Reducing Self-Injurious Behaviour using non-contingent sensory reinforcement

By

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Abstract

Self-injurious behaviour (SIB) in individuals with Autism Spectrum Disorder (ASD) is a common occurrence. The behaviour can have a detrimental effect on the individual's quality of life and lead to lasting physical damages. The purpose of this research was to establish whether SIB could be reduced by using non-contingent sensory reinforcement. In previous literature, SIB has been successfully reduced using reinforcement procedures however research is lacking in use of sensory reinforcement to do this. This study focused on one individual with ASD to see whether the SIB of finger biting could be reduced using a chew necklace. Both descriptive and indirect functional assessment methods were used in order to assess the function of the behaviour. The intervention consisted of a chew necklace that was provided on a non-contingent basis throughout the day. The use of the chew necklace was successful in reducing finger biting behaviour, although further interventions are suggested in order to reduce the behaviour to zero levels. The findings are discussed and implications for future research are suggested.

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1. Introduction

Self-injurious behaviour (SIB) is a common behaviour seen in those with Autism Spectrum Disorder (ASD) (Summers et al., 2017). It can lead to huge negative impacts on the individual, both on their physical health (Iwata et al., 1990) as well as their quality of life (Maskey et al., 2013). The behaviours can have life lasting impacts on the individual, with the behaviours occurring throughout the individual's life (Oliver et al., 2012). There is an abundance of research, looking at treatment options of SIB's for those with ASD or other co-occurring conditions (Lundqvist., 2013). Many of the behavioural interventions focus on establishing the function of the behaviour and implementing a corresponding intervention (Pelios et al, 1999). However, few areas of research have addressed the intervention matching the topography of the behaviour, when the behaviour is automatically reinforced (Piazza et al., 2000).

1.1 Purpose of the Study

There is little research on sensory integration theory being an effective intervention for SIB, and whether it is effective alongside the behavioural principles of ABA. Therefore, the purpose of this study was to replicate the findings of Piazza et al (2000) and Luiselli (1994), by integrating sensory stimulation with behavioural principles in order to reduce multifunctional SIB in an individual with ASD. A 6 week follow up was then conducted in order to establish whether the findings could be maintained. The findings will be discussed as well as directions for future research in the field.

1.2 Aims of the study

The primary aim of this study was to reduce self-finger biting in an individual with ASD. More specifically, the behaviour would be reduced by using matched sensory stimulation as a reinforcement technique. A secondary aim to this study was to explore whether the results could be maintained over a 6-week period, building on a currently limited body of research.

1.3 Literature review

This section will start by discussing ASD, it's prevalence and the links between the diagnosis and SIB. One theory behind this, sensory integration theory, will be explored and how this can be linked to the behavioural approach of Applied Behaviour Analysis (ABA). A history

and outline of ABA will be provided and the section will discuss through the functions of behaviours, interventions, and the importance of linking the intervention to the function. Additionally, interventions that encompass both behavioural interventions alongside providing sensory reinforcement are assessed. Ethical implications will also be discussed in reference to the types of interventions used; as well as interventions for self-injury in particular.

1.4 Methods

This section will begin by discussing the individual who was involved with the intervention and the ethical implications surrounding this. It will then move through discussing how the target behaviour was selected and how the study was to be set up, including the materials, people to record data and the setting of the study. The section will then go into detail discussing how the baseline data was collected, and more specifically, the way in which the intervention was implemented. Each intervention condition, along with the maintenance condition, will be discussed alongside the ethical implications of the intervention, and an overview of how inter observer agreements were taken.

1.5 Results

Within this section, the data will be displayed in the form of line graphs, clustered column charts and pie charts. Each phase of the intervention will be discussed, beginning with the baseline, moving through the differing interventions and discussing the reversal element of the design. Maintenance probes will then be discussed, looking at what this means for the longevity of the intervention. Frequency of the finger biting will be discussed alongside the functions and antecedents of the behaviour and how these were manipulated throughout the study.

1.6 Discussion

This section will evaluate in detail the research outlined above, and will separately examine the strengths and limitations of the intervention in terms of the effectiveness of the intervention and the level of social validity that it held for both parents and tutors. Finally, the future research possibilities will be discussed alongside how this study has added to the current body of research.

1.7 References and Appendices

Lastly, all references will be provided below, listing in alphabetical order and in the Harvard style of referencing. The appendices will be listed below this, listed in the order they have been discussed throughout. These will include the consent and ethics forms, data sheets and questionnaires used.

Chapter 2: Literature Review

2.1 Autism Spectrum Disorder (ASD)

As outlined in the DSM-V edition, Autism Spectrum Disorder (ASD) can be categorised as a disorder with communication deficits and restrictive, repetitive behaviours that present in early childhood (American Psychiatric Association, 2013; Mahjouri & Lord, 2012). Research into ASD has increased in recent years alongside the increasing prevalence rates being reported (Matson & Kozlowski, 2011; Wing & Potter, 2002). ASD prevalence rates have risen from around 5 in 10,000 people (Fombonne, 1997) to 62 in 10,000 people (Elsabbagh et al., 2012) over the last 15 years worldwide. Research indicates that prevalence rates can vary greatly across the research and countries and cultures, with Baron-Cohen et al., (2009) finding a prevalence rate of 157 per 10,000 people in the United Kingdom, versus 24 per 10,000 people in China (Wan et al., 2013). Factors such as awareness or differences in psychiatric access (Zaroff & Uhm, 2012) could account for the cultural variation in prevalence. Many reasons for this increase of prevalence have been suggested, including early identification (Halfon & Kuo, 2013), changes to the DSM criteria (King & Bearman, 2009) and raised awareness all representing contributory factors (Dillenburger et al., 2013). Despite the increase in prevalence rates and research into ASD, the causes of ASD are still relatively unknown (Frith & Happé, 2005), with several genetic and environmental links being identified (Geschwind, 2011; Sealey et al., 2016).

As part of the diagnosis of ASD, individuals typically display repetitive movements, rigid behaviours or an altered input of sensory stimulation (American Psychiatric Association, 2013). This can manifest itself as challenging behaviours in individuals with ASD (Williams et al., 2018) and lead to individuals displaying abnormal sensory reactions (Gabriels et al., 2008), such as body rocking (Pence et al., 2019), inability to change task (Poljac et al., 2017) and eye poking (Hansen & Wadsworth, 2015). These behaviours can interfere with the individual’s day to day life and ability to learn. One theory as to why individuals with ASD have additional sensory difficulties is the Sensory Integration Theory.

2.1.1 Sensory Integration Theory

Sensory integration theory (SIT) suggests that individuals who have difficulty processing sensory information suffer negative effects on their behaviour (Schaaf & Miller, 2005), which could explain why individuals with ASD display sensory seeking behaviours such as eye poking and hand flapping (Smith Roley et al., 2007). SIT suggests that there are three core

senses: tactile, vestibular and proprioceptive (Miller et al., 2007). Tactile refers to the sense of touch, including temperature and pain changes (Hatch-Rasmussen, 1995). The vestibular system refers to the sense of movement and balance which individuals with ASD can find difficult (Siaperas et al., 2012). Finally, the proprioceptive sense refers to the sensory receptors in the muscles and joints which enable the individual to coordinate their body (Hatch-Rasmussen, 1995). Abnormalities within these three senses could go some way to explaining individuals with ASD displaying sensory seeking behaviours including behaviours that are self-injurious.

2.2 Self injurious behaviour

Self-injurious behaviours (SIB) are highly prevalent in individuals with intellectual or learning disabilities in comparison to neuro-typical populations (Cooper et al., 2009). Research has suggested that SIB can begin in early development however the cause for this has not yet been reliably established (Symons et al., 2005). Nevertheless, several risk factors for self-injury and ASD have been highlighted as significant, such as abnormal sensory processing and a higher severity of ASD (Baghdadli et al., 2003; Duerden et al., 2012). Self-injury can continue to persist over time and last through to later life (Cooper et al., 2009; Emerson et al., 2001; Richards et al., 2016). The effects of SIB can include causing detriments to the individuals health as well as having detrimental effects of the individual's ability to build relationships and have peer to peer interactions (Nguyen, 2019). Research has shown that in the US, individuals with ASD are more likely to visit the hospital with self-induced injuries than those with other intellectual disabilities or neuro-typical individuals (Kolb et al., 2016). This demonstrates the impact that SIB's have on medical services. An increase in hospital admissions may also coincide with an increase of emotional harm and stress to the individual with ASD, who may find the experience difficult to understand or process. This knowledge it indicates that specific interventions are likely to be warranted in order to reduce the damaging behaviours over the individual's lifespan (Matson et al., 2008) as well as to reduce the impact on hospital systems.

2.2.1 Definition

SIB is generally defined as an action that produces or aims to inflict harm to one's self (Matson & Turygin., 2011; Nock & Favazza., 2009). However, the definitions in much of the research suggest that 'deliberate harm is inflicted'. The 'deliberate' aspect of the definition could be questioned in individuals with severe presentation of ASD and lower cognitive abilities as certain levels of understanding would need to be present to comprehend the

resultant harm occurring following the incident. Due to the lack of a clear, unified definition, and the wide range of topographies included in 'self-injury', each individual case should be operationally defined clearly with reference to the specific behaviour being targeted.

SIB can take many forms from low to high intensity topographies (Folch et al., 2018). Low intensity behaviours may take the form, or topography, of nail picking (Ladd et al., 2009), whereas high intensity behaviours may take the form of head hitting (Leon et al., 2013), self-biting (Zaja., 2011) and hair pulling (Rapp et al., 1999). Many behaviours can fall into both high or low intensity categories depending on the magnitude of the behaviour. For example, an individual may bite themselves once without leaving marks on the skin, however another individual may pick their nails hundreds of times a day causing scarred skin and bleeding (Teng., 2003). Therefore, the physical consequence, alongside the intensity of the behaviour, must be taken into account when determining the necessity and intensity of the intervention implemented. If left untreated, SIB is known to lead to severe injury and can be extremely damaging to the individual; leaving callouses, scars and severe organ and tissue damage depending on the topography and magnitude of the behaviour (Iwata et al., 1990).

2.2.2 Self injurious behaviour and Autism

Despite SIB not being classed as a symptom of ASD, SIB has high prevalence rates within this population. Over the years there have been several studies that have highlighted the link between SIB's and ASD. Prevalence rates for SIB in people with ASD range around 30% to 50% (Richards et al., 2012; Summers et al., 2017). This is compared to rates of 12.5% for ADHD and 12.7% for Fragile X syndrome (Lundqvist., 2013); two conditions that can be co-morbidly diagnosed with ASD (Abbeduto et al., 2014; Antshel et al., 2013), indicating that SIB is more common in individuals with ASD than similar disorders. Some studies have reported that the SIB typically starts in early childhood for those with ASD (Waters and Healy., 2012). The aetiological basis for these statistics is unknown: however, Oliver and Richards (2015) hypothesised a model to explain the link between SIB and ASD. They suggested that the behaviour is classed as a repetitive behaviour as outlined in the diagnostic criterion for ASD (American Psychiatric Association, 2013). This indicates that further investigation needs to be conducted to understand whether self-injury is a key dimension of ASD or whether it is a secondary consequence. Further to this, some researchers have suggested that lower cognitive ability, a higher severity of ASD and abnormal sensory processing may be risk factors for displaying SIB (Baghdadli et al., 2003; Duerden et al., 2012). With communication deficits being a key facet of ASD, and low cognitive abilities found to be a risk factor, it would be conceivable to assume that those with

language impairments also have self-injurious or aggressive tendencies due to their frustrations of not being able to communicate their wants and needs. However, Dominick et al (2007) found evidence that those with ASD have a higher prevalence rate of SIB and earlier onset of SIB. Dominick et al (2007) found the prevalence rate between SIB and ASD to be around 32.7%. This is comparable to those with a history of language impairment, where the prevalence rate is around 12.8%, while general population studies indicate a lifetime prevalence between 4.0% (Briere & Gil, 1998) and 5.9% (Klonsky, 2011). This suggests that a communication deficit may be a contributing factor to the level of SIB the individual engages in, however other factors such as low cognitive abilities and a higher severity of ASD also influence SIB prevalence. Duerden et al. (2012) followed this with a large sampled study which suggested that functional communication ability was not a risk factor for self-injury in individuals with ASD. With large sample sizes, this suggests that communication ability is not a risk factor for SIB in individuals with ASD.

Overall, some reasons for the high prevalence for SIB in individuals with ASD have been proposed however more research is needed to establish the causes and risk factors for individuals with ASD displaying SIB. This will help clinicians to develop further successful interventions for reducing or preventing self-injury in these individuals.

2.3 What is Applied Behaviour Analysis (ABA)

Applied Behaviour Analysis (ABA) is a science, aiming to understand the variables that influence behaviours that are socially significant to the individual and their families (Cooper et al., 2014, pg 23). Behaviourism and then Experimental Analysis of Behaviour (EAB) were two psychological approaches that were used prior to ABA, and led to the approach. Behaviourism primarily investigated and outlined the theory behind the concept of behaviour (Dillenburger and Keenan, 2009). Skinner (1938) defined behaviour as any action that an organism can produce. Minshawi et al (2015) elaborated and defined behaviour as the physical form of the behaviour (topography) and the relationship between the prior environmental variables as well as the consequences of the behaviour occurring. EAB then takes the theory of Behaviourism to conduct foundational research, with Skinner's research in the 1930's focusing primarily on respondent and operant behaviour (Cooper et al., 2014, pg30). From this, experiments began to establish relations between behaviour and the environment, suggesting that behaviours that were initially viewed as involuntary (such as salivation, a respondent behaviour), could be conditioned to occur under different stimuli (Polgárdi et al., 2000; Watanabe & Mizunami, 2007). Alongside these studies, behaviours arising from operant conditioning were examined, finding that behaviours could be

influenced through previous experiences. An example of this is Skinner's rat, who learnt to press a lever in order to access food (McLeod, 2007). However, as much of this early research was conducted on animals, it arguably has little applicability to the socially significant human behaviours that ABA nowadays should be based upon (Wolf, 1978), due to the difficultly of extrapolating the results from animals to humans.

Baer et al. (1968) outlined what is meant by Applied Behaviour Analysis: that the research should always be applicable to the individual, and only target behaviours that are socially significant to that individual. The behaviours should be targeted with precise definitions of the topography of the behaviour, meaning that the behaviours must be observable and measurable. Finally, the behaviour must always be analysed, noting the importance of taking data on the behaviour and intervention that has been implemented, and demonstrating the interventions effectiveness at altering a behaviour. Baer et al. (1968) also outlined further dimensions of what ABA should include. They stated that the intervention should be replicable by other people, highlighting the importance of specifically written procedures and data, that the intervention should be based upon the principles of behaviour, and that the intervention should be generalizable, meaning that it should produce the same change in behaviour by other people and in different environments (Haring et al., 1987).

