2011:132) study. However, Kelly (2011:134) identifies a potential gender bias: in the Positive Futures scheme, girls are consistently under-represented. This is mirrored by Nichols (2007:15) who warns of both 'gender and class biases'.

Furthermore, bonds formed between leader and student are of importance: they have the power to control the experiences of the student and they can also work as role models (Nichols, 1997; Fraser-Thomas *et al.*, 2005; Sandford *et al.*, 2006). Nichol's (2007) evaluations of the WYSC scheme and the Haffotty Wen 14 Peaks programme noted leaders forming positive role models as one of the reasons for their success. Positive leadership and role models were also highlighted in the findings of a study by Sandford *et al.* (2008) as a successful project element, and more recently as a crucial part of the 'theory of change' evaluated by Morgan *et al.* (2018:2).

2.3.3 Employment

Eventual access to employment is not provided by sport intervention programmes, but rather the desired eventual outcome. It can be an indirect result, for example a consequence of factors such as raised self-esteem (Nichols, 1997; Morgan *et al.*, 2019). However, Kelly (2011:139) found in her study that some former participants of Positive Futures were in fact volunteering with the programme and were hoping to progress to employment there. Nichols (2007) found both a direct and an indirect link in his evaluation of both WYSC and Hafotty Wen 14 Peaks: self-esteem, coupled with opportunities within the programme,

had allowed for participants to gain voluntary experience and then employment. Kelly (2011) also noted that success was more likely when the participant was interested in a sports-related career.

2.3.4 Crime Reduction

Nichols and Crow (2004), through categorising the typology and mechanism of crime reduction in sports-based intervention programmes, outlined the ways in which crime reduction could be measured. The method for evaluating tertiary pro-social development programmes was measuring individual reconviction rates, and this was used by Nichols (2007) to evaluate how effective sports-based intervention programmes were at reducing crime. For example, in order to assess how effective the WYSC scheme was at reducing crime, the likelihood of 49 eligible offenders being reconvicted (within 2 years of their last conviction) was calculated and then compared to the actual reconviction rate. The results concluded that the WYSC programme had had a positive impact on crime reduction as the reconviction rate was less than the predicted rate (Nichols, 2007). The same method was also applied to the Hafotty Wen 14 Peaks programme (sample size of 28 offenders) and the same conclusion reached, although this was disputed by the omission of other factors. Further statistical analysis showed that there was only a 1.3% chance that this reduction occurred was purely coincidental (Ibid, 2007). However, Nichols and Taylor (1996 in Waddington & Smith, 2004) argued that the sample sizes were too small to provide a reliable conclusion.

2.3.5 Programme Evaluation

The lack of evaluation of sports-based intervention programmes was frequently noted. Although Nichols and Crow (2004) offer explanations of how to evaluate some types of programmes, this is contradicted elsewhere: Nichols (1997) states that measuring reconviction rates is both unreliable and unpractical, and that measuring another outcome, such as self-esteem, is only valid if this is shown to be a causal factor in recidivism. Furthermore, there is a need for more evaluation of programmes in general (Smith & Waddington, 2004) and Bailey (2005:86) notes the 'widespread failure' of programmes to monitor and evaluate performance. Sandford *et al.* (2006) express the need for better long-term evaluation as, in studies such as the one by Sandford *et al.* (2008), long-term data is limited. The idea has also been posited that sports-based programmes should form part of a model, not the entire model itself (Fraser-Thomas *et al.*, 2005; Sandford *et al.*, 2006).

2.4 Conclusion

In conclusion, DLC theories have provided an insight into trajectories of offending, which in turn offers an insight into where intervention programmes might fit in to change someone's trajectory. Risk factors mark those who might go on to offend, and therefore who the programmes are aimed at.

Overall, the literature shows that sports activities have had a positive impact on at-risk or disaffected youths. These impacts can be seen in two ways: the structure of the programme and the direct impacts of the activities. The impacts of the structure have the potential to reduce crime simply because they divert youths away from a time and place where they might offend. An important aspect of these programmes is also to help cultivate a sense of community and belonging. Furthermore, the development of social relationships, role models and positive leadership are all highlighted in the literature as important factors to help reduce crime. Although these are all identified in the context of sports, these impacts might not relate specifically to sports, but rather to the structure of any programme.

There are also impacts of the activities that are directly related to sports. These are personal impacts, such as improvements in self-esteem, physical fitness, mood, confidence and engagement. Although an increase in cognitive abilities has been identified as an impact, this is disputed by lack of evidence. We must consider here that these impacts may also be negative, for example exaggerating food disorders, aggression or stress – although this is only discussed to a limited extent.

The literature itself is limited not only by the number of studies, but also by a lack of recognised and reliable methodologies to assess the true impact of sports programmes on crime, and this limitation is commonly emphasised throughout the current research. Measuring rates of reconviction is unreliable and unpractical; measuring personal factors is only reliable if they are casual factors of offending. Therefore, future research needs to address this issue and to determine a reliable and consistent form of evaluation.

