THE UNIVERSITY OF HULL

Executive Functioning and Social Cognition following a Brain Injury

Being a thesis submitted in partial fulfilment
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by

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Acknowledgements

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Overview

This portfolio thesis comprises of three parts; a systematic literature review; empirical paper and supporting appendices.

Part one is a systematic meta-analytic review of the effectiveness of educational interventions for social communication difficulties following an acquired brain injury. A systematic search identified seven studies to be included in the meta-analysis. The results from the meta-analysis are discussed, as well as clinical implications and suggestions for future research.

Part two is an empirical paper which examines whether decision making is different following a brain injury. Following this, it investigated whether this difference was related to poor executive functioning in the domains of inhibition and planning, or poor social cognition. The results from the study are discussed in relation to previous theories and the clinical implications are considered, finally potential ideas for future research are presented.

Part three contains appendices relating to the systematic literature review and the empirical paper, in addition to an epistemological statement and reflective statement.

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Table of Contents

Page Number

Part three - Appendices

List of Tables and Figures

Part one - Systematic Literature Review

A Review of the Effectiveness of Educational Interventions for Social Communication Difficulties proceeding an Acquired Brain Injury.

Part two - Empirical Paper

The Impact of Executive Functioning and Social cognition on Decision Making following an Acquired Brain Injury.

Part three – Appendices

Part one: Systematic Literature Review

This paper is written in the format for submission to the Journal of Neuropsychology.

Please see Appendix C for ‘‘Author Guidelines’’

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A Review of the Effectiveness of Educational Interventions for Social Communication Difficulties Proceeding an Acquired Brain Injury.

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Abstract

A common consequence of an acquired brain injury (ABI) is social communication impairment. Social communication denotes communication that occurs within various social contexts (Gordon & Duff, 2016). This systematic literature review aimed to investigate the effectiveness of educational interventions designed to improve social communication skills. A systematic literature search was completed on Medline, PsycINFO, Cinahl, Academic Search Premier, and PsycARTICLES up until February 2019. Seven studies were eligible to be included in the meta-analysis. The meta-analysis provided evidence for the use of educational interventions designed to improve social communication skills for individuals after a traumatic brain injury. However, the majority of the studies included in the meta-analysis were cohort studies, which limited the strength of the present review. The review highlights the need for further research within this field using more robust research methodologies, including randomised controlled trials. Further, it demonstrates a considerable gap in the literature with regards to interventions designed to help people following a brain injury.

Keywords: social communication; traumatic brain injury; intervention; education

Introduction

Communication is a fundamental mechanism in the constitution of the social world (Kashima & Lan, 2013). It may be defined as the 'verbal interchange of a thought or idea' (Hoben, 1954) or as 'the transmission of information' (Berelson & Steiner, 1964). There are many definitions that exist for communication and it appears to be a broad concept which cannot be constrained within a single paradigm. One specific aspect of communication is social communication.

Social communication relates specifically to communication that occurs within various social contexts (Gordon & Duff, 2016). Struchen et al. (2011) defined it as a combination of verbal and nonverbal skills that allow individuals to express themselves and understand the meanings intended by others in a range of environments and with different communication partners. Social communication relies on many cognitive correlates including; declarative memory, executive functioning, working memory, attention and social cognition (Rowley, Rogish, Alexander & Riggs, 2017). It is also an important dimension of social activities that individuals engage in (Kashima, Klein & Clark, 2007). Further, it is with social communication that humans develop their sense of self and are able to construct their social world (Mead, 1934). Therefore, if one's ability to effectively use social communication is impaired, it is likely to have an adverse impact on their social self.

In particular, social communication is altered following an acquired brain injury. An acquired brain injury is a term that captures traumatic brain injury, stroke, aneurysm, brain tumour, vestibular dysfunction, and anoxic or hypoxic brain injury (Ciuffreda, Kapoor, Taub, Bartuccio & Maino, 2012). Social communication is an area that people persistently struggle with subsequent to a brain injury (Struchen et al., 2008). A brain injury can lead to changes in the structure and content of conversations (Biddle, McCabe & Bliss, 1996). It can cause difficulties with turn-taking (Murphy, Huang, Montgomery & Turkstra, 2015) and in making conversations fit the context in which they occur (Strauss-Hough & Barrow, 2003). Additionally, social communication deficits may also manifest in poor eye contact

(Wiseman-Hakes, Stewart, Wasserman, & Schuller, 1998). This consequently makes it difficult for those who have experienced a brain injury to sustain meaningful conversations.