ABA has been used successfully within a number of settings and a range of individuals including those with Dementia (Heard & Watson, 1999; Trahan et al., 2011), Fragile X Syndrome (Hall et al., 2009) and ASD (Charlop-Christy et al., 2002; Axelrod et al., 2012; Odom et al., 2019). The methodologies of ABA can be used to implement interventions which modify a range of behaviours including increasing language skills (Shillingsburg et al., 2019), extending play skills (Kourassanis et al., 2015) and reducing challenging behaviour (Dowdy & Tincani, 2019; Phillips et al., 2017). In particular, early interventions based on behaviour analytic principles have been praised for their effectiveness in increasing communication, daily living skills and reducing challenging behaviours (Peters-Scheffer et al., 2011).

2.3.1 Criticisms of ABA

Despite a large body of research demonstrating the positive effects of ABA, ABA has previously been criticised, particularly by education and health professionals, who have provided resistance to implementing behavioural interventions within the individual's setting (McPhilemy & Dillenburger, 2013). Goldiamond (1974) pointed out that much of what ABA is based upon is reinforcement and punishment, which can mean depriving an individual of an

item that is then either ‘earned’ back or removed from the individual. This could have contributed towards the negative attitude that is still held by some people today. However, the most recent version of the Behaviour Analysts Certification Board Ethical Code of Compliance (BACB, 2016) has aimed to create a code of best practice for all behaviour analysts to follow. This code states that individuals have a ‘right to effective treatment’ (Code 2.09), punishment must only be used when reinforcement techniques have been exhausted and that reinforcement procedures should be used wherever possible (Code 4.08), clients have the right to the least restrictive procedures possible (Code 4.09) and that reinforcers that could cause harm to the individuals health should be minimised (Code 4.10).

Behaviour Analysts Certification Board Ethical Code of Compliance (BACB, 2016), alongside Baer et al’s. (1968) recommendations of what ABA should be, have helped to provide a more positive image of ABA in today’s society. ABA is now one of the most widely used method to support individuals with ASD in the United States, with 50 states mandating that ABA must be included in medical insurance (Fennell & Dillenburger, 2018), however it is yet to be as widely available in the United Kingdom and in surrounding countries, with ABA still considered to be one of the many treatments available (Dillenburger et al., 2012; McKenzie, 2011).

2.4 Functions of behaviour

When implementing an intervention within ABA parameters, the most important facet is ensuring that the intervention is based on the function of the behaviour (Cooper et al., 2014, pg511). There are three main functions of behaviours; positive reinforcement, negative reinforcement and automatic reinforcement (Iwata et al., 1994). Many behaviours can be classed as being multi-functional, meaning that there can be more than one antecedent to the behaviour that it is contingent on (Iwata et al., 1994). With this in mind, it is essential to attempt to identify the function of the behaviour prior to implementing an intervention to ensure that the likelihood of the intervention being successful is increased.

2.4.1 Positive reinforcement

Positive reinforcement can be defined as the addition of a preferred stimulus after a behaviour has occurred which in turn increases the occurrence of said behaviour (Cooper et al., 2014, pg278). This can be broken down into two sub-categories; access to tangibles and attention. If a behaviour is maintained by positive reinforcement, the addition of attention or a preferred item is delivered contingent upon the appearance or non-appearance of the

behaviour. This was demonstrated by Hanley et al. (1997) who reduced SIB to near zero levels by removing the adult's attention when SIB occurred. In contrast, research has confirmed that by providing non-contingent reinforcement or providing attention on a schedule, attention maintained SIB could be reduced to significantly lower levels (Ritter et al., 2018; Vollmer et al., 1993). Similarly, self-injury has also been established to be maintained through access to tangibles. Hagopian et al, (2001) found that self-injury could be reduced by introducing a functional communication response of 'toys please' which provides a more appropriate method of communicating their wants and needs.

2.4.2 Negative reinforcement

Negative reinforcement is defined as the removal of an aversive stimulus after a behaviour has occurred, that, increases the occurrence of the behaviour (Oliver, 1995). This suggests that the behaviours are learnt to function as escape or avoidance to a particular situation (Keeney et al., 2000; Slocum & Vollmer, 2015). Iwata et al (1994) found that, from an extensive analysis of over 152 single-subject cases, negative reinforcement was the most common function of SIB. This is supported by the current literature, suggesting that SIB is commonly maintained by escape contingencies. The literature has revealed that escape maintained behaviours can be reduced through several different procedures. Escape extinction procedures are one method whereby the target behaviour no longer enables escape to occur, and the original situation is continued. Tereshko & Sottolano (2017) used escape extinction in order to reduce hand biting by providing protective equipment in order to prevent access to the hand. This enabled demands to be followed through without risking harm being caused to the individual, therefore the behaviour of hand biting no longer contacted any escape. A further procedure is that of differential reinforcement of an alternative, which involves reinforcing a response to an instruction, contingent on the occurrence of a more appropriate behaviour such as compliance in this case (Veilleux, 2019). Both methods have been seen to be successful in reducing escape maintained behaviours (Berth et al., 2019).

2.4.3 Automatic reinforcement

Hagopian et al. (2015) stated that around 25% of SIB cases are maintained through automatic reinforcement. Unlike positive and negative reinforcement, which are reliant on environmental contingencies, automatic reinforcement is maintained through unobservable events, making reinforcement contingencies difficult to establish (Vollmer, 1994). These behaviours are generally believed to be maintained by sensory feedback, making

interventions difficult to implement. One characteristic of an ASD diagnosis is that the individual may display repetitive behaviours and hypo/hyper-sensitivity to sensory input, as outlined in the diagnostic criteria in the DSM-5 (American Psychiatric Association, 2013). These behaviours could take the form of hand flapping, touching tactile surfaces repeatedly or eye-poking to change the visual input that the individual takes in. This could explain the causes behind individuals with ASD seeking deeper sensory input in the form of SIB, with the severity of repetitive self-injury predicting the severity of ASD (Bodfish et al., 2000). Due to the internal reinforcement the individual receives, a successful intervention can be more difficult to implement. Rooker et al. (2018) expanded on this and established that non-contingent reinforcement is most commonly used as an intervention for a range of automatically reinforced self-injury, however there were a wide variety of treatments based on the differing reinforcement contingencies such as differential reinforcement (Bonner & Borrero, 2018) or token economies (Minshara & Kastenbaum, 1973).

2.5 Functional assessments

As discussed above, the function of the behaviour must be established before an intervention can be implemented. The same behaviours can occur for several different reasons and these reasons or functions must be taken into account (Day et al., 1994). Functional assessments are utilized in order to improve the effectiveness and quality of the interventions (Horner, 1994). There are several types of functional assessments which can be used to establish the function of a behaviour including functional analyses, descriptive observations and indirect observations.

2.5.1 Functional analyses

Arguably, the most accurate way to determine the function of a behaviour is by conducting a functional analysis (Hanley et al., 2003; Thompson & Iwata., 2007). A functional analysis must be conducted by or overseen by a Board Certified Behaviour Analysis (BCBA). The analysis aims to identify the function that the target behaviour is contingent on (Hanley et al., 2003). It is conducted in four settings, using an alternating treatment design, whereby they represent the main functions of behaviour; escape condition, attention condition, alone condition and free play condition (Carr, 1994; Iwata., 1994). Each condition is conducted individually and the target behaviour is recorded within these sessions. Within the escape condition, demands are placed upon the individual and when the individual displays the target behaviour, demands are stopped, effectively enabling the individual to escape demands if they display the behaviour. This procedure is then continued until the end of the

allotted session. Similarly, for the attention condition, attention is provided contingent on the target behaviour being displayed. If attention is removed and the individual displays the behaviour again, attention is provided and the assumption can be made that attention is the maintaining variable for the behaviour. Within the alone condition, the researcher would sit away from the individual, or ideally behind a one-way mirror, and take note of the number of times the behaviour occurs. If the behaviour occurs within this session, it would be assumed that the behaviour was occurring due to automatically reinforcing variables, with no social influencing factors. Finally, the free play condition can be seen as the 'control' condition, with the individual having access to attention and their reinforcing items throughout the session, independent of the target behaviour.

However, for behaviours such as self-injury, a functional analysis is not always appropriate. This is because a functional analysis would allow SIB's to occur which, within ABA practice guidelines (BACB, 2016), is not ethical. Whilst assessing the behaviour using a functional analysis, the behaviour could increase or be strengthened as each of the conditions are tested (Cooper et al., 2014, pg278). Borrero et al. (2002) attempted to implement a functional analysis whilst using protective equipment to reduce the level of harm that would come to the individual, however this was found to influence the overriding functions of the target behaviours, with the protective equipment reducing the frequency of the behaviour as the sessions continued. This was an extension of the work of Le & Smith (2002) who found the same results, noting the difficulty of using a functional analysis to assess SIB whilst minimising harm.

2.5.2 Descriptive functional assessments

In addition to, or in place of functional analyses, descriptive or indirect assessments can be carried out; such as observations or questionnaires. An example of a descriptive assessment is the Antecedent-Behaviour-Consequence (ABC) recording method (Appendix 1). This provides information on the antecedent of the behaviour, which enables the researcher to determine what happens prior to the behaviour occurring, in turn seeing which condition a behaviour is more likely to occur in. It then provides the topography of the behaviour shown as well as the consequence that was applied when the behaviour occurred, facilitating the researcher to establish the maintaining variable of the behaviour. This type of recording can be taken as a whole or partial time sample or across a day, for example in Powell et al., (1977). It can be argued that a functional assessment is not as accurate as a functional analysis, Thompson & Iwata (2007). They discovered discrepancies between the maintaining variable of the behaviour when assessing the behaviour using a

functional analysis and interval recording for the descriptive assessment, suggesting that there could be subjective biases to the responses provided, highlighting the importance of ensuring that the behaviour is operationally defined. In contrast, Alter et al. (2008) found consistent results using ABC recording and a functional analysis, with both assessment methods resulting in the same function being determined.

2.5.3 Indirect functional assessments

The third method of functional assessments are indirect assessments. Interviews, checklists or questionnaires are typical forms of indirect assessment that can be issued to either the individual displaying the behaviour or others who know the individual well. There are several types of questionnaires that can be used, such as the Motivation Assessment Scale (MAS) (Durand & Crimmins, 1988) or the Questions About Behavioural Function (Matson & Vollmer, 1995). Research has suggested that there is variability as to how reliable and conclusive each type of functional assessments is with one another (Alter et al., 2008; Healy et al., 2013; Tarbox et al., 2009; Wasano et al., 2009).

It is widely agreed that more than one form of functional assessment should be conducted in order to more accurately establish the function of a behaviour (Koritsas & Iacono, 2013). Paclawskyj et al. (2001) established that the MAS questionnaire agreed with traditional functional analysis techniques 54% of the time. Therefore, further functional assessment techniques should be implemented in order to strengthen this agreement.

2.6 Self-injurious interventions

Carr (1977) suggested that SIB can be maintained by positive, negative and automatic reinforcement. Therefore, the function must be established before an intervention can be implemented. In order to reduce behaviours, either reinforcement, punishment or extinction procedures can be used.

2.61 Reinforcement procedures

As outlined in BACB ethical code of conduct (BACB, 2016), reinforcement procedures should be used prior to implementing any punishment interventions. Reinforcement by definition is the addition of a reinforcing stimulus or removal of an aversive stimulus that increases a target behaviour (Ferster & Skinner, 1957). Research suggests that reinforcement procedures can be highly effective in reducing SIB’s (Heffernan & Lyons,

2016; Vollmer et al., 1993). Two reinforcement procedures that are frequently used in the treatment of SIB are outlined below.

2.6.1.1 Differential reinforcement

The most common type of reinforcement procedure used as a self-injurious intervention is that of differential reinforcement (Kahng et al., 2002). There are multiple types of differential reinforcement procedures including differential reinforcement of an alternative behaviour (DRA), differential reinforcement of an incompatible behaviour (DRI), and differential reinforcement of other behaviours (DRO). The DRA or DRI procedures involve the individual being taught an alternative or incompatible response when displaying the target behaviour. When the alternative or incompatible behaviour is used, reinforcement is provided to the individual (Mace et al., 2010). In comparison, reinforcement is provided on a fixed or variable schedule for the individual displaying any behaviours other than the target behaviour for the DRO procedures (Healy et al., 2019). Each of these procedures have been used as interventions for self-injury successfully (Dorey et al., 2009; Heffernan & Lyons, 2016; Petscher et al., 2009). Research suggests that differential reinforcement procedures can reduce SIB's quickly, with lasting effects (Cowdery et al., 1990).

2.6.1.2 Non-contingent reinforcement

Non-contingent reinforcement (NCR) differs to differential reinforcement techniques as it involves providing a reinforcer frequently, in order for the behaviour to no longer occur (Holden, 2005). The extant literature indicates that non-contingent reinforcement has been used successfully to reduce self-injury rates in individuals with ASD (Vollmer et al., 1995, Wilder et al., 2005). Before implementing a non-contingent reinforcement procedure, a time schedule must be established. This must ensure that the schedule is dense enough to supress the target behaviour, but thin enough that the individual does not satiate on the reinforcement (Fischer et al., 1997; Kahng et al., 2000). NCR has been used within the literature both with and without secondary interventions, often combined with punishment or extinction based procedures (Sprague et al., 1997; Carr et al., 2002).

2.6.2 Punishment procedures

Punishment procedures should only be used after reinforcement procedures have been attempted and unsuccessful or, if the behaviour is too severe, that an immediate and more intensive intervention is needed (BACB, 2016). A punishment procedure can be defined as

the addition of an aversive stimulus or removal of a reinforcing stimulus that causes a decrease in a behaviour (Fennell & Dillenburger, 2018). Punishment procedures have been found to be very effective in reducing SIB's (Matson et al., 2008). Two procedures that are commonly used in the treatment of SIB are outlined below.

Restraint and over correction have frequently been utilized to reduce SIB (Jones et al., 2007; Luiselli et al., 1981). Restraint can be either self, manual or physical. Using physical restraint involving others, or protective clothing, can prevent the individual from injuring themselves (Kerth et al., 2009; Silverman et al., 1984). Both procedures have been found to be effective in the literature. Dorsey et al (1982) found the use of protective equipment such as padded helmets and football gloves has been effective in reducing SIB. Similarly, short term physical restraint can be used effectively to reduce self-injury levels to near zero levels in individuals with ASD (Rapoff et al., 1980). Secondly, over correction is the action of the individual repetitively engaging in effortful behaviour in order to rectify the damage done by the target behaviour. For example, in order to reduce the number of objects thrown towards people, each time the individual threw an object, they had to apologise to the other person and, pick objects up from the floor for 5 minutes (Matson & Stephens, 1977). In accordance with ethical guidelines, punishment is often used alongside reinforcement procedures in order to teach alternative behaviours (Measel & Alfieri, 1976; Persel et al., 1997).