Although this literature review does not relate to robotics activities as forms of intervention, we can draw potential parallels. Firstly, the structure (pro-social tertiary) is similar to that of certain sports programmes. The importance of social relationships, role models and leadership are also important in a robotics intervention programme, although the programme evaluated in this research does not offer any community-based aspects. The personal impacts of the activities are not known for robotics intervention programmes, although we can say for certain that physical fitness will not be among them.

3.0 Methodology

This chapter justifies the methodology chosen, taking into consideration ethical issues, and addresses the limitations of the method of data collection. Furthermore, the method of data analysis chosen is discussed.

3.1 Method Outline

When considering what data collection method would be most appropriate, it was decided that qualitative data collection would provide richer data and allow for a deeper understanding into the impacts of robotics activities. Moreover, Shover (2012:139) emphasises the ‘enormous potential’ of ethnographic methods (such as interviewing and observations) in understanding the risk factors that might lead to a criminal career.

Two semi-structured interviews were conducted, one with an employee of an external company that referred students to the courses, and another with the leader of the courses. Semi-structured interviews are informal one-to-one conversations that follow an initial framework, accompanied by spontaneous follow-up questions. They are useful for understanding the thoughts of an individual, particularly if there is potential that the participant might not be entirely honest when discussing sensitive subjects (Adams, 2015). They were therefore chosen because of their informal nature that would allow for an in-depth discussion about the topic.

Two focus-group-style discussions were also conducted. The first took place with an employee from North Lincolnshire Council and two directors of an external company that refers students to the programme. The second took place with two employees at the same external company that had worked closely with those on the programme. A focus-group typically involves six to ten participants (Morgan, 1996), although the groups in this research had a maximum of three participants. However, the nature of a focus-group – collecting data through the use of discussion between participants – promotes the style of discussion used (Morgan, 2001). A focus-group-style discussion was the research method of choice for chosen groups of participants because this style gave the opportunity for participants to question each other and to think more deeply about their own views (Morgan, 1996). For the purpose of this research, the focus-group-style discussions will be hereinafter referred to as focus-groups.

In addition, the researcher was able to observe the activities during the sessions as a ‘complete observer’ – being in the room where the activity was taking place but having no interaction with the participants during the activities (Baker, 2006:174). This was to observe the delivery of the sessions

and to gain a better understanding of the activities. Observation as a method of research is advantageous because it is unobtrusive and typically provides reliable data (Queirós *et al.*, 2017).

3.2 Limitations

A limitation of using ethnographic methods is the ability of the researcher to employ them effectively (Shover, 2012). This limitation is manufactured in different ways depending on the type of method: for semi-structured interviews, the researcher has to be wary of introducing interview bias (Adhabi & Anozie, 2017). This was limited as the framework of the interview was written beforehand, careful to omit any potential biases.

The challenges faced in a focus-group include keeping control of the discussion and managing where the discussion is heading (Queirós *et al.*, 2017). In addition, skill is needed to open up an 'ideal' discussion that in theory only needs contribution from the researcher at the beginning and the end (Morgan, 2001:10). Furthermore, there is the potential for a focus group to be dominated by one or more people and this carefully moderated by the researcher (Smithson, 2000). These limitations were somewhat negated by the small group sizes which meant the conversation was easily managed, allowing for significant contribution from all participants.

In observations, the researcher has to stay impartial in order to ensure reliability and validity of data collected (Baker, 2006; Queirós *et al.*, 2017). This limitation was perhaps the most difficult one to overcome as there was a pre-existing relationship between the participant and observer. However, the nature of observation meant there was limited risk of bias.

3.3 Ethical Considerations

Major ethical issues that should be considered include informed consent, confidentiality, potential harms and benefits and maintaining research integrity (Israel & Hay, 2012). This research made sure the above points were all addressed. Before research commenced, approval was given by the University of Hull Research Ethics Committee. In addition, to ensure that consent was informed and voluntary, prior to each interview and focus group, all participants were given an information form and asked to sign a consent form. All participants were given the opportunity to freely withdraw their consent up until the 31st January 2020 and made aware that audio-recorded interviews and transcripts will be destroyed on the 1st July 2020.

Walford (2018) argues that it is impossible to offer complete anonymity in light of the expansion digital communication such as social media. A common method used to attempt to grant anonymity,

however, is the use of pseudonyms (Allen & Wiles, 2015). Therefore, pseudonyms are used throughout this research to protect the real names of the participants. However, authoritative figures from both North Lincolnshire Council and UK STEM Ltd. voluntarily expressed their consent directly to the researcher for the names of their organisation/company to be used.

The harms and benefits were considered prior to this research and there was no risk of any physical or emotional harm to any of the participants (or the researcher). However, the researcher's details were given out to all participants in case they wanted to get in touch after the study.