There are far reaching functional implications for individuals who have sustained a brain injury and subsequently experience difficulties with social communication. It can impact one's ability to stay in employment (Brooks, McKinlay, Symington, Beattie, & Campsie, 1987); deficits in communication skills are one of the most frequent causes of losing employment (Sale, West, Sherron & Wehman, 1991). As well as this, social communication difficulties can lead to a decrease in involvement in leisure activities (Kersel, Marsh, Havill & Sleigh, 2001) and difficulty in maintaining and developing relationships (Nonterah et al., 2013). The consequence of these difficulties is that it may lead to social isolation and loneliness (Ylvisaker & Feeney, 2007).

A variety of interventions have been developed to help improve social communication. Some interventions are developed on the basis that communication is a set of behaviours that can be learned. For example, greetings and requests may be taught which are then transferred into different settings (Gajar, Schloss, Schloss, & Thompson, 1984). Furthermore, protocols have been designed which teach topics such as turn-taking, introducing one's self, and maintaining eye contact in an educational fashion to people with a brain injury (Mcdonald et al., 2008).

In contrast, sociolinguists place importance on the relationship between the participants in the interaction (Togher, Hand & Code, 1997). Communication is seen as an interactional process that is mediated by the relationship between two people. Bond and Godfrey (1997) found that, compared to controls, individuals with a brain injury required more direct questions from their partner to keep the conversations meaningful. This study showed evidence in favour of having training programmes in which partners are trained to help facilitate communication between people after a brain injury has befallen one of them. Based on this principle a training programme was developed which aimed at improving the communication of police officers during service encounters with people with a brain injury

(Togher, McDonald, Code & Grant, 2004). The study demonstrated the effectiveness of training communication partners rather than the individual with a brain injury.

In recent years there has been an increase in the number of clinical assessments and interventions for social communication that aim to help individuals with an acquired brain injury (Finch, Copley, Cornwell & Kelly, 2016). Despite the availability of several research studies, there is no contemporary systematic quantitative review of this literature pertaining to whether social communication interventions are effective at improving social communication. This paper aims to provide such a review by systematically assessing the literature and conducting a meta-analytic review of the data extracted. This information may help inform practitioners about the effectiveness of social communication interventions subsequent to a brain injury.

There has been one previous review which has specifically focussed on interventions for adults with a traumatic brain injury who struggle with social communication (Finch et al., 2016). Finch et al., (2016) examined those interventions addressing a specific impairment in social communication, and context-specific interventions with a holistic focus on social communication skills up until 2013. The present review aimed to conduct an updated investigation which looked more broadly at the literature by encompassing individuals with any type of acquired brain injury, synthesising findings quantitatively using meta-analysis. It aimed to answer the following question: What is the effectiveness of educational interventions designed to improve social communication skills subsequent to a brain injury?

Methods

Search Strategy

An initial search using the Cochrane database was conducted to investigate whether any systematic literature reviews had been done to assess the effectiveness of interventions for

social communication following an acquired brain injury. However, none were found, except Finch et al., (2016), as discussed above.

A systematic literature search was undertaken in February 2019. The search engine that was used was EBSCOhost and included a substantial literature search of the following databases; Medline, PsycINFO, Cinahl, Academic Search Premier, and PsycARTICLES. These databases were selected because they provide a wide variety of literature from nursing, psychology and allied health disciplines.

Search Terms

The following search terms were used:

brain damage OR (Brain injur*) OR (Acquired brain injur*) OR (Traumatic brain injur*) OR TBI OR ABI OR (Head Injur*) OR (head traum*) OR frontal lobe damage OR frontal lobe dysfunction OR Stroke AND Social communication AND training OR intervention OR program OR education.

Please see the Appendix H for further information on how the search terms were defined.

Search Limits

The search terms were applied