2.6.3 Extinction procedures

An extinction procedure is a procedure whereby the individual no longer receives reinforcement for the behaviour shown, resulting in a decrease in behaviour. Extinction procedures are often used alongside other treatment procedures to reduce behaviours (Pace et al., 1993). Unlike reinforcement and punishment procedures, extinction procedures have distinct negative side effects including extinction bursts (Lerman et al., 1999). Extinction bursts occur when a behaviour is no longer reinforced and the individual escalates the behaviour in order to gain a response, before ceasing the behaviour altogether (Minshawi et al., 2015). Therefore, extinction procedures alone are rarely used with SIB due to the potential intensity of the behaviour during the extinction intervention. Research has suggested that these effects can be negated when combining extinction with other procedures such as NCR (Lerman et al., 1999).

2.6.4 Reinforcement, punishment or extinction procedures for self-injurious behaviour, which has the best outcomes?

Within the body of research, there is varying evidence for whether reinforcement or punishment procedures are more effective. Morano et al. (2017) found that using a combined intervention package of both reinforcement and punishment procedures was the most effective in reducing SIB whereas Kahng et al (2002) found that reinforcement procedures alone as an antecedent intervention had a 100% success rate in comparison to punishment or extinction combinations. There are suggestions that punishment procedures may reduce the challenging behaviour quickly however they can have a shorter-term impact on the behaviour compared to reinforcement procedures (Morano et al., 2017). In contrast, reinforcement procedures can be slow acting however often teach a replacement, appropriate behaviour and therefore have a more positive long-term impact (Favell et al., 1982). Despite this, Pelios et al (1999) suggested that, when choosing an intervention based on the function of the behaviour, reinforcement procedures can be more effective than punishment procedures, reducing the need for more intense interventions. Because interventions should be individualised to the client, the procedure that will be most effective for that individual should always be used.

2.7 Integrating sensory stimulation with reinforcement procedures

There is a growing body of work which has explored the integration of sensory stimulation alongside traditional ABA procedures. As previously mentioned, individuals with ASD often have additional sensory needs due to an altered sensory input. Interventions based on SIT suggest that by using sensory based activities, self-stimulatory behaviours can be reduced, such as vocal stereotypy, enabling the individual to engage in more functionally appropriate activities (Smith et al., 2005). Specifically, chew necklaces have been found to be successful in reducing automatically reinforcing behaviours of saliva play in individuals with ASD (Luiselli et al., 2004).

Varying success is reported for interventions with SIB, with some studies suggesting that sensory stimulation such as the use of weighted vests or chewable toys have reduced levels of SIB (Favell et al., 1982; Sandler & McLain, 2007) whilst others find no significant changes, with behavioural interventions alone being more successful (Lang et al., 2012; Devlin et al., 2009). However, those who have conducted a functional analysis prior to implementing a sensory integrative intervention, or have used behavioural interventions alongside, have demonstrated a greater reduction in SIB (Fevell et al., 1982; Piazza et al., 2000). Luiselli (1994) was able to reduce PICA like symptoms of mouthing objects to near zero levels when offered a functionally equivalent stimulus to chew on, on a non-contingent basis, therefore combining both reinforcement and sensory stimulation techniques.

2.6. Topography based interventions

Where a behaviour occurs under several behavioural functions, an intervention based on the topography of the behaviour may be more effective. A topography based intervention will address what the behaviour is as opposed to the function, and why the behaviour occurs (Manente et al., 2010). Utilizing an intervention that addresses both, could lead to a more effective intervention. In addition, when reducing a behaviour, a functional replacement should be found. Ladd et al (2009) found that by providing an object to manipulate, the target behaviour of finger picking was reduced. Similar results were found by Donnelly and Olczak (1990) who demonstrated that by using placebo PICA stimuli, that was topographically the same to the cigarette butts that were ingested. This suggests that behaviours can be reduced by finding a functional equivalent behaviour to replace it with.

2.8 Maintenance of self-injurious behaviour interventions

Previous research has suggested that severe behaviours such as aggression and SIB can be persistent over time and often resurge following a seemingly successful intervention (Podlesnik & Kelley, 2017). Therefore, when considering an intervention for SIB, it is important to assess the extent to which the behaviour reduction can be maintained over time. Research has suggested that the use of behavioural interventions such as differential reinforcement and escape extinction have been found to reduce SIB, and maintain treatment effects for up to 35 months (Heidorn & Jenson, 1984); despite the function of the behaviour (Lydon et al., 2017). Further to this, Foxx (1990) found that SIB could be reduced to levels whereby it was no longer causing tissue damage through a combination of reinforcement and punishment procedures. Levels stayed low over a nine year follow up with no punishment being used, with the behaviour no longer resulting in tissue damage. This supports the notion outlined in Code 4.08 (BACB, 2016). This states that when implementing an intervention based on punishment procedures, there should be a plan on how to remove the intervention when it is no longer needed, suggesting that they should not be used on a long-term basis (BACB, 2016). There is limited research that utilizes sensory reinforcement as an intervention which also addresses ability for the results to be maintained over a period of time. This study will aim to assess the ability for results to be maintained across a 6-week period.

3. Methods

3.1 Participant

For the purpose of this paper, a pseudonym was used for the participant, and they have therefore been referred to as Alex throughout. Alex was an 8-year-old boy who has a diagnosis of ASD, Global Developmental Delay, Language and Communication delay, Sensory needs and PICA. He was non-verbal and used Makaton sign language to communicate his wants and needs. Alex was educated in a specialist ABA/VB School and received his education there for the past one and a half years. Within the school, a mix of group learning sessions, Intensive Teaching Trial (ITT) sessions, Natural Environment Teaching (NET) sessions and manding sessions were employed to encourage and promote generalisation of skills across settings. He was being educated using the Verbal Behaviour Milestones Assessment Placement Programme (VB-MAPP, Sundberg, 2008) as well as the Essentials For Living (EFL, McGreevy, Fry & Cornwall, 2012) programmes for tolerance goals. From this, Alex had an Individualised Education Plan (IEP), devised by the Board Certified Behaviour Analyst (BCBA) who leads and supervises the class. This is then implemented by Alex's two tutors who are trained in depth in the programme by the Class Supervisor and Instructor.

The VB-MAPP has three levels; 0 to 18 months, 18 - 30 months and 30 - 48 months. Individuals systematically work through the VB-MAPP assessment tool which encompasses skills such as requesting, imitation, group and social skills as well as numeracy and literacy; covering all verbal operants. Alex was working at around Level 1 (0-18 months) with some emerging skills in Level 2, such as matching, requesting and group skills (Appendix 2). Alex had around 20 Makaton signs that he used each day to request items that he enjoyed such as 'tickles', 'drink' and 'shaker'. The EFL curriculum tool was also used in order to teach tolerance goals such as medical procedures, which Alex found aversive.

3.2 Ethics

Before commencing this study, ethical approval was sought from the University ethics committee in the School of Social Sciences, Education and Social Work department. This involved completing an ethical application form (Appendix 3) and making minor amendments (Appendix 4) to ensure that the study was cleared by the ethics committee. Once ethical approval had been granted (Appendix 5), information sheets (Appendix 6) and consent forms were distributed to those taking part in the study. The consent forms were

individualised and sent to the parents of the participant (Appendix 7), staff members who would be helping to implement the intervention (Appendix 8) and the head of the school where the intervention would be taking place (Appendix 9). The research only began to take place once consent had been gained from all of the above. The target behaviour discussed within this piece of research was chosen to be targeted due to the level of injury being sustained by Alex. Despite Alex also having a PICA diagnosis, the PICA was managed by removing those items commonly ingested from the Alex's environment such as sand, playdoh and marbles. The behaviour of biting his own finger was occurring at a high rate, leaving callouses on the Alex's hand and causing a bend in the finger, and was therefore deemed to be the most harmful behaviour to Alex at this time. Typically, when implementing an intervention to reduce a behaviour, a functional analysis is conducted in order to establish the function of the behaviour, enabling the intervention used to target the correct function and improve treatment efficacy. However, due to the nature of the intervention, and the target behaviour being SIB, it was deemed unethical to implement a functional analysis. Therefore, functional assessments in the form of questionnaires and antecedent-behaviour-consequence (ABC) data were administered instead. This was to ensure that there was no risk of the behaviour increasing during the initial phase.

3.3 Setting of the study

The study took place in Alex's school setting as it is an ABA/VB school. The intervention was conducted by Alex's tutors under the supervision of the researcher and the class BCBA. Alex's key tutor conducted the intervention from Monday to Wednesday, and his second tutor conducted the intervention on Thursdays and Fridays on the weeks that the intervention was in place. The two tutors implemented the intervention across all aspects of the day including in ITT, NET and group sessions within the classroom, playground and soft play and sensory rooms.

3.4 Target Behaviour

In order to ensure that the same behaviour was being recorded by each individual, the target behaviour needed to have been operationally defined. The target behaviour focused on for this study was operationally defined as 'finger inserted into Alex's own mouth and teeth clamped down'. The behaviour was deemed to have begun when the teeth clamped down on Alex's finger and ended when the teeth moved away from the finger. If the teeth were lifted from the finger and he bit his finger again this would be classed as a second finger bite.

3.5 Materials

The materials needed for the baseline data to be collected included the MAS questionnaire, which was distributed to both tutors who worked with Alex. Antecedent-behaviour data sheets were used to record the daily data each day and were then inputted onto a password protected online system each evening. The raw data sheets were then destroyed once the data had been inputted online. For the intervention, two chew necklaces were used, both attached on an individual piece of string, which was placed around Alex's neck. Once the intervention had been completed, a Social Validity Rating Scale was given to both tutors who worked with Alex throughout as well as his parents.

3.6 Design

This research study utilises a single subject case design. The research method initially implemented was an A-B design whereby A was the baseline and B was the intervention. Due to the initial chew necklace breaking, a second necklace was introduced. These were denoted by B1 (first necklace) and B2 (second necklace) for the purpose of the study. However, due to the chew necklace not being returned to school, the design was changed to a reversal design (A-B1-B2-A-B2-C-B2) design. This enabled the researcher to establish whether the intervention could be effective, without having to deliberately remove the intervention. After the intervention had been completed, maintenance probes were taken in order to establish the effectiveness of the intervention long term.

3.7 Inter Observer Agreements

Each individual involved with the data taking process had time to complete inter-observer agreements (IOA) with the researcher throughout the intervention. This was to ensure that everyone was recording the data in the same manner and with the same level of accuracy to ensure high levels of treatment integrity (Cooper et al., 2014, pg133). The researcher aimed to ensure that blind IOA sessions were conducted alongside the tutors for 15 minute sessions to ensure accuracy. This would help to ensure that the tutors did not alter their behaviour on the basis that they were being observed. These sessions were conducted throughout the length of the study, across multiple settings, to ensure behavioural drift did not occur with the tutors and to maintain at least 90% accuracy in data taking (Sandler & McLain, 2007). If the IOA scores dropped below 90%, verbal feedback was provided to tutors to ensure accuracy was maintained and IOA sessions were conducted more frequently until the target accuracy was achieved.

Within the IOA sessions, the tutor implementing the intervention had access to their data sheet at all times. The researcher had access to the same IOA data sheet and a timer. When the tutor started the next 15-minute session, the researcher started their timer and took note of each instance that the target behaviour occurred. At the end of the 15 minutes, both data sheets were analysed and trial by trial IOA was calculated by using the following formula:

$$\frac{\text{Number of trials in agreement}}{\text{Total number of trials}} \times 100$$

3.8 Baseline

Prior to baseline data being recorded, the Motivational Assessment Scale (MAS) was completed by the two tutors who work with the Alex (Durand & Crimmins, 1992). This was to establish the function of the target behaviour, and ensure reliability within the results.

The MAS (Appendix 10) is a 16-point questionnaire which assesses each question on a Likert scale of 0-6 from ‘never’, ‘almost never’, ‘seldom’, ‘half the time’, ‘usually’, ‘almost always’ and ‘always’. Examples of the questions asked are ‘Does the behaviour occur following a request to perform a difficult task?’ and ‘When the behaviour is occurring, does this person seem calm and unaware of anything else going on around her/him?’ The score from each question is totalled into subscales to establish the perceived function of the target behaviour. The scores are broken down into five functions of behaviour; sensory, escape attention, escape demands, attention and tangible. The function with the highest score is then taken as the most likely function of the behaviour. The MAS has been used successfully in research conducted with those who display self-injurious or aggressive behaviours (Bihm et al., 1991), with Durand and Crimmins (1988) finding the questionnaire to be a reliable predictor of the function of behaviours.

Baseline data was also taken by Alex’s two tutors in the form of a descriptive functional assessment, using an antecedent-behaviour data sheet (Appendix 11). Data was recorded within each session, broken down by the antecedent of the behaviour, such as ‘interruption’, ‘told no’ or ‘demand’. This helped establish which activities the behaviour occurred in more frequently, such as an ITT session or soft play time, as well as the antecedents within the

activity, to support the MAS questionnaire previously delivered and enable the main functions to be established. For example, the data taken would be ’15 minute sessions, ITT, 1 demand, 4 sensory, 3 interrupt’. This data was recorded for 5 days for the data to stabilise and to ensure that both tutors taking the data had inter-observer scores above 90% with the researcher. If Alex displayed the behaviour of finger biting whilst the baseline data was being taken, he was asked to fold his hands. This provided an incompatible response and was previously found to be ineffective. This may have been due to the lack of alternative sensory reinforcement, something that this intervention aimed to introduce.

3.9 Intervention

The intervention took place in several phases, as outlined in the design section. There were two main interventions, with a variation of the first intervention. How the intervention was implemented will be discussed below.

3.9.1 Intervention B1

The data from the functional assessments, including the MAS and ABC data, suggested that the target behaviour of finger biting was multifunctional with elements of automatic, positive and negative reinforcement all maintaining the behaviour, but concluded that automatic reinforcement was the overriding maintaining function. Due to the sensory input being received through his finger as well as his mouth, a chew necklace was introduced as the chosen intervention, non-contingent on the target behaviour. If an immediate decrease in the finger biting behaviour was seen with the chew necklace, this would suggest that the behaviour was being maintained through the sensory input from his mouth. The necklace was the shape of a Lego block (see Figure 1 below), providing an alternative behaviour that had stimulus similarity to the target behaviour. This was chosen because matched stimuli have been suggested to be more effective (Piazza et al., 2000).

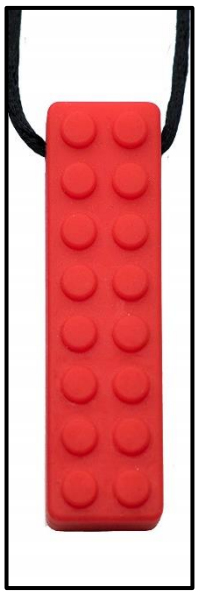

Figure 1: The first chew necklace that was introduced. Picture taken from: https://www.amazon.co.uk/Chew-Sensory-Teether-Necklace-2-Pack/dp/B07BX8ZNVV

It was placed around Alex's neck when he was collected from the car in the morning on his arrival at school, was kept on throughout the day, and removed when he arrived at the car to travel home, enabling the intervention to be in place for 6 hours a day. He was allowed to chew on the necklace at any time throughout the day. If Alex engaged in the behaviour of finger biting, the chew necklace was offered as a replacement, to provide an incompatible alternative, which provided stimulus similarity, until the finger was removed from the mouth. The finger was never physically removed from the mouth as this was previously found to increase the intensity of the bite. When Alex chewed on the chew necklace, social praise was given. Examples included 'good job using your chew necklace' and 'well done for chewing on the chew necklace'. Intervention data was taken on the same data sheet as the baseline data (see Appendix 11).