3.4 Method of Data Analysis

The audio data was transcribed and then analysed using thematic analysis. Thematic analysis exposes patterns – or themes – within qualitative data (Braun & Clarke, 2006). The data was coded using key words and phrases, then grouped into themes or patterns. Themes were drawn from the existing literature on sports-based intervention programmes and the codes were analysed with these in mind. However, in order to prevent any themes from being missed because they might not appear in the existing literature, the data was also coded to allow for other new themes that arose. The observations of delivery were used to support the themes found in the interview data.

4. Findings

This section outlines the findings from the observations and interviews/focus-groups. Transcripts were coded using the method outlined in the previous chapter. Within each theme there are factors that have been identified. Since observations were purely to gain a further understanding of the activities and the delivery, the only themes identified here were social bonds in the context of leadership and structure in terms of short-term successes.

4.1 Personal Development

A factor identified across all interviews and focus-groups was the potential of the courses to raise self-esteem and confidence. This was the focal point when discussing the impacts of the programme, and the increase in confidence throughout the programme was highlighted:

‘Liam – had a lot of potential really, but great anxiety problems, ... on that first day he came in the room and you can see him thinking this isn’t for me, I’m going to be forced to talk to people, I don’t want this. ... but then as his confidence grew, he ended up helping other people didn’t he.’ *(Sharon, Focus-group participant)*

In addition, another student was spoken about as an example of how valuable the programme was in raising confidence levels:

‘Sam came in with his hood up in every session, but by the end he had started taking it down.’
(Alex, Interview participant)

‘To see that kid smile, it’s rare, ... it was great to see him so happy’ *(Kate, Interview participant)*

This suggests the programme was effective at raising confidence and self-esteem levels. The level of attention given to this factor might demonstrate how the increase in confidence or self-esteem is an important and noticeable impact of the course.

Another factor of personal development is engagement with the programme. This was mentioned throughout both interviews and one focus-group as an additional impact and can be summarised by using Sam’s experience on the programme as a case study:

'That has been the only thing that's engaged him.' (Kate, Interview participant)

We can see here how engaging with the programme is a form of personal development as this shows a successful step forward in terms of re-engaging with education. Moreover, the frequency of comments might indicate the importance of this as a part of the programme.

Engaging was also identified as a potential negative, as there was no form of progression after the programme. Particularly in one focus-group, there was concern that having fully engaged with the programme, lack of progression would lead to a drop in engagement with other activities and that success would lead to further problems:

'If we don't show there is something else to follow on from then that success can turn into a barrier' (Ben, Focus-group participant)

Although this was only discussed in one focus-group, which might indicate this was a less important impact (or observed less), long-term impacts were not discussed frequently, so the true importance of this aspect is unknown.

The development and exploration of problem-solving skills was less frequently mentioned but it was briefly touched on in focus-groups when discussing positive impacts of the robotics activities:

'Enables you to explore your skills at solving problems.' (John, Focus-group participant)

This shows how the programme can be useful in expanding skillsets and potentially provide valuable experience when looking for employment. However, the fact it was only mentioned once might show this is either a less important aspect, or it is not seen as an impact.

4.2 Social Bonds

Social bonds was a prominent theme running through the transcripts. How students viewed authority figures was discussed most frequently: in one focus-group and both interviews. It was evident that

participants did not respond well to authority and would have potentially not continued with the course if there had been someone there who had played an authoritative role:

‘They don’t like authority, they don’t like anybody to be waltzing around in a suit, or present themselves in a certain way, they like an informal environment.’ *(Kate, Interview participant)*

This demonstrates an awareness that the programme needed careful structuring in terms of leadership and delivery. In one interview and one focus-group, the quality of leadership was also mentioned:

‘It’s really well delivered for the different learners’ *(Sarah, Focus-group participant)*

‘He’s quite – he’s quite pleasant, he’s got something warm about him doesn’t he, he doesn’t scream headteacher does he. The delivery was good. ... he recognised Sam and he recognised he was uncomfortable, and he just needed to sit with a familiar face I think, ... But he kept coming over and giving him small praise, which is good.’ *(Kate, Interview participant)*

Leadership style was therefore beneficial to the programme: the delivery was informal and not overbearing. Furthermore, the leadership style was adaptable to various levels of ability and learning differences.

This was also identified as a theme in the observations:

The room is a small classroom with desks and chairs, but these are not set out in rows, rather in sets of six or four. On the front desks, trays overflowing with Vex kits are laid out. Posters and booklets are scattered over the desks haphazardly. The students come in in dribs and drabs, one here, one there, three altogether. The leader greets them all with a handshake and an introduction, asks them all to take a seat where they would like. Explains they are using the Vex kits today and building remote control robots, but it is up to them how they do it. Instruction booklets are on the desks, but they can make up their own thing too.