3.9.2 Intervention B2

Throughout the intervention, due to the intensity of the use of the chew necklace that was first introduced, Alex chewed through the chew necklace within the first three days of the intervention being in place. A new chew necklace was introduced the following day, however this was a rounded shape and therefore displayed less stimulus similarity to the target behaviour, however was still matched to the sensory input gained from finger biting. This is demonstrated in Figure 2 below:

Figure 2: The second chew necklace that was introduced. The picture was taken by the researcher.

3.9.3 Reversal of the intervention

Five days into the intervention, the chew necklace was not sent into school for two consecutive days. This turned the intervention into a reversal (A-B1-B2-A-B2) design which would not have otherwise been ethical to include in the study. It would have been considered to be unethical to remove an intervention that was successful, where the removal of the intervention could have caused an increase in SIB (BACB, 2016). However, due to naturally occurring external factors outside of the researcher's control, the intervention was able to be assessed as a reversal design.

3.9.4 Intervention C

After the data had stabilised, a follow up intervention was introduced in order to target finger biting under other antecedents such as 'transition', 'denied access' and 'interrupts'. Therefore, when the demand was placed to transition or an item was removed (interrupt), the chew necklace was immediately offered to Alex as an antecedent manipulation, to anticipate finger biting. However due to the target behaviour increasing, this intervention was removed after three days, altering the design to: A-B1-B2-A-B2-C-B2.

3.9.5 Maintenance

After 6 weeks of summer holidays, the intervention (B2) was re-implemented in order to assess whether the previous intervention levels of finger biting had been maintained. The intervention was implemented in the same environment under exactly the same contingencies as in the previous intervention conditions. Only four days of data could be collected due to the chew necklace splitting down the middle and it became unsafe for Alex to use due to choking or swallowing hazards.

3.10 Social Validity

Baer et al (1968) stated that a characteristic of ABA is that the intervention should be effective. This in part means that the intervention should hold significance for the individual and their family. Social validity refers to the extent to which the intervention is socially significant and appropriate for the individual and their families (Wolf, 1978), and the idea of assessing social validity should be common practice to those working in the field of ABA (Schwartz & Baer, 1991).

Alex's parents had expressed their concerns about the behaviour, and their eagerness to implement an intervention prior to the study commencing. The finger and area around it was becoming calloused and the skin was cracking, leading to the intervention being implemented as a priority for his health. Due to Alex's parents' willingness to target this behaviour, the target behaviour held social validity. Social validity questionnaires for the intervention were provided to both tutors who implemented the intervention as well as Alex's parents (Appendix 12). The social validity questionnaire held 5 questions which were rated on a Likert scale from 1 to 5, with 1 meaning 'strongly disagree' and 5 meaning 'strongly agree'. Due to the intervention being implemented within the school setting, the tutors witnessed first-hand the effectiveness of the intervention and therefore were asked for their views as well as his parents.

4. Results

4.1 Baseline

The purpose of this study was to reduce SIB in an individual with ASD using reinforcement techniques alongside sensory stimulation. As per the BACB ethical guidelines (BACB, 2016), all data was graphed and analysed accordingly throughout the intervention. Prior to the intervention being implemented, the MAS questionnaire suggested that automatic reinforcement was the overriding maintaining variable with positive reinforcement being the second, followed by negative reinforcement. Baseline data from the ABC data also showed finger biting behaviour to be multifunctional, occurring under all antecedents of behaviour at a rate between 50 and 120 times a day, with a mean occurrence of 66 finger bites per day (see Figure 3 and Figure 4 below).

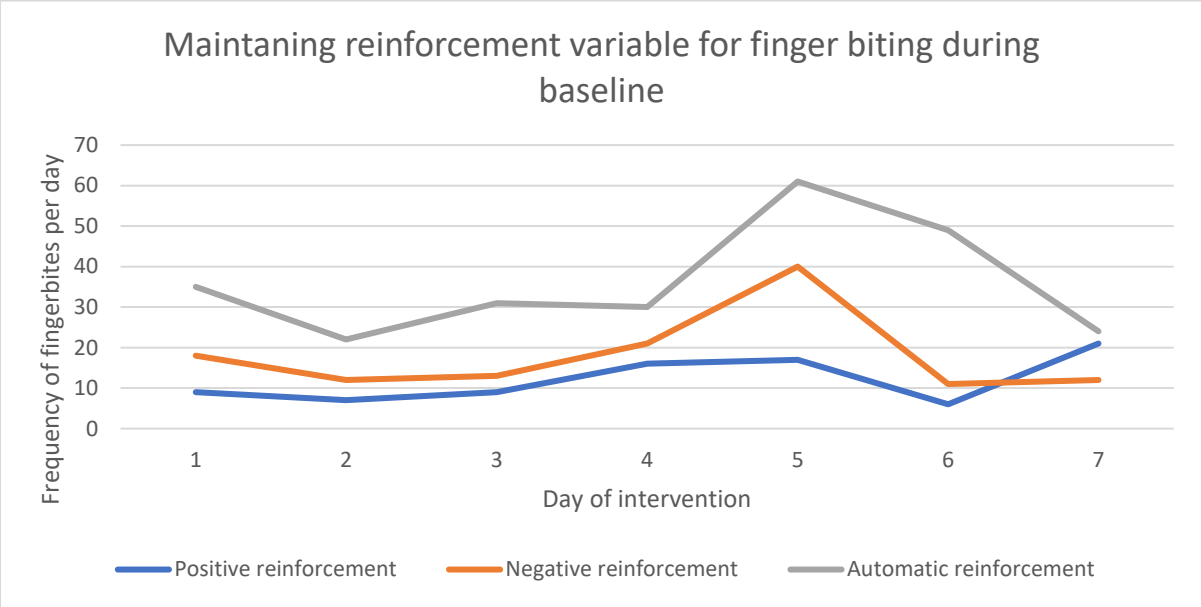

Figure 3: Line graph outlining the maintaining reinforcement variable of finger biting throughout baseline, from ABC data.

However, from Figure 4, it can be established that ‘demands’ and ‘sensory’ are the two most common antecedents that the behaviour occurs after, with sensory being the highest influencing maintaining variable. Both functional assessment methods suggested that automatic reinforcement was the main function of the behaviour, however provided different conclusions relating to the relative contribution of the remaining functions of behaviour,

therefore indicating that there were limitations to the convergent validity between the two measures.

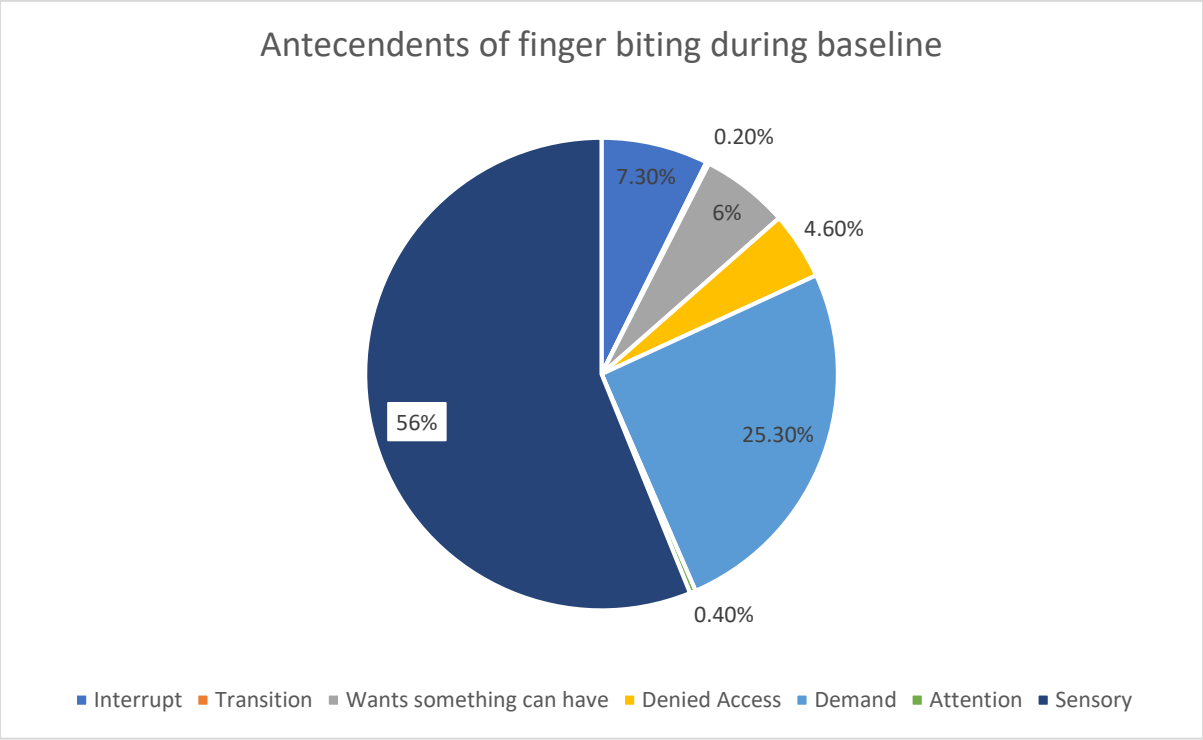

Figure 4: Graph outlining the antecedents that finger biting occurs under throughout baseline from ABC data by percentage.

4.2 Chew Necklace Intervention – Intervention B1 and B2

Figure 5 below displays the overall frequency of finger biting. As shown, once the intervention was implemented, an immediate reduction in the target behaviour was seen. In day 9, there was an increase in the behaviour to 72 finger bites throughout the day. There are several factors that could have contributed to this increase.

Finger biting then dropped back down to below baseline levels. By the end of day 10, Alex had chewed through the first chew necklace completely. Therefore, on day 11, a new chew necklace was introduced (Intervention B2). Despite the second chew necklace being a different shape to the previous necklace, and having less stimulus similarity with his finger, no increase in the finger biting behaviour was seen.

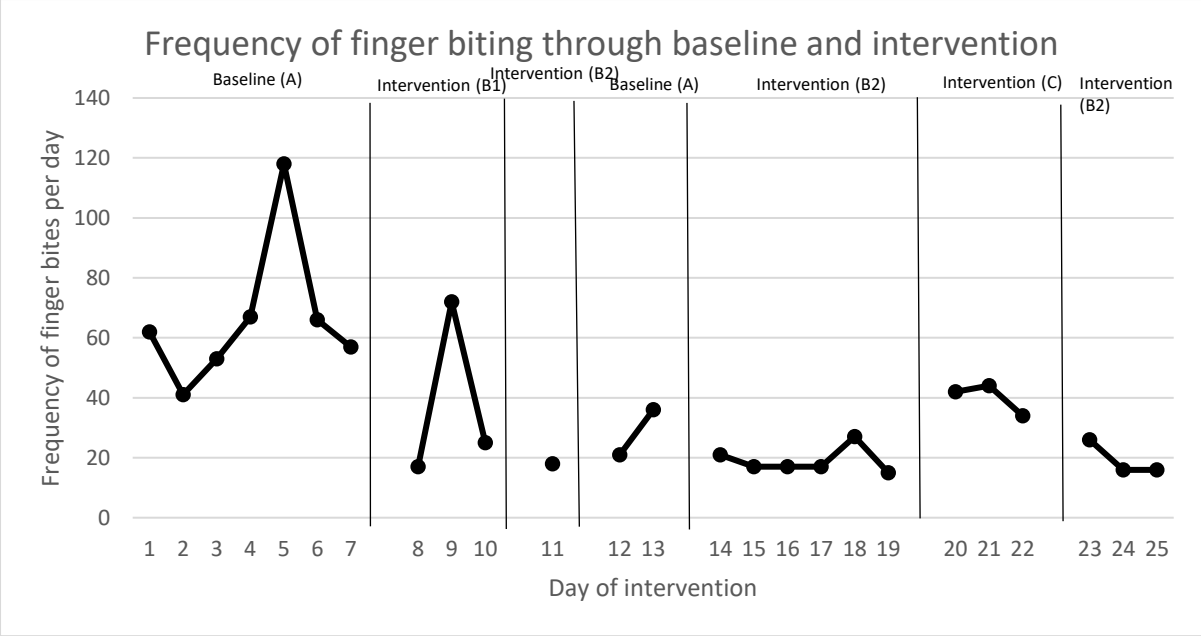

Figure 5: Overall frequency of finger biting behaviour

Day 12 and 13 are treated as occurring under a reversal condition due to the chew necklace not being sent back into school. Despite this, finger biting levels remained low but did begin to increase on the second day (up to 36 finger bites per day), near to the lowest baseline levels (lowest baseline frequency was 41 finger bites per day). Once the chew necklace was sent back into school, levels remained low with an average of a 71% decrease in the target behaviour from baseline data to day 19, with a mean number of finger bites of 19 per day.

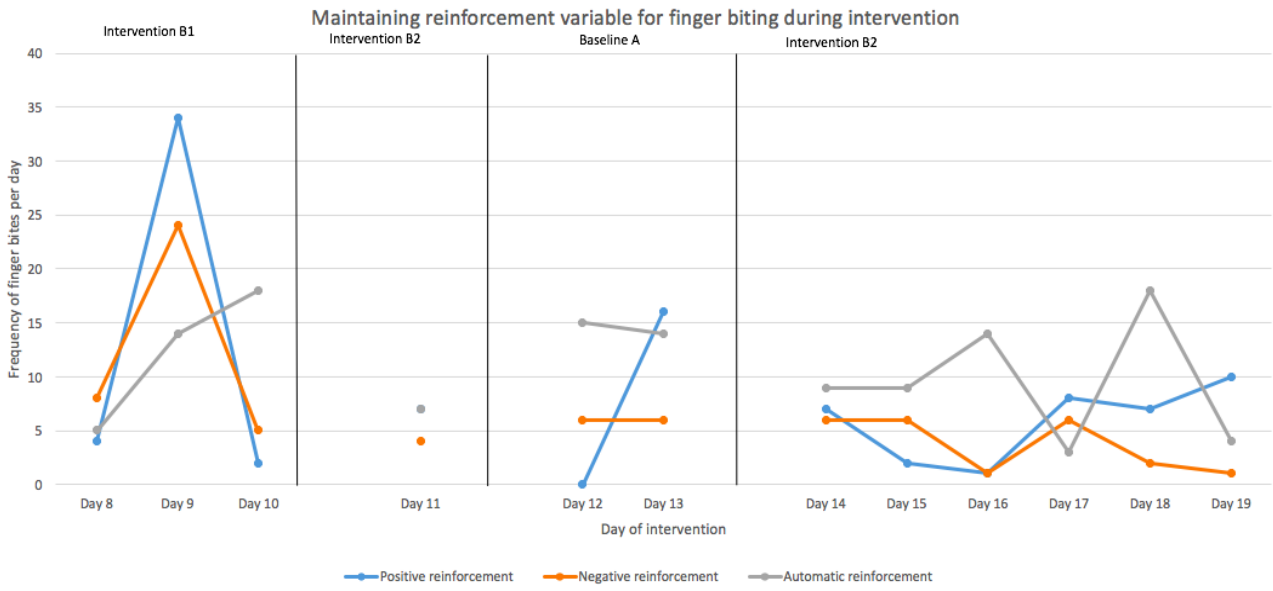

Figure 6: Line graph to show the maintaining reinforcement variable for finger biting throughout chew necklace intervention

When establishing the maintaining reinforcement variable for the baseline, Figure 3 shows that automatic reinforcement was the clear maintaining variable. Conversely, Figure 6 demonstrates that there was no longer a clear maintaining variable throughout the chew necklace intervention. During the steady intervention from day 15 to day 19, both positive and negative reinforcement remained low, with less than 10 finger bites per day, per function. This is in comparison with the number of finger bites under automatic reinforcement fluctuated between 3 and 18 per day. During the reversal period where contingencies were reverted back to baseline, both negative and automatic reinforcement contingencies stayed relatively steady whereas the finger bites under positive reinforcement increased from 0 to 16. This suggests that the removal of the chew necklace had a larger effect on those finger bites that were maintained by positive reinforcement.

When evaluating the data from the intervention, excluding days 12 and 13 due to the lack of access to the chew necklace, there was a reduction in finger biting under almost all antecedents. This is demonstrated in figure 7. The largest reductions were seen under the antecedents of ‘sensory’ and ‘demand’, with a mean reduction of 25.9 and 11.5 finger bites per day respectively. There was little difference seen under the antecedent ‘interrupt’, and there was an increase in the number of finger bites that occurred under ‘transition’ from 0.1 to 1.6 mean finger bites per day.

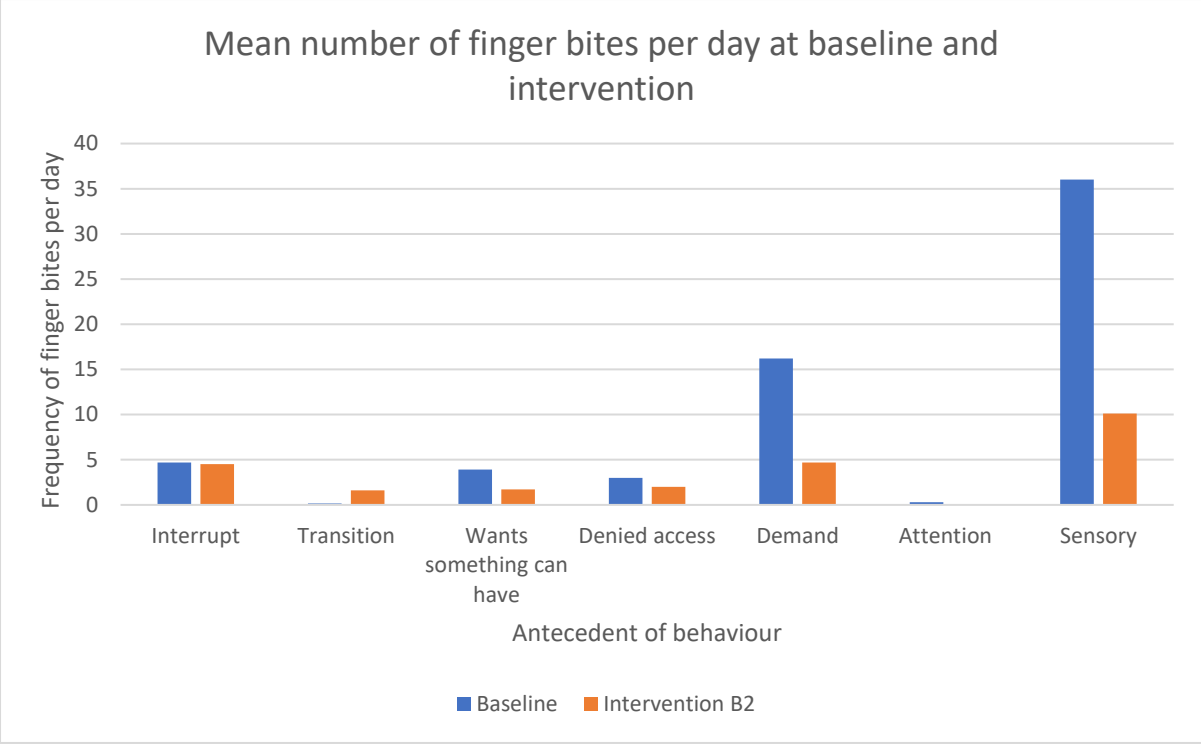

Figure 7: A graph to show the mean number of finger bites per day at baseline and intervention. Intervention data was taken from day 8 to day 11 and day 14 to day 19 inclusively.

4.3 Chew Necklace Intervention - Intervention C

As seen in Figure 7 above, there was little to no change or an increase in ‘interrupt’ and ‘transition’ categories. There was some decline under ‘denied access’. Therefore, a further intervention was introduced whereby the chew necklace was offered by the tutor to Alex as one of these antecedents were placed, in order to anticipate a finger bite and offer an immediate incompatible response. However, as demonstrated below in Figure 8, this was unsuccessful: finger biting rose above baseline levels under the ‘interrupt’ antecedent, and above previous intervention levels for the four other antecedents. The only decrease in finger biting was seen under ‘denied access’.

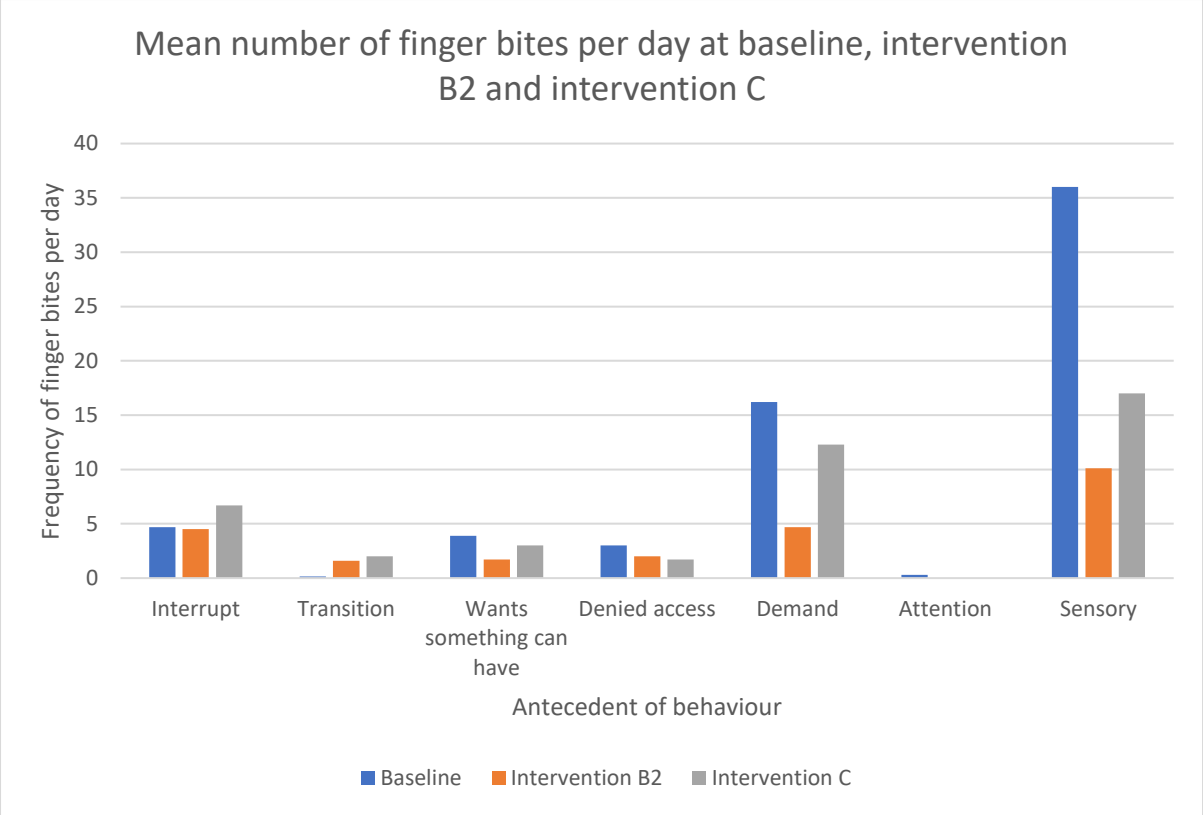

Figure 8: Comparison bar chart of the mean frequency of finger bites under antecedents, for baseline, Intervention B2 and Intervention C.

Due to the frequency of finger biting raising to above the lower baseline levels on day 20 and day 21, it was decided to remove the intervention and return to intervention B2 (see figure 5 above). Finger biting levels were maintained and stayed similar to pre-intervention C levels.

4.4 Maintenance

After a 6-week summer break, the intervention was reintroduced. As Figure 9 shows below, the finger biting behaviour increased to 35 finger bites on average per day. This is an increase in finger bites in comparison to previous intervention phases however the behaviour is still at lower levels than the lowest baseline data point. The maintenance probes show stability with a downward trend.

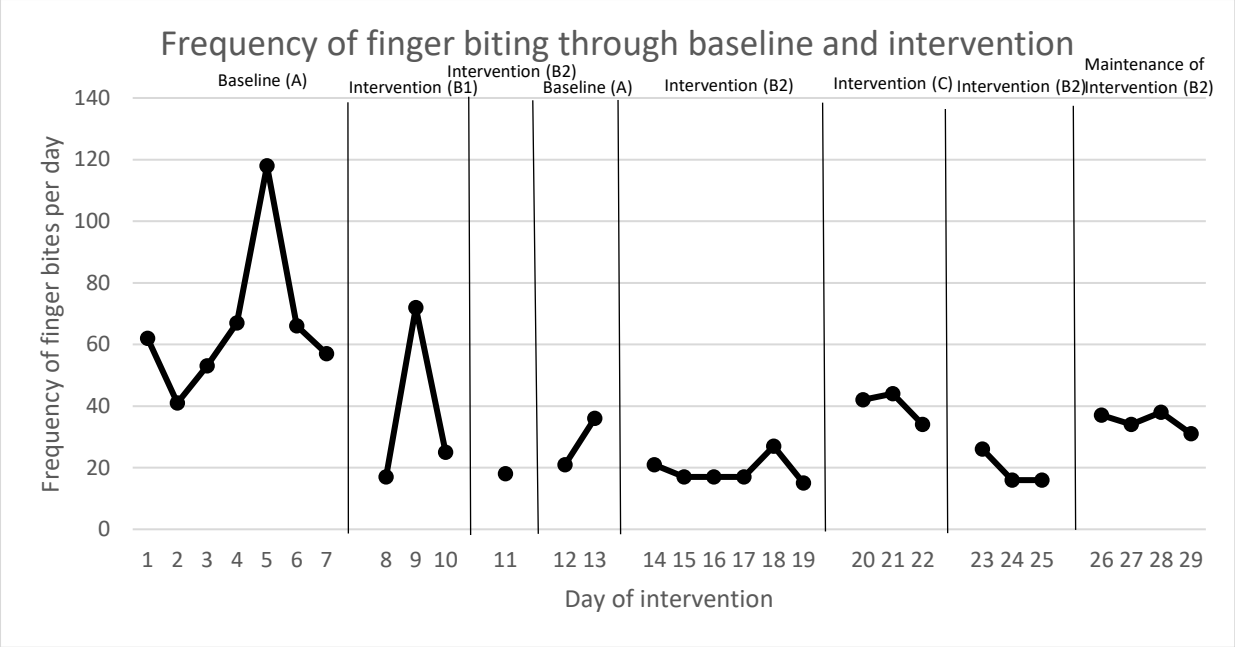

Figure 9: A graph to show the frequency of finger biting through baseline, intervention and maintenance.

4.5 Social validity

Table 1 below outlines the results provided from the two tutors that worked with Alex. The mean response was calculated.

Statement number	Statement	Average response
1.	Reducing finger biting was important for me and my child	5
2.	My child's finger biting behaviour has reduced since the intervention began	4.5
3.	This intervention was easy to understand	5
4.	The condition of my child's finger has improved	4.5
5.	I feel that the chew necklace interfered with my child's learning	2.5

Table 1: A table to show the mean response per question from two tutors.

The results were rated on a scale from 1 to 5, with 1 meaning 'strongly disagree' and 5 meaning 'strongly agree'. As seen in Table 1, both tutors rated the intervention highly in

reducing the target behaviour, being easy to understand and improving the condition of Alex's finger. The tutors also rated the chew necklace to have little interference on Alex's ability to continue learning, enabling Alex to continue with his programme.

The parents were also asked to rate the intervention on the Social Validity Rating Scale. The results can be seen below in Table 2.

Statement number	Statement	Response
1.	Reducing finger biting was important for me and my child	5
2.	My child's finger biting behaviour has reduced since the intervention began	5
3.	This intervention was easy to understand	5
4.	The condition of my child's finger has improved	5
5.	I feel that the chew necklace interfered with my child's learning	3

Table 2: A table to show the response per question from Alex's parents.

Alex's parents responded answering 'strongly agree' to all aspects of the intervention except the final statement. The final statement of 'I feel that the chew necklace interfered with my child's learning', was answered with 'neither agree nor disagree'. This was a similar result to the views of the two tutors who also worked with Alex.

5. Discussion

There were two aims to this study. The first aim was to reduce SIB in an individual with ASD using reinforcement and sensory stimulation techniques. This replicates, to an extent, the research by Piazza et al. (2000) who applied a behavioural intervention alongside sensory stimulation to automatically reinforced behaviours. The intervention matched the topography of the problem behaviour, and was successful in reducing the target behaviour of hand mouthing by doing so. Additionally, Luiselli (1994) was also able to reduce inappropriate sensory seeking behaviours such as object mouthing and grabbing by replacing the behaviour with a non-contingent chew toy. Therefore, this study represents an extension of this research, exploring whether multifunctional SIB's could be reduced through combining a behavioural intervention with sensory stimulation.

At the outset, finger biting for Alex was maintained by all three reinforcing variables; positive reinforcement, negative reinforcement and automatic reinforcement. Automatic reinforcement was found to be the key variable maintaining the behaviour. The results from this study showed an overall decrease in the target behaviour, reducing it by around 71% using a chew necklace, non-contingent on the target behaviour. Using non-contingent reinforcement to decrease SIB has been established in previous research as being effective in reducing SIB to low levels (Vollmer et al., 1995; Wilder et al., 2005).

Prior to the intervention beginning, the function of the target behaviour was established. This was assessed through the MAS questionnaire and antecedent-behaviour data. With these two measurements combined, it was concluded that the behaviour was primarily automatically reinforced but also functioned as to escape demands or transitions, as well as to access tangible items. However, the measures disagreed with the secondary functions of the behaviours, suggesting that they may lack convergent validity.