Around half an hour into the session, the session feels relaxed, laidback, everyone working at their own pace. The leader is sitting in a chair near the front helping someone, but every now and then moves round to check everyone is okay and praise their progress. He offers to do a tea run, he has got biscuits, teas, coffees. At the end, there is no tidying up – people just get up, get their stuff, say goodbye and leave.

Mentoring within the courses was discussed in two interviews. This is a form of social bonding as it shows how the programme can have a positive impact by cultivating bonds:

‘It’s a social aspect for the likes of Ryan and Sean and they can work together, ... they can peer mentor each other’ (*Kate, Interview participant*)

‘I particularly admired his willingness to help out other members of the group who didn’t have English as their first language’ (*Alex, Interview participant*)

Both statements were in response to a question around the short-term positive impacts of the courses and show the programme as a space where social relationships could develop. However, in one focus-group, robotics was seen as a more isolating and a less social experience:

‘In one sense it can be an isolating experience, which is good for people that don’t want to interact at all.’ (*John, Focus-group participant*)

The contrast between these two thoughts might demonstrate how the programme can be both social and individual, depending on the needs of the students.

Group dynamics could potentially affect the success of the courses. This was discussed in one focus-group as a challenge of running the programme since they are delivered by an external company, which decides on group size:

‘You have to think about the dynamics of the group as well, ... I know you guys think about that all the time, because it could make things worse’ (*Sharon, Focus-group participant*)

The response within the group was not unanimous, however, and an example was referred to of students who typically would not be placed together, but who were brought together by the programme:

‘We’d identified some students who would benefit from it and we took them down, and when we got there, there was some students that we knew of and we’re thinking there’s no way I’d put them together because it’s like fireworks, but actually, ... they seemed to have that respect for each other’ *(Ben, Focus-group participant)*

This demonstrates that even though some students would not be put together normally, if placed together on the courses they had respect for each other and did not become disruptive. The contrasting thoughts within the discussion and the fact it was only discussed in one session might suggest that group dynamics have been consistently positive on the programme.

4.3 Employment

Interviewees were asked about the prospect of employment for students who participated in the programme. It became clear that this was a complex and challenging issue, and the robotics course alone would not gain students employment:

‘That’s a massive question for kids like these, that’s our whole endgame, is to try and get them employed, so it’s part of the puzzle.’ *(Kate, Interview participant)*

In addition, there was the concern that there was no progression in place after the robotics programme. This was discussed across all interviews and focus-groups:

‘When you have a student who really enjoys it, generally if we could take it further then we would do. It would be really good if we could say ‘right, that was brilliant, now you can do stage 2’, we just need more of it really’. *(Sarah, focus-group participant)*

There were proposals about what could come next for these students and how this could potentially put them on a path to employment (although there was no guarantee these would come to fruition), and this was discussed in one interview:

‘What I’m working on at the minute ... a bridging course which some of the more advanced students could access. ... with that course they could then go on a two-day course at CATCH - Centre for Assessment of Technical Competence Humberside – to see if they want to take that opportunity forward.’ *(Alex, Interview participant)*

‘Putting together an enterprise project so students who enjoy the programming and design of components, and are perhaps more creative and arty, could put together a little business where they are designing, manufacturing and packaging these programme projects for sale in science museum gift shops and places like that.’ *(Alex, interview participant)*

This demonstrates that employment is a long way off for these students and there is currently no direct path from robotics programmes into employment. However, this programme could potentially become a starting point for those who want to gain employment in engineering.

4.4 Structure

The most frequently discussed factor of structure was length which was discussed in all interviews and focus-groups as the biggest drawback. The statement below shows how the courses were not long enough for participants who were able to access and engage with them.

‘It wasn’t long enough. For Sam, he could have done that every week’ *(Kate, Interview participant)*

The recurring issue of length shows that this perhaps should be a consideration of future programmes, although funding was identified as the key reason for this.

An aspect of the programme structure that was deemed as particularly important was a certificate of attendance. This was discussed in one interview and both focus-groups:

‘Then they get a certificate, and they see that they’ve built something, they’ve made something, and that sense of achievement is a really big thing’ *(Sarah, Focus-group participant)*

It was explained in a different focus-group that many of the students might never have had a certificate before, and this could demonstrate how important this element of the programme was, even though the certificate (and programme) hold no value in terms of formal qualifications.

Another significant factor of the programme structure was the achievement of a short term – or quick – win. This was identified in both focus-groups as a key element that would keep students' interest and give them a feeling of success:

‘Having a short-term success like that is priceless.’ (Ben, Focus-group participant)

This indicates how effective short-term successes can be. Furthermore, the way in which it was spoken about demonstrates how important the element is for the programme to be successful.

Observations were able to explore short term successes and noted that all the activities were short:

The activities are short and easily achieved. The Vex instruction booklets are all pictures – no text – so they are easy to follow and only include one small step at a time. There is the option to build a remote-controlled robot in its simplest form – a set of wheels, motors and a Vex brain. There is the option to go on to build a claw that moves after this. Then there is the option to code the robot – but the leader makes it clear that whichever level they achieve is a success. When they have finished, they can compete against each other playing robot football on a large arena at the back of the classroom.