The initial intervention (Intervention B1) involved the chew necklace being placed around Alex's neck throughout the day, enabling him to access the chew necklace on a non-contingent basis. This provided Alex with an incompatible alternative to biting his finger, and was a matched alternative in terms of similarity to his finger. This intervention was shown to be successful in Figure 5, as an immediate decrease was seen. On the second day of intervention (day 9 on Figure 5), an increase was seen to 72 finger bites throughout the day. This was a rise back to the average of finger bites throughout baseline and was a cause for concern for the researcher. The number of finger bites under automatic reinforcement remained lower than baseline on that day, however the number of finger bites under the

antecedents ‘interrupt’ and ‘demand’ dramatically increased, returning to baseline or higher than baseline levels. On day 9, Alex also had significantly more other challenging behaviours throughout the day than typical levels. Other challenging behaviours included throwing, crying and bolting. The following day, finger biting reduced back down to below baseline levels and therefore the intervention continued. Therefore, it may have been that there was a higher incidence of finger biting due to him experiencing a more challenging day.

After three days of intervention, due to the intensity, magnitude and frequency of biting that the chew necklace had undergone, Alex chewed through the first chew necklace completely. A second chew necklace (Intervention B2) was then introduced, however it was rounded in shape and therefore had less stimulus similarity to Alex’s finger. Despite this, according to Piazza et al (2000), the second chew necklace was still a matched stimulus as it served the same function as the finger. No rise in behaviour was seen with the alternative chew necklace, suggesting that the level of stimulus similarity had no effect on the behaviour. This suggests that despite the lack of stimulus similarity to the finger, the second chew necklace was still a matched stimulus and continues to provide sensory reinforcement similar to that of the finger, and provides similar reductions in behaviour. Therefore, it suggests that as long as the stimulus is matched to the topography of the behaviour, and the sensory feedback provided, the level of stimulus similarity is insignificant.

Following this, the chew necklace was accidentally sent home. It was then not returned into school for two days. This altered the design to a reversal design. This period demonstrating the impact of the necklace intervention. During these two days, no intervention was implemented, and the finger biting behaviour remained below baseline levels. This provided promising results for when the intervention could be later faded out. The number of finger bites did begin to increase to 36 finger bites per day, which with prolonged removal of the chew necklace, could continue to increase to baseline levels. The chew necklace was sent back in and the intervention was implemented for 6 continuous days with the behaviour continuing to decrease, to as low as 15 finger bites per day.

As shown in Figure 6 above, once the chew necklace was introduced, there was no longer one single key maintaining variable of finger biting with the behaviour being maintained evenly between positive, negative and automatic reinforcement. Figure 7 shows that the chew necklace had the largest effect on those behaviours maintained by automatic reinforcement (sensory) as well as finger bites that occurred under the antecedent ‘demand’.

In order to further reduce the target behaviour, an additional antecedent manipulation was introduced, whereby the chew necklace was directly offered to Alex when an ‘interrupt’ or ‘told no’ antecedent was placed. As can be seen on Figure 5, finger biting immediately rose to lower baseline levels. There could be several reasons for this. For example, it could have been that, when the chew necklace was offered, Alex may not have wanted it, and therefore the act of presenting the necklace served as a further interrupt or demand to take the chew necklace. This theory is supported by the data in Figure 8, which confirms that finger biting then increased, particularly under ‘interrupt’ and ‘demand’ antecedents. Due to the immediate and sustained increase in finger biting, this intervention was removed after only three days, which immediately reduced finger biting back down to low levels.

The second aim to this study was to assess whether the results from the intervention could be maintained over a 6-week summer break. For the maintenance probes, the intervention was reintroduced in the same environment. Figure 9 above shows that the intervention continued to be effective in reducing the target behaviour of finger biting. The behaviour did not increase to baseline levels however was higher than the previous intervention sessions. There are several reasons for why this could be. Firstly, due to the intervention not being able to be transferred to home, Alex will have had access to finger biting throughout the 6-week period. Therefore, when reintroducing the chew necklace, an initial spike in the behaviour may be seen due to the offering of the alternative. This was seen initially when the chew necklace was introduced where the behaviour spiked to baseline levels. However, promisingly, the behaviour did not increase to baseline levels and is on a downward trend by day 29. A second explanation for the increase in the target behaviour could also be due to the chew necklace. The chew necklace became damaged due to the intensity of the usage and the necklace had split in the middle. Therefore, the same sensory reinforcement may not have been gained through the chew necklace as was previously gained. If the behaviour continues at this level rather than on a downward trend, a further intervention should be considered to bring the behaviour back down to the previous low levels.

Overall, this study demonstrated how the non-contingent use of a chew necklace could reduce the levels of finger biting in an individual with ASD. Levels were able to be reduced by 71% within the first two weeks of intervention. Further interventions and maintenance probes suggest that the initial intervention was the most effective. This suggests that the combined the use of behavioural interventions of non-contingent reinforcement as well as sensory stimulation are effective in reducing finger biting.

5.1 Social Validity

As seen in Table 1 above, both tutors rated four out of the five items as either ‘agree’ or ‘strongly agree’. This suggests that they both viewed the intervention as strongly socially valid, with the intervention reducing the target behaviour of finger biting, as well as improving the condition of his finger. They both viewed the intervention as being easy to implement which holds promise for it being generalisable to other individuals to implement, including parents at home. One question was scored 2.5 on average: ‘I feel that the chew necklace interfered with my child’s learning’. This is also promising, suggesting that the individual was still able to learn effectively whilst the intervention was being implemented. Qualitative evidence was also provided as part of the questionnaire, with one tutor stating that Alex could ‘become distracted by playing with the chew necklace’. This was observed throughout the intervention. When Alex started to play with the chew necklace, the tutors would prompt Alex to either chew on the necklace or offer alternative toys for Alex to request. However, they also stated that ‘it was easy to understand and implement’ and ‘appeared to reduce the physical impact on his finger’.

The Social Validity Rating Scale was also provided to Alex’s parents, who provided the results found above in Table 2. Prior to the intervention, Alex’s parents had highlighted the importance of implementing an intervention for finger biting as this was damaging to Alex’s health. As seen above, these views were held throughout the intervention and despite the intervention not being implemented at home, the impact from school had transferred to home. When asked if they had any further comments to add, they stated that ‘the intervention has helped a lot with reducing the behaviour of finger biting’ and that ‘the condition of his finger is much better and it’s evident from this that the intervention has been effective’. They continued on to say, ‘that if the intervention were to be continued, they are confident that the end goal of completely reducing the behaviour will be achieved’. This suggests that they felt that the intervention should be continued past the study constraints and stressed how beneficial they have felt it has been for their child. By reducing the finger biting behaviour, less damage is being caused to the affected finger and with time, the skin should be able to recover without lasting damage. This was therefore a socially significant behaviour to target, both for Alex and his family.

5.2 Limitations

There were several main limitations in the way this research was conducted. Due to time and material constraints, further follow ups were prohibited. Ideally, each intervention condition would have been able to be conducted for around 2 weeks in order for the data to

stabilise and the intervention to be assessed, allowing the researcher additional time and further data in order to gain a more accurate understanding of the functions of the behaviour as well as the success of each individual intervention. These constraints also limited the maintenance probes that were completed at the end. Limited time and due to the second chew necklace splitting, the maintenance probes could not continue to see whether the behaviour would have reduced back down to the previous intervention levels. Additional interventions, as stated above, would also have been implemented in order to reduce the behaviour further and test more hypotheses, however these could not be achieved.

Secondly, during this period of research, the intervention could not be generalised to the home setting again, due to time restraints. Although Alex's parents were fully informed on the intervention throughout, it was not possible during the time of the study for the intervention to be run consistently at home, with the chew necklace being an offered as an alternative to each finger bite and ensuring that Alex kept the necklace on at all times, with concerns being raised that when using a chew necklace at home, Alex would typically throw it away. This was a behaviour that was not observed in the school setting (the setting of this research) with the chew necklace.

Despite evidence suggesting that the MAS questionnaire can successfully predict the function of SIB's (Bihm et al., 1991), Duker and Sigafoos (1998) found ambiguity with the construct validity of the MAS questionnaire. They suggested that the scale should be used alongside other functional assessment techniques, as it was within this study. Ambiguity was found between the results of the MAS and the antecedent-behaviour data that was taken within this study. Perhaps a further questionnaire or functional assessment technique should have been used to assess function when this discrepancy was found and establish which functional assessment method was most accurate. This had little impact on the data for this study, as due to the multi-functionality of the behaviour, the intervention was selected based primarily on the topography of the behaviour as opposed to solely on the functions.

Another limitation may have been the number of tutors recording data on the target behaviour. Despite the behaviour being operationally defined, there could have been discrepancies between the two tutors and the researcher, as well as the procedural aspect of the implementation of the intervention. For example, it may have been possible for one of the tutors to record less 'denied access' finger bites, simply because that tutor avoided telling Alex 'no' or did not contrive opportunities to tell him 'no' throughout the day.

Inter-observer agreement (IOA) data was recorded between the researcher and each tutor independently, in order to mitigate the effects of having two tutors taking the data, and reduce the risk of behavioural drift as the intervention continued. The IOA sessions were conducted blind, however observer bias may have still had an influence on the data due to the researcher being present in the room. The researcher was unable to be present for the entire day and therefore, when Alex and the tutor left the room, it is possible that the data recorded was not fully accurate. However, the IOA data was taken at regular intervals throughout the intervention, and across multiple settings, in order to reduce the negative effects of behavioural drift and to ensure that the most accurate data possible was recorded.

Furthermore, Alex was still able to bite his finger throughout the intervention. Prior to this intervention, physically blocking the behaviour was found to escalate the force applied when Alex bit down and therefore was deemed as being too dangerous to be included in any future intervention. Therefore, throughout the intervention, Alex was still able to access biting his finger which may have provided a different sensory input to that of the chew necklace, which would make it difficult to reduce the behaviour to zero levels. Thus, further interventions should assess the sensory input also gained through the finger with interventions such as finger squashes to provide similar sensory input to the behaviour of biting.

Finally, the design of the study was a single case design, implying that the results cannot necessarily be generalised to other individuals. However, this is a limitation within the majority of the literature body within ABA, and so further research should aim to replicate this research with additional participants.

5.3 Future research

There are several areas in which future research can expand using the findings from this study. Firstly, there is a lack of research addressing the use of sensory stimulation alongside a behavioural intervention. There is limited research on automatically reinforcing self-injury and using sensory reinforcement as an intervention. As highlighted within this study, it can be used as a successful intervention and therefore further research can solidify this as a technique to reduce SIB. There were also opportunities which could not be implemented due to time restraints within this study. For example, the chew necklace competed with the finger biting to an extent, but did not fully reduce the behaviour to zero levels. Therefore, there may be sensory input that was being gained from the finger which was not considered, and with additional time, an intervention based on the finger could have been implemented, alongside

the oral intervention of the chew necklace. Alternatively, the intervention may have needed more time to act to reduce the finger biting to zero. Future research can act upon this, running an alternating treatment design to assess the sensory needs of the individual and target each area systematically.

Additionally, when implementing an intervention, there must be a plan of how to fade the intervention out. Once the chew necklace was established to be effective, as this intervention did, a request for the chew necklace could then be introduced, fading off the element of non-contingent reinforcement. There are then opportunities to transfer this to another object, such as a raw carrot for example, which may provide the same sensory input and be more socially appropriate, eliminating the need for the individual to wear a chew necklace at all times, which could become socially stigmatising.

Another area of research that this study may influence, is that of establishing the importance of the similarity of the alternative matched stimuli. Whilst this study found that there was no difference between the two differently shaped chew necklaces on the finger biting behaviour, this may not be the case for all individuals with different challenging behaviours that are self-injurious. Further research could explore the importance of this for other behaviours and with a larger sample of individuals.

Furthermore, a further building block to this study would be for research to focus on the maintenance of their intervention. Despite interventions being implemented successfully with challenging behaviours, behaviours are known to be able to persist and resurge, even when the levels of the behaviours are decreased to low levels. Thus, future research should aim to establish whether the intervention is able to be hold the same results across time and settings to establish generalisability of the intervention. This would reduce the likelihood of the behaviour resurging at a later time.

This approach, of combining sensory stimulation with behavioural interventions, could have a positive impact for other individuals with other challenging behaviours. Further research should expand on the number of participants used; a limitation within this study, in order to demonstrate the potential effectiveness for others. This could be taken further to discuss the successes of using sensory stimulation with behavioural interventions in those with ASD, and could expand to further disorders where self-injury is also prevalent, such as Fragile X Syndrome (Symons et al., 2003) or Cornelia de Lange Syndrome (Oliver et al., 2009).

5.4 Conclusion

This study was successful in achieving its objectives. SIB of finger biting, which was maintained through positive, negative and automatic reinforcement, was reduced in an individual with ASD by using non-contingent reinforcement of sensory reinforcement. A reduction of over 70% was made, with the behaviour being maintained over a six-week break. Some increase in the behaviour was seen initially in the maintenance period however it quickly reduced back to intervention levels. As previous research suggested, the alternative stimuli of the chew necklace, should be matched to the behaviour as it was within this piece of research. Interestingly, what was found within this study was that matched stimuli were effective in reducing the target behaviour, however the similarity of the matched stimuli did not have any significant effect, suggesting that the oral stimulation feedback from the back teeth did not play a significant part in the maintenance of the behaviour. No difference was found in the results between the lego shaped chew necklace, which was a similar shape to the finger, in comparison to the rounded shaped chew necklace, until the rounded shaped chew necklace split. This provides clarification for further research that the similarity of the matched stimuli has little to no effect on the frequency of finger biting.

This study has added to a minimal body of research to conclude that the use of sensory reinforcement used as non-contingent reinforcement can reduce the SIB of finger biting if the alternative sensory reinforcement is matched to the target behaviour. Due to the current body of research being limited, there are a range of further opportunities that future research can explore. These include, establishing the importance of similarity when using matched stimuli, using further types of sensory reinforcement in order to replicate the results found here with other individuals who exhibit a range of SIB and establishing a protocol in order to fade out the reinforcement. Each of these areas of further research should also aim to extend the body of research to a larger number of individuals as well as those with other disorders other than ASD.