The Crumble activities are also short – shorter than the Vex activities. The programming is drag and drop which again makes it easy to use. You can code a sparkle to flash, or a number of sparkles to flash. If you want, you can add a distance sensor, or a switch but it is made clear you do not have to. Whatever is achieved is met by praise and a new small challenge that is engineered to your ability.

An additional concern identified was the environment in which the courses took place. The courses were run at a technical college in an area local to North Lincolnshire, and this was a barrier to some because of the authoritative school-like setting:

‘Authority is a massive barrier, ... we’ve got a lad called Luke and he would have been fantastic at that and I think he would have enjoyed it, but he wouldn’t have set foot in the building’
(Kate, Interview participant)

The need to avoid this setting was discussed in two interviews as a drawback and a potential consideration for future programmes. Having been mentioned in both interviews but not in the focus-groups, this might be considered as a relatively important limitation, but overall perceptions were that programme setting was not a problem because it still allowed some to access it.

4.5 Suitability

This theme was identified in response to a question about who the courses are suitable for in the participants’ opinion. The most popular response was that the courses were more suitable for students with autism, and this was discussed in one focus-group and one interview.

‘It’s a particular person with a particular need isn’t it, you know certain kids on the autistic spectrum seem to really engage with it.’ *(John, Focus-group participant)*

‘You’re reaching out to a perhaps forgotten target area – the quiet ones are often forgotten about. ... for autistic people, generally you don’t see them engaging in group sports’ *(Kate, Interview participant)*

It is possible that this was not discussed frequently because of the risk of stereotyping (this was implied in an interview); however, the statements above show that the programme was engaging for students with autism and offered an effective alternative to other programmes such as sport.

Lastly, gender was not mentioned frequently but it was discussed in one interview when a follow-up question asked specifically about the suitability of the programmes for females. There were more

males than females that are eligible for referral to the programme, and in addition the female specified would not be interested in taking part:

‘You’re in such a danger of being stereotypical aren’t you but I think it is a male dominated area, ... there’s only one girl and I don’t think she’d have any interest in it.’ (*Kate, Interview participant*)

4.6 Summary

In summary, five key themes were identified. In the first, mental health and personal development, significant findings include an increase in confidence and self-esteem, engagement with the course and development of cognitive skills. In social bonds, authority, leadership, mentoring and isolation were most relevant. Progression programmes as potential way into employment was also a significant finding. Significant features of the programme structure were certificates and quick wins, and the environment was significant as a barrier to some. Lastly, the courses were notably discussed as being suitable for people on the autistic spectrum.

5. Analysis and Discussion

This chapter explores the validity of the key findings within the overriding themes of personal development, social bonds, employment, structure and suitability by drawing parallels with the existing literature on sports-based intervention programmes. In addition, the themes crime reduction and programme evaluation are discussed as they were identified in the current research but not in the findings.

5.1 Personal Development

Three key areas were identified: confidence and self-esteem levels; engagement and problem-solving ability. These findings are predominantly in line with the findings of sports-based interventions which reported an increase in physical fitness, self-esteem and cognitive abilities to be key impacts (Nichols, 1997; Bailey, 2005; Fraser-Thomas *et al.*, 2005). The expected difference was that the robotics-based programme did not cause an increase in physical fitness due to the nature of the activities. Furthermore, the results that show the programme results in an increase in confidence, self-esteem and engagement are significant as they are recurring themes across the interviews and focus-groups.

The finding that engaging with the programme had an initially positive but then potentially negative impact after the programme had finished was unexpected. It was not previously identified: the potential negative impacts of sports-based activities, for example injury or eating-disorders (Fraser-Thomas *et al.*, 2005), are all based around the sports activity itself and therefore were unlikely to be reflected in the findings of a robotics-based programme. However, we must question here whether this potential negative effect is a direct result of the robotics programme itself or rather the external company that takes responsibility for the future of the participant after the programme has finished.

Interestingly, the ability of the programme to explore problem-solving skills was only identified in one focus-group discussion. Although an increase in cognitive skills has been debated within current research on sports-based intervention programmes (Bailey, 2005), research has shown robotics activities have been associated with an increase in the development of these type of skills (Kandlhofer & Steinbauer, 2016), and therefore it was expected that increasing problem-solving skills or cognitive ability would have been a prominent theme. There is potential that the broad-natured way of asking questions was not narrow enough to elicit sufficient information on the impact of cognitive ability. However, it might also be possible that robotics activities do not commonly lead to an increase in these skills. Future research is required to cement the validity of this result.