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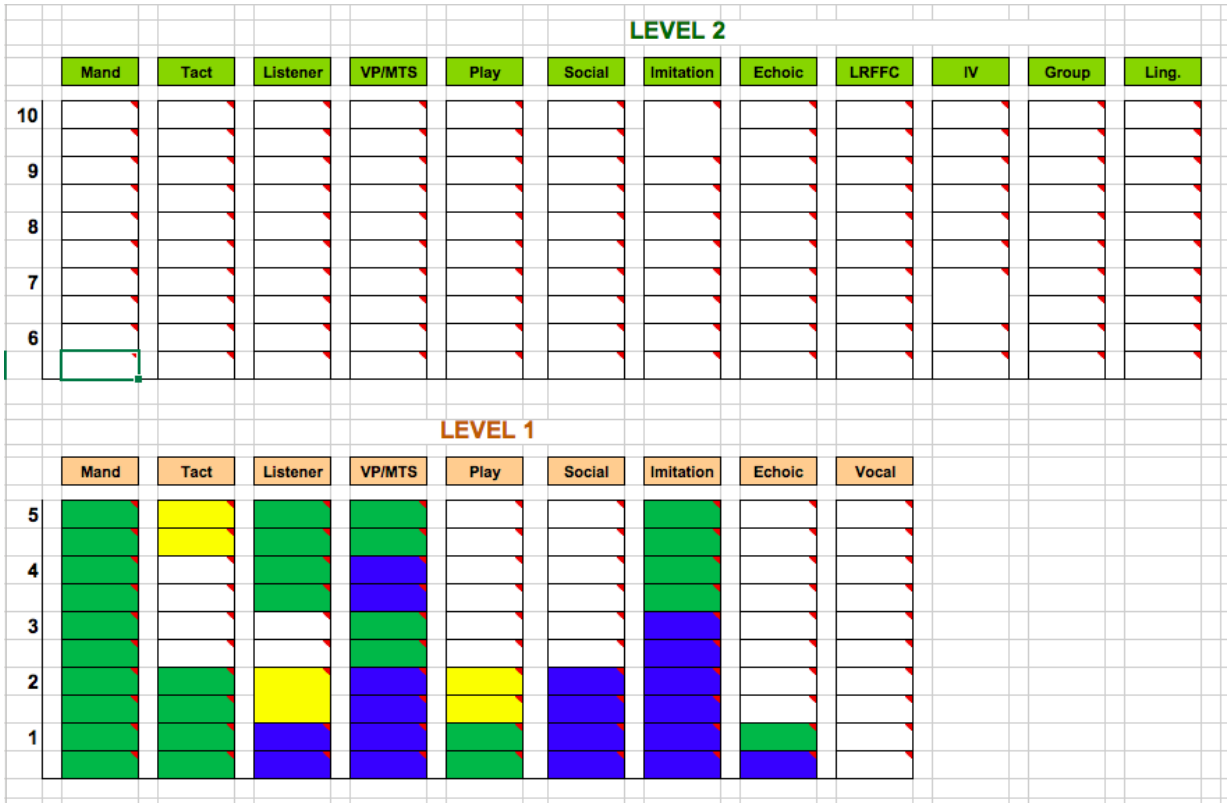
7. Appendices

7.1. Appendix 1: Antecedent Behaviour Consequence data sheet example

Name		Date	Time: Duration:
Antecedent	**Behaviour**	**Consequence**	
❑ Interrupt activity	❑ Crying	❑ Physically guide to comply	
❑ Told no	❑ Whining	❑ Ignored problem behaviour	
❑ Wants something - can have	❑ Screaming	❑ Deny access to reinforcer and physically guide to comply with demand	
❑ Sensoryreinforcement is valuable	❑ Flopping	❑ Count and mand procedure	
❑ Demand at table	❑ Pinching	❑ Contingent effort procedure	
❑ Wants attention can't have it	❑ Biting	❑ Block behaviour and redirect	
❑ Demand away from table	❑ Hitting	❑ Other	
❑ Other	❑ Kicking		
	❑ Scratching		
	❑ Other		

Name		Date	Time: Duration:
Antecedent	**Behaviour**	**Consequence**	
❑ Interrupt activity	❑ Crying	❑ Physically guide to comply	
❑ Told no	❑ Whining	❑ Ignored problem behaviour	
❑ Wants something - can have	❑ Screaming	❑ Deny access to reinforcer and physically guide to comply with demand	
❑ Sensoryreinforcement is valuable	❑ Flopping	❑ Count and mand procedure	
❑ Demand at table	❑ Pinching	❑ Contingent effort procedure	
❑ Wants attention can't have it	❑ Biting	❑ Block behaviour and redirect	
❑ Demand away from table	❑ Hitting	❑ Other	
❑ Other	❑ Kicking		
	❑ Scratching		
	❑ Other		

Appendix 2: Alex's VB-MAPP milestones assessment



Appendix 3: Ethical approval application form for SSESW

Queen's University Belfast

School of Social Sciences, Education and Social Work (SSESW)

Ethical Scrutiny and Approval of Research Proposals

Notes for Proposers

1. Before you complete this form, please read the Guidance Notes for SREC applicants. Failure to provide the required information, detail and support documentation will delay the application process.
2. The completed application form alongside support documentation should be emailed to: e.gray@qub.ac.uk
3. This ethics application form, along with any correspondence (e.g. approval letter, request for amendments etc.), will be kept as a formal record of the application process. QUB Research Governance does undertake regular spot checks and may request to see these documents. You must therefore keep a record of the application form and ethical approval memo alongside the completed consent forms and anonymised datasets for 5 years in line with the School's Data Storage and Security Policy.
4. Your research may only commence once ethical approval has been granted. Ethical approval applies only to the procedures outlined in your submission to the Ethics Committee. If any changes to the approved research proposal are considered then you must inform the SREC in writing of these **changes of research protocol**. Examples where this is required are: a change in recruitment procedure; a change in research methodology; a substantial change in the number of research participants etc.
5. It is the responsibility of the principal investigator to add any research project involving human participants, their material or data to the University's Insurance Database, which is accessible through QOL under 'My Research'. Principal Supervisors must also add their students' projects to this database.

Application for Ethical Approval of Research Proposals

SREC Submission Type (please click the respective box) **First Submission** ☒

Resubmission ☐

Date of application 27.02.19

Title of Research Project

Applicant's Name Rebecca Lowes

QUB Email Address

Contact Telephone No.

Category of Applicant (please click the respective box) **Staff** ☐

Student ☒

If you are a student, please complete the following:

Student Number 40213709

Level of Study (please tick) **Doctoral** ☐ **Masters** ☒ **UG** ☐

Supervisor Name Susan Keery

Please provide the proposed funding source (if applicable) and name(s) and position(s) of any co-investigator(s):

Proposed funding source

Co-Investigator (1)

Co-Investigator (2)

Proposed start and end dates of this study: ___27.02.19 to 16.09.19_____

1. Please give a non-technical description of the proposed research, including the methods you intend to use (300 words maximum)

I am proposing to implement an intervention with a student in my class who exhibits challenging behaviours in the form of biting their fingers. This is causing harm to the individual, causing with damage to the skin, and is a socially significant behaviour and therefore interventions are needed. I intend to take a baseline of the target behaviour and to run a functional assessment to determine the function of the behaviour. Once this has been completed, a reinforcement procedure will be implemented. Kahng, Iwata and Lewin (2002) reviewed nearly 400 articles which found that antecedent based interventions and reinforcement procedures was effective in reducing the target behaviour 100% of the time, therefore these are the procedures that will be utilized. The intervention will be dependent on the function of the behaviour found in the assessments. The research will be assessed by comparing over time the frequency and/or duration of the behaviour during a day.

Kahng, S., Iwata, B.A. and Lewin, A.B., 2002. Behavioral treatment of self-injury, 1964 to 2000. *American Journal on Mental Retardation*, *107*(3), pp.212-221.

2. Please answer the following questions in relation to your proposed research. Please note that answering 'Yes' to questions (b), (c) or (d) will require detailed explanations and may be referred for additional scrutiny by the University Ethics Research Committee. Answering 'Yes' to (e) will require a separate application to the relevant NHS Research Ethics Committee.	**Please tick**	
	Yes	**No**
a. Does the research involve children (under-16s) or regulated activity with adults? If in doubt, consult the EDC Factsheet at:	☒	☐
b. Can any aspect of the research give rise to any form of harm to participants, including the researcher(s)?	☒	☐
c. Can any aspect of the research produce information that could lead to criminal prosecution of the participants or others?	☐	☒
d. Is deception of the participants planned in any aspect of the research?	☐	☒
e. Does any aspect of the research involve patients (or their relatives or carers) or other users of health and social care services, the premises or facilities of such services, access to personal records or the participation of health or social care staff?	☐	☒

3. Please give a description of the proposed participants and any relationship you have with them.

(Research in your own organisation or among acquaintances poses particular challenges. If you are in a position of authority in relation to your participants, or if you have any other relationship with them, you must indicate here how you will deal with the potential influences of such a relationship.)

The proposed participant is an 8-year-old non-verbal autistic student who currently attends an ABA School that I work in. He has autism and PICA diagnoses and engages in self-injurious behaviour multiple times a day which will be my area of focus. I am currently working as the ABA Instructor in his class, working alongside a BCBA to train tutors and implement individual education plans and individual behaviour plans. As the student is a pupil in my class, I will be able to implement the intervention myself and train tutors to run it in my absence. This is an ideal opportunity to implement this intervention due to the expertise of staff and the continuous training of the staff implementing the intervention. There are high numbers of staff for students per class which enables time to be dedicated to that individual child throughout the day and the intervention ran by his one to one tutor. Discussions with parents have occurred around this behaviour and they are keen for an intervention to be implemented as it is causing damage to him and his finger is calloused and starting to bend.

4. Please give details of the method of recruitment for participants and the inclusion/exclusion sampling criteria. Approximately how many participants will be recruited? Please detail any ethical issues that must be considered, including the proposed use of any incentives.

(Small samples have a potential impact on participant anonymity. If your target sample is small, you must address issues related to anonymity and confidentiality. Please detail your back-up plan if your original method of recruitment does not yield the number of participants)

One participant will be needed for this research as it will be a single case study. The participant has been chosen on the basis of his behaviours and the need to reduce them. Discussions have been had with the parents as this is a behaviour that they are concerned about and are keen for an intervention to be implemented.

Ethical issues include harm to the individual through biting their finger. For the baseline, each time the individual attempts to self-injure, they will be asked to fold their hands. This is a redirecting procedure to minimise harm to the individual. Previously, blocking the hand has resulted in escalation of behaviours or increased biting of the finger in terms of frequency and magnitude therefore the behaviour will not be blocked as more harm could come to the individual. If at any point the frequency of the biting behaviour increases during the intervention, the intervention should be removed and re-evaluated.

I will maintain anonymity and confidentiality by referring to the participant in a manner that could not identify them. There are strict GDPR procedures implemented throughout the school setting that I work in. Any data that contains full names must be shredded immediately and the data collected for the purpose of this intervention can only be accessed on the secure online system by myself and those involved in the research. If at any time a member of staff involved in the research decides to drop out, their access to the online data will be terminated. The online system is password protected with access to the file only by those involved. Any identifying information about the participant that will be outlined and discussed in the dissertation research are unlikely to result in identification of the participant as the only individuals who have detailed knowledge of this information are the individuals who will be assisting in the research (namely my BCBA supervisor and the tutor(s) who will help to run the program) and no full names will be used on any materials used with the participant.

5. Please give details of the location(s) at which the data collection will be undertaken and any circumstances that might give rise to security concerns for participants or researchers, conflicts of interest where data might be critical of working practices, or disclosure of illegal activities.

(Applicants must give special attention to circumstances which may present security problems, potential disclosure of illegal activity, or research which potentially involves situations that may pose risks to participants or researchers. Such circumstances might include some forms of home visits, one-to-one meetings in non-public areas, and interviews with children or vulnerable adults, prisoners etc. A separate protocol on dealing with risky situations must be attached for studies such as these.)

Data collection will be undertaken in the child's classroom under the supervision of a BCBA. The researcher will be implementing the intervention and training the child's tutors to run it in their absence. The tutors and other members of staff involved in the research will be asked to provide consent to their data being used and will be reminded that they can withdraw their participation at any time should they wish to. Within the consent forms for the parents and staff members involved, listed will be any advantages as well as disadvantages or adverse effects from the study and how these will be overcome. If any adverse effects do arise such as the behaviour increasing, the intervention should be terminated and re-evaluated. Due to the controlled setting in which the research and intervention will be taking place, there are unlikely to be any security concerns or disclosure of illegal activities. There will not be any conflicts of interest relating to the criticism of working practices, as the intervention will be novel with regards to the behaviour. I currently hold a valid DBS clearance from the school and have approval from my University Supervisor in the form of a supervision form.

6. Please indicate how the active, informed consent of all participants will be gained. Give consideration whether consent needs to be sought from indirect participants.

(Consent forms and information sheets must be attached. Active (opt-in) and written consent are seen as good practice. If verbal and/or passive consent (opt-out) is planned, you must give a rationale for this. Proposer(s) must indicate how they will deal with circumstances in which consent has been withheld for some participants (e.g. parental consent withheld for some pupils in a classroom context).

Informed consent will be gained from the parent's due to the lack of capability from the participant themselves. The participant is non-verbal with minimal communication however I will be taking consent from the child in other forms e.g. the body language of the child and the willingness of the child to take part in the intervention. If the child shows any distress from the intervention (only reinforcement procedures will be utilized), the intervention will be terminated. A visual aid will be provided to the child to explain the intervention to them however consent from them will not be sought. Parents have already expressed their vocal interest in an intervention being implemented. As well as this, consent will be gained from the members of staff implementing the intervention as well as the head teacher of the school where the research will take place. If at any point the child and family do wish to withdraw from the research, the consent form clearly states that they are able to do so with no risk to the child's education or school placement.

Similarly, if at any point the members of staff involved would like to withdraw their participation, they can do so without any risk to their jobs.

7. Please indicate how the participants' rights to privacy (including confidentiality and anonymity) and the privacy of their data will be protected. Highlight potential limitations of confidentiality in the ethics form and also in the information sheets for participants (e.g. for small samples or insider research and how this will be addressed). Please also indicate how the data will be stored and ultimately destroyed in line with the SSESW Data Handling and Security Policy.

Names will not be used on any data sheets collected or any data that is processed. Data will be logged onto a secure online system by the collector at the end of each day and the data sheet destroyed. The data will also be logged against a pseudonym to ensure that no personal information is divulged. The online system is a password protected system that is only accessible to those who are involved in the research. Should any of the members of staff ask to no longer be involved with the research, their access to the folder will be immediately terminated. Once the research has been completed, the dissertation will be stored online by SSEW and will after this time.

As outlined above in Section 4, confidentiality and anonymity of the participant will be maintained by references to the participant during the research being strictly controlled without reference to any details that would indicate their identity, as well as through the strict data protection procedures in place within the school setting.

There will be no paper copies of any data kept. Consent forms will be returned and immediately scanned into the online file. Similarly, data will be collected on paper sheets and uploaded onto the online file at the end of the day. Once this has been done, all paper copies will be shredded.

8. Please complete the checklist below to indicate what support documents you supply alongside your application. Use N/A where not applicable. (Note that the supporting documentations will be scrutinised and any omissions or inadequacies in detail will result in a request for amendments).	**Please tick**
Evidence of peer review (For **PhD students:** successful differentiation; for **EdD** and **DChild students**: successful APR; **UG** and **Masters students**: your supervision counts as peer review.	☒
Recruitment letter(s)	☐
Consent form(s)	☒
Participant Information Sheet(s)	☒
Draft research instrument(s) (e.g. draft questionnaire, group discussion or interview schedule)	☐
Study protocols for dealing with potentially risky situations	☐
Data access agreement/license (for secondary analysis studies only)	☐
Any other supporting material ***(please specify)***	☐

Declaration by All Proposers:

I have read and understood the SSESW Policy and Principles on Ethics in Educational Research and the University Policy on the Ethical Approval of Research and I undertake to adhere to its directives and to follow all principles and procedures outlined therein.