5.2 Social Bonds

The findings identified authority and leadership, peer mentoring and isolation, and group dynamics as key features of the impacts of social bonds in robotics-based programmes. There were similarities to themes identified in sports-based intervention: peer support; a sense of community; role models and leadership (Moreau *et al.*, 2018; Kelly, 2011; Nichols, 2007). However, finding a sense of community as an impact was not identified in robotics-based programmes because of the differences in nature of the two activities: the robotics programme catered for referrals only and had a limited number of participants.

The view of students concerning authority highlights the importance of the delivery and leadership style of the robotics programme. For instance, it is likely that the dislike the students held for authority meant an authoritative or 'teacher-like' manner would lead to disengagement from the robotics-programme. Moreover, the need for a positive leader-student relationship was highlighted by Nichols (2007) as a key feature for success in sports-based interventions (specifically the WYSC scheme) and leadership has been emphasised as an important aspect of teaching robotics (Johnson, 2003; Lindh & Holgersson, 2007). We can therefore conclude this result is significant, although more research is needed into the effectiveness of different teaching styles.

Interestingly, the robotics programme appears to be more flexible than sports-based interventions in terms of catering for differences in social ability. Examples of peer mentoring as a social aspect and isolation from the group were both discussed in the interviews/focus-groups as positives, but only peer mentoring was identified in sports-based programmes (Moreau *et al.*, 2018). Indeed, potential isolation was identified as a negative impact by Fraser-Thomas *et al.* (2005). However, it may be possible that robotics-based programmes cater for a wider range of participants than sports-based, and some may not feel able to engage in a sociable environment but prefer and have more confidence when working in isolation. This will be discussed further in suitability.

Group dynamics was noted as a potential challenge for the programme; however this was disputed within the focus-group in which it was discussed. Interestingly, Kelly (2011) found that antisocial behaviour could be increased when there were participants from rival areas coming to the same activity. However, there is the suggestion that robotics-based interventions can negate some of the potential discord between students, although it is not clear why. More research is required to verify these findings and expand on any potential reasons for this.

5.3 Employment

There is no direct pathway into employment as a result of the robotics programmes, rather it is part of the puzzle that aims to eventually gain students employment. This finding was reflected in a study by Kelly (2011) that, in evaluating the sports-intervention Positive Futures, found that for the majority of people there was no direct route into employment. However, we might have expected to find a clearer link between robotics-based interventions and employability, perhaps because of the experience and specific skills (for example coding) gained through robotics activities.

A response perhaps to the lack of pathway into employment, the lack of progression onto follow-up courses (leading to eventual qualifications) was discussed frequently. There is progression within the robotics industry that is possibly harder to identify in sports. This was evidenced in the observations that described progression within the sessions, and for those who engaged with and enjoyed it, the progression seemed only limited by the programme. However, this is harder to address in future programmes because of barriers such as potential funding issues.

Potential progression was discussed in an interview that outlined several proposals for pathways into employment after the robotics courses. We can see similarities in Kelly's (2011) study which noted that some of the course participants ended up working for the company (Positive Futures) that ran them: although students would not be working for the company that delivered the courses, these pathways are proposals by the company that ran the robotics programme and would be likely facilitated by them. Furthermore, an additional similarity between Kelly's (2011) study and the research findings is that progression would likely be in the same industry as the programme.

Although progression was only discussed in one interview, this finding is still significant as the participant of the interview was currently writing the proposal themselves. However, future research is needed to determine whether or not these progression programmes come into fruition, and if they do, how successful they are at gaining participants employment.

5.4 Structure

The structure of the programme was identified as being too short; certificates and 'quick wins' as particularly effective; lack of progression; the school environment. Although the structure of sports-based interventions as a theme in the literature review was not identified, it is possible to compare these aspects with those found in individual sports-based intervention programmes.

The length of programme was not identified in relation to sports-based activities possibly because it varies so widely from programme to programme. For example, the Hafotty Wen 14 peaks programme

lasted approximately two or three sessions: several training events followed by a twenty-four-hour peak-climbing challenge (Nichols & Crow, 2004). In contrast, the West Yorkshire Sports Counselling (WYSC) programme ran twelve one-to-one sporting sessions once a week (Ibid, 2004). From this we might conclude that there is no optimum length for intervention programmes, rather this differs depending on the programme, and might depend on factors such as funding and the length of the activities. However, the frequency with which this was mentioned would suggest that there is cause for consideration in developing future programmes of a similar nature.

Another significant finding was that certificates were a key element of the programme. Although they were not specific to robotics-based programmes, they were effective because they made the participant feel as though they had achieved something, and it was commented on frequently that this was perhaps the first time many students had ever received a certificate. Although it had no value in terms of qualification, it is perhaps the first step in re-engaging students and demonstrate how valuable their attendance was. Furthermore, certificates are an effective form of incentive in schools (Shreeve *et al.*, 2002) and can improve performance in universities (Ostermaier, 2017), and we can reasonably see here how this is therefore also the case in the robotics-based programmes.

Robotics offers a 'short-term win' in terms of small activities that can be completed quickly or within one or two sessions, and these short-term – or quick – wins were described as being particularly effective in engaging students. A short-term win is potentially harder to achieve in sports as games are usually competitive and there is a chance participants may not win. However, schemes such as the Hafotty Wen 14 Peaks programme might be considered a short-term win as the challenge lasts only twenty-four hours, and the major achievement of completing this was emphasised by Nichols (2007) as a significant result of the programme. Interestingly, certificates of achievement were given out, but it is the effect of the short-term win rather than the receiving of a certificate that was highlighted (Ibid, 2007).

The final aspect identified was the barrier that the school environment provided to some. This was not identified in relation to sports-based programmes, potentially because sports activities are more likely to take place outdoors, so the environment is less of an issue. In addition, it is likely that the setting might vary from programme to programme. In terms of robotics, the school environment was too much of a barrier for some individuals to take part in the activities, and this implies that the programme is not inclusive for all. Consequently it may be worth considering the development of future programmes in places such as youth clubs that are more informal. However, it is worth

considering that the school environment provides a more professional setting, and this is a way of re-introducing students into these types of environment.

5.5 Suitability

The most common finding within suitability was that students with autism were most likely to engage with the robotics programme. Although this finding can be considered as significant as it was discussed in several interviews/focus-groups, care must be taken not to assume that this is the case for all people with autism. Autism is a complex learning difference that does not exhibit in the same way from person to person: there is a spectrum of behaviours associated with it. It can be diagnosed when behaviour differences from the norm are exhibited in three areas: 'social interaction', 'communication' and 'restricted patterns of behaviour, interests and activities' (Milton, 2012). We may therefore find that certain behaviours associated with autism mean that robotics activities are well suited for the participant. For example, robotics activities might be more suited for people who find social interaction extremely difficult, because it can be very individual and isolated if you want it to be. In addition, for those who exhibit 'Monotropism' – having a narrower range of interests – and hyper-intelligence, robotics activities may work well in engaging and challenging them (Ibid, 2012:6). Furthermore, sports-based programmes are potentially less suitable for some people who exhibit these behaviours as some of the key features identified include community and teamwork (Fraser-Thomas *et al.*, 2005; Kelly, 2011; Moreau, 2018). This is reflected in the findings when the interview participant discusses how robotics-based programmes are targeting a different group of people to sports.

The gender imbalance was briefly touched upon in one of the interviews as there have been few females who have attended the programme. The emphasis on male participants was also highlighted in relation to sports-based programmes: Kelly (2011) and Nichols (2007) found that fewer females took part in sports-based programmes than males. The reason behind this bias potentially relates to the activities the programmes are based around: Riegle-Crumb *et al.* (2019) stated that females are less likely to pursue study in science, technology, engineering and maths (STEM) fields. In addition, the findings imply that the gender imbalance might be due to lack of interest. However, it could be argued that the gender imbalance exists simply because there are fewer females eligible to take part in the programme. This is supported by Morton *et al.*'s (2019) finding that there was no difference in interest between men and women that took part in certain robotics activities.

5.6 Crime Reduction

Crime reduction was identified in the literature on sports-based interventions but was unlikely to be discussed in the interviews and focus-groups because it is difficult to measure given that not all students on the programme had a history of offending. Moreover, a measure of crime reduction in terms of reconviction rate would require a longer study and more information about the participants. However, it is possible to gauge an idea of how effective the programme might be at reducing crime by identifying factors that are known to reduce initial offending and recidivism. This directly relates to the alternative hypothesis of this research. Some of these factors, for example NEET, are identified as a requirement to take part in the programme, and therefore there is already the potential that the programme is effective in reducing potential offending. In addition, factors such as increased self-esteem have been identified as reasons why sports-based interventions have been successful in reducing crime (Nichols, 2007). As increased self-esteem and confidence levels have been a significant finding in robotics-based programmes, we might reasonably assume that robotics programmes are potentially successful for reducing crime. However, more thorough research is needed to offer a more confident conclusion.

5.7 Programme Evaluation

Current evaluation of the programme was not discussed, however the lack of existing literature regarding robotics-based interventions suggests that there is a need for more evaluation. Although there is also a need for more consistent and robust evaluation of sports-based interventions (Bailey, 2005), we can look to existing studies for initial methods of evaluation. Kelly (2011) studied the Positive Futures programmes with eighty-eight interviews across managers of the projects, staff, participants and partners. More recently, a study by Morgan and Parker (2017) conducted eighty semi-structured interviews and focus-groups with participants of two programmes, leaders and coaches, and those associated with partner and community groups. From this we might conclude that semi-structured interviews and focus-groups are important to evaluations, however they should be conducted with those who work on every level, for example from the participant to the director. In addition, long-term impacts should be measured rather than solely short-term, and potentially studies that include the overall process of re-engaging youths rather than just one small part.

6. Conclusion

The starting point for this research was the hypothesis that robotics-based intervention programmes are an effective way of reducing crime; this, however, has a complex answer and it is difficult, impossible even to reach firm conclusions. There is also the shortage of relevant robotics-based research to consider, although research into sports-based interventions has allowed the exploration of relevant themes such as personal development, social bonds, employment, crime reduction and programme evaluation.

Primary results from an evaluation of interviews, focus-groups and observations of robotics-based intervention programmes for vulnerable youths (as categorised by North Lincolnshire Council) indicate that positive impacts on personal development and social bonds may result; notable impacts were an increase in confidence, self-esteem and engagement. Moreover, the style of delivery (informal) that promoted a positive student-leader relationship was significant as it allowed these changes in personal development to occur. In other words, there is potential for programmes such as these to bring about change in a potential offender's trajectory, and ultimately, therefore, reduce crime.

In addition, the most significant features of the programme were attendance certificates and short-term successes. These findings were significant because they contributed to the positive impacts on personal development; both the certificates and the successes gave a sense of achievement to the student that in turn raised confidence, self-esteem and engagement. The implication of this finding is the potential for it to be adopted in the planning and delivering of other similar programmes in the future.

There are other key findings, that are not concerned with the change in personal development: an additional finding is that the programme was perceived as being most suitable for those with autism. We must approach this finding tentatively, however, as it should not be assumed that only people with autism will engage with the programme and some people with autism may not engage with the programme at all. Further research should recognise the spectrum of autism and what this means for who is more likely to engage.

Furthermore, the findings of this study go beyond the hypothesis and research questions to offer an insight into the courses as a whole. For instance, a key finding of this study was the pathway to employment that is currently in development, and there is opportunity for future research to assess the proposals should they come to fruition. It is likely that if there is, this would be a major factor in changing the trajectory of an offender or potential offender. Furthermore, this research has demonstrated that the positive impacts of robotics-based far outweigh the negatives: the benefits encompass the majority of the themes but most significantly the changes in personal development. The most significant aspect for future consideration is the length of the programme, although it is not clear how factors such as funding and availability affect this.

A significant finding that was unrelated to the robotics-based programmes, but key to future delivery of all interventions, was the finding that youths had a specific dislike of authority. This is an essential finding because it has implications for the success of similar programmes and allows for the leadership style to be adapted, potentially resulting in more successful programmes in the future. Implications of this research also include the ability to develop programmes that are tailored to reduce risk-factors associated with crime and there is the potential to provide evidence to support the funding of future programmes.

The limitations of this research should also be discussed. The predominant limitation of this research was the scale of the study: six people in total took part in interviews or focus-groups. Although this was unavoidable because of the small scale of the programme, some of the results might be less reliable. Moreover, the lack of existing research into robotics-based interventions meant that there was no pre-existing research to support or question. However, research around sports-based interventions provided a framework to draw parallels with.

Finally, this research makes two future recommendations. The first is the need for larger-scale studies that include interviews with the participants of the courses. In addition, longitudinal studies, or studies engineered towards calculating recidivism or initial offending rates are needed to conclude whether robotics-based interventions are effective at reducing crime. Lastly, further research into individual impacts is needed to ensure the reliability of the results.

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8. Appendices

8.1 Appendix A

North Lincolnshire Council: Categories of Vulnerable People

RPA Engagement Programmes

Analysis and discussions with providers and key partners have identified barriers in learning for a small cohort of young people in our area. Where these barriers are faced by our young people we need to continue to support them in meeting their RPA duty, to participate in education or training until their 18th birthday.

For young people having LDD needs and for Children in Care the local authority has a continuing duty to support effective transition to adulthood.

In North Lincolnshire we have established a **RPA Engagement Panel Group that, on a case by case basis, identifies suitable engagement programmes that are bespoke to individual need** and often with alternative rather than mainstream post 16 providers. The majority of those types of providers do not access EFA mainstream funding therefore costs will need to be covered.

There is presently a small pot of money available to pay for these services. **North Lindsey College will be the fund holder, and the Engagement Panel will agree and oversee the use of the fund allocation.** To ensure equality and fairness in granting this money the following criteria has been set out:

The young person falls into one or more vulnerable category:

- Free School Meals
- SEN/LDD
- Children in Care
- Care Leaver
- Offender
- Alternative Provision (attended a substantial period in alternative provision)
- Families Initiative
- Permanent Exclusion / Poor Attender (below 50%)
- NEET (Post 16)

The young person's needs cannot be met, at present, by mainstream provision (REASONS SPECIFIED IN THE APPLICATION BELOW)

For RPA purposes the funded re-engagement activity follows the DfE guidance. Please refer to the statutory guidance: <https://www.gov.uk/government/publications/participation-of-young-people-education-employment-and-training>

The North Lincolnshire Engagement Panel will review **all approvals** for funding

The re-engagement programme for each learner must lead to a positive outcome, (participation as defined by the DfE in the RPA guidance