I declare that the details above accurately reflect my research proposals **and I undertake to seek updated approval if substantive changes are proposed after this submission**. I have consulted an authoritative set of educational research guidelines.

Appendix 4: Ethics minor amendments form

QUEEN'S UNIVERSITY BELFAST

School of Social Sciences,
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BT7 1HL
TEL: +44 (0) 28 9097 3041/5906
www.qub.ac.uk

Memorandum

To Rebecca Lowes

From Dirk Schubotz, SREC Chair

Date 14 May 2019

Distribution Susan Keery, Supervisor
File

Subject: **Ethics Review – 'Evaluating the effects of using differential reinforcement techniques for reducing self-injurious behaviour of finger biting'.**

The School of Social Sciences, Education and Social Work Ethics Committee has approved your proposed study subject to you making some minor amendments, listed in the left column of the table below. Please indicate in the right column how the amendments have been or will be addressed. Once you have completed this, please return this form alongside any respective amended support documents, if this is required, to Eileen Gray, the SREC secretary (Email: e.gray@qub.ac.uk). You will then receive an official ethics approval memo, **without which you are not permitted to proceed with your research.**

Minor Amendments	***How these have been/will be addressed***
What is the title of the research project? This requires clarification.	The title is: An intervention using reinforcement techniques to reduce self-injurious behaviour in a child with autism.
It is also very difficult to assess the ethical implications of the project when the research aims and objectives are not clear.	I have clarified this in the consent form and in section 1 of the application form. The aim of the research is to reduce the participants finger biting behaviour to a level whereby he no longer suffers any damage to his skin.
Please outline the difficulties of conducting research with a child who you work with in terms of subjectivity and researcher bias. *Can you describe the inherent power imbalance between you as a researcher and the child as a participant?*	To address both of these points, in order to overcome any subjectivity, researcher bias or power imbalances, several procedures are in place. Within the school, there are strict safeguarding procedures to ensure the welfare of the child is held paramount. There will only be reinforcement techniques used and therefore no harm should come to the participant. If the participant does become distressed at any point of the study, it will be immediately terminated and the intervention will be re-evaluated.

Section 5 Reference is made to tutor and staff data. Please clarify the nature of the data that will be collected from these individuals. At the moment, it is implied they will also be research participants (as well as the autistic child). If this is indeed the case, details need to be provided, together with relevant information sheets and consent forms. *In addition, consent must be obtained from the school principal.*	Tutors will be collecting the data, consent forms can also be provided. I have reworded this to make it clearer and attached a consent form for them. Consent from the school principal has been added to section 5 and is referenced in section 6
Section 6 What happens if the participant withdraws from the research? Is there a contingency plan or would the study collapse?	If that were to happen, I would look at recruiting further participants. There are other participants in the school who may also be suitable to take part in this research.
Section 7 Please state how SSESW data management policy will be implemented. For example, will the data (rather than just the thesis) be retained for a minimum of 5 years after completion of the study?	Only the dissertation will be held by SSESW for a minimum of 5 years. Raw data will be transferred onto the school's online system as discussed and is held there for an additional 7 years after the pupil has left the school.
Information Letter Within the section 'Why we are targeting this behaviour?', please refrain from using phrases such as "I believe we agree that this is an intervention that needs to be implemented as soon as possible and is very important to your child". Let the parent/guardian make up their own mind about whether they agree or not.	This phrase has been omitted from the information letter.
Further details are needed on data storage to ensure compliance with SSESW policies.	I have added to the information letter under the data subheading, information on how the data will be stored.

Notes: It is the responsibility of the PI of this study, including supervisors of student research projects to add any research projects involving human participants, material or data, to the University's Human Subjects Database for insurance purposes. (The Human Subjects Database is accessible through QOL under 'My Research')

Students: Amendment(s) relating to the advice **must be discussed with your supervisor** and incorporated into your overall plan. If the advice is not satisfactorily addressed your studies **are not permitted to proceed.**

The SREC must be notified of any major departure from the approved procedures as this may require additional ethical approval.

Appendix 5: Ethical approval

QUEEN'S UNIVERSITY BELFAST

School of Social Sciences,
Education and Social Work
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Memorandum

REF	129-1819
To	Rebecca Lowes
From	Dirk Schubotz, SREC Chair
Date	22 May 2019
Distribution	Susan Keery, Supervisor File

Subject: **Ethics Review – 'Evaluating the effects of using differential reinforcement techniques for reducing self-injurious behaviour of finger biting'.**

The School of Social Sciences, Education and Social Work Ethics Committee has reviewed your proposed study and has granted approval for you to proceed.

- It is important to ensure that you follow the procedures outlined in your submission. Any departure from these may require additional ethical approval.

Note for the principal investigator: it is the responsibility of the investigator to add any research projects involving human participants, their material or data, to the University's Human Subjects Database for insurance purposes. (The Human Subjects Database is accessible through QOL under 'My Research').

The Committee wishes you every success with your research.

Dirk Schubotz
Chair, SSESW SREC

Appendix 6: Informed consent

Participant Information Sheet

Research Project: An intervention using reinforcement techniques to reduce self-injurious behaviour in a child with autism.

Dear Parent/Guardian,

My name is Rebecca Lowes and I will be undertaking a research project as part of my Master's degree in Applied Behaviour Analysis at the School of Social Sciences, Education and Social Work at Queen's University Belfast. I would be very grateful if you could allow your child to take part in my intervention in order to reduce the number of times he bites his finger. This is damaging to his skin and is leaving callouses on his fingers and hands and as we discussed I believe this to be a priority for him.

The study

Having assessed the previous research on self-injurious behaviour, the study aims to find out whether the use of differential reinforcement techniques will decrease the behaviour of finger biting and provide a positive replacement behaviour that is safe for your child. A baseline of the behaviour will be taken at the beginning of the study to find the frequency your child engages in the target behaviour. Within this, a functional analysis of the behaviour will be completed in order to establish the function of the behaviour (is it attention based, sensory, escape etc.). Once this has been completed, an intervention will be implemented to reduce the target behaviour by using reinforcement techniques. This research will occur within the school day and you will not need to do anything.

Why we are targeting this behaviour?

As we discussed, this behaviour is dangerous to your child and is causing visible damage to their finger therefore I believe it is important that this is targeted as a priority. As with any intervention, there are advantages and disadvantages however I believe that the advantages strongly outweigh the disadvantages. With the intervention, the aim is to reduce the finger biting behaviour and hopefully this will open your child up to more

activities and help develop their fine motor skills further which will support them with their sign communication. Disadvantages could include an increase in finger biting behaviour however if this occurs, the intervention will be terminated immediately and reassessed. If successful, this will enable us to teach more play skills and to be able to engage in self-help skills without the interference of self-injurious behaviour.

Data

Data taken within this study will be stored on a password protected system where no one else but myself will have access. Once the study has been completed, data will be kept on the school's password protected system for up to 7 years after the participant has left the school in accordance with school procedures however after this time, they will be destroyed in alignment with GDPR regulations. Your child's information will be kept completely confidential and will not feature anywhere within the research. In the future, the research may be published however no identifying information will be released. The dissertation will be kept on the database within the School of Social Sciences, Education and Social Work (SSESW) for 5 years after the completion of the research, after which time it will be destroyed.

Please note that this research is completely voluntary, and you are allowed to withdraw your child from the research at any time with no repercussions to you or your child's education within the school however your help will be greatly appreciated.
Should you need any further information, please do not hesitate to call or email myself or my University supervisor.

Researcher: Rebecca Lowes
Email:
Phone:
Supervisor: Susan Keery
Email:
Kind regards,
Rebecca Lowes
Applied Behaviour Analysis MSc Student

Appendix 7: Consent form for parents

Queen's University Belfast

Consent Form

Research Project: An intervention using reinforcement techniques to reduce self-injurious behaviour in a child with autism.

I have read the attached information letter which explains the research about an intervention that will be implemented to reduce the self-injurious behaviour of finger biting.

I understand that the letter is asking my child to participate in the research.

I understand that all the information gathered will be kept strictly confidential and that my child's and the name of the school will not be included in any reports in alignment with GDPR regulations.

I understand that participation is voluntary and that I am free to withdraw my consent at any time.

I understand that this research will be published in form of a Masters dissertation within the SSESW and held for 5 years, with no personal information being included.

I understand that this research has passed Queen's University's ethics board.

I understand that I can contact the researcher or supervisor at any time if I have any questions.

☐ I **AGREE** to taking part in the above research

Signature: _____ **Date:**_____
(Name)

Appendix 8: Consent form for tutors

Queen's University Belfast

Consent Form for Tutors

Research Project: An intervention using reinforcement techniques to reduce self-injurious behaviour in a child with autism.

I have read the attached information letter which explains the research about an intervention that will be implemented to reduce the self-injurious behaviour of finger biting.

I understand that the letter is asking for my consent to take part in the data collection process.

I understand that all the information gathered will be kept strictly confidential in alignment with GDPR regulations.

I understand that participation is voluntary and that I am free to withdraw my consent at any time.

I understand that this research will be published in form of a Masters dissertation within the SSESW and held for 5 years, with no personal information being included.

I understand that this research has passed Queen's University's ethics board.

I understand that I can contact the researcher or supervisor at any time if I have any questions.

☐ I **AGREE** to taking part in the above research

Signature: _____ **Date:**_____
(Name)

Appendix 9: Consent form for Head teacher

Queen's University Belfast

Consent Form for the Head teacher

Research Project: An intervention using reinforcement techniques to reduce self-injurious behaviour in a child with autism.

I have read the attached information letter which explains the research about an intervention that will be implemented to reduce the self-injurious behaviour of finger biting.

I understand that the letter is asking for my consent to the research being conducted within the school.

I understand that all the information gathered will be kept strictly confidential in alignment with GDPR regulations.

I understand that participation is voluntary and that I am free to withdraw my consent to the research at any time.

I understand that this research will be published in form of a Masters dissertation within the SSESW and held for 5 years, with no personal information being included.

I understand that this research has passed Queen's University's ethics board.

I understand that I can contact the researcher or supervisor at any time if I have any questions.

☐ I **AGREE** to taking part in the above research

Signature: _____ **Date:**_____
(Name)

Appendix 10: Motivation Assessment Scale (MAS) questionnaire

MOTIVATION ASSESSMENT SCALE

Name:_____ **Rater:** _____**Date:**_____

Description of Behavior (be specific):_____
_____

Instructors: The MAS is a questionnaire designed to identify those situations where an individual is likely to behave in specific ways. From this information, more informed decisions can be made about the selections of appropriate replacement behaviors. To complete the MAS, select one behavior of specific interest. Be specific about the behavior. For example "is aggressive" is not as good a description as "hits other people." Once you have specified the behavior to be rated, read each question carefully and circle the one number that best describes your observations of this behavior.

Questions	Never 0	Almost Never 1	Seldom 2	Half the Time 3	Usually 4	Almost Always 5	Always 6
1. Would the behavior occur continuously if this person was left alone for long periods of time?							
2. Does the behavior occur following a request to perform a difficult task?							
3. Does the behavior seem to occur in response to your talking to other persons in the room/area?							
4. Does the behavior ever occur to get a toy, food, or an activity that this person has been told he/she can't' have?							
5. Would the behavior occur repeatedly, in the same way, for long periods of time if the person was alone? (e.g. rocking back and forth for over an hour.)							
6. Does the behavior occur when any request is made of this person?							
7. Does the behavior occur whenever you stop attending to this person?							
8. Does the behavior occur when you take away a favorite food, toy or activity?							
9. Does it appear to you that the person enjoys doing the behavior? (It feels, tastes, looks, smells, sounds pleasing).							
10. Does this person seem to do the behavior to upset or annoy you when you are trying to get him/her to do what you ask?							
Go to next page							

Taken from *Michael J. Delaney /Mark Durand, Ph.D. 1986*

1

11. Does this person seem to do the behavior to upset or annoy you when you are not paying attention to him/her? (e.g. you are in another room or interacting with another person)							
12. Does the behavior stop occurring shortly after you give the person food, toy, or requested activity?							
13. When the behavior is occurring does this person seem calm and unaware of anything else going on around her/him?							
14. Does the behavior stop occurring shortly after (one to five minutes) you stop working with or making demands of this person?							
15. Does this person seem to do the behavior to get you to spend some time with her/him?							
16. Does the behavior seem to occur when this person has been told that he/she can't do something he/she had wanted to do?							

	Sensory	**Escape**	**Attention**	**Tangible**
	1.	**2.**	**3.**	**4.**
	5.	**6.**	**7.**	**8.**
	9.	**10.**	**11.**	**12.**
	13.	**14.**	**15.**	**16.**
Total Score =				
Mean Score =				
Relative Ranking =				

Motivation Assessment Scale: Functions for usage

- **To direct our understanding of the behavior challenge to the intent of the challenge versus the way it appears or makes us feel.**
- **To understand the correlation between the frequency of the challenging behavior and its potential for multiple intents.**
- **To identify those situations in which an individual is likely to behave in certain ways (e.g., requests for change in routine or environment lead to biting).**

Outcomes:

- **To assist in the identification of the motivation(s) of a specified behavior.**
- **To make more informed decisions concerning the selection of appropriate reinforcers and supports for a specified behavior.**

Note: Like any assessment tool, the MAS should be used in an on-going continually developing mode.

Taken from *Michael J. Delaney /Mark Durand, Ph.D. 1986*

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Appendix 11: Antecedent-Behaviour data sheet

	Date	NO	WSCH	Interrupt	Transition	Sensory	Demand	Attention	Cumulative frequency
	9:15-9:30					II	~~IIII~~ I		8
	9:30-9:45	II		I		II			5
	9:45-10:00								
Group	10:00-10:15					I			1
	10:15-10:30								
	10:30-10:45						I		1
SNACK & PLAY	10:45-11:15	I							
	11:15-11:30		I			II			3
	11:30-11:45					III			3
	11:45-12:00								
English	12:00-12:15	I				III	I		4
	12:15-12:30		II						2
LUNCH	12:30-1:00			I		I			2
PLAY	1:00-1:30					(II)			4
	Transitions					~~IIII~~ ~~IIII~~ I			11

There can be multiple topographies and antecedents per day, please note all in each box.
There should be an accompanying cumulative graph for daily frequency of self-injurious behaviour.

Appendix 12: Social Validity Rating Scale

Social Validity Rating Scale

Please read the statements below and circle or highlight the number you feel describes your opinion the best.

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
Reducing finger biting was important for me and my child	1	2	3	4	5
My child's finger biting behaviour has reduced since the intervention began	1	2	3	4	5
This intervention was easy to understand	1	2	3	4	5
The condition of my child's finger has improved	1	2	3	4	5
I feel that the chew necklace interfered with my child's learning	1	2	3	4	5

If you would like to add any comments about the intervention then please write them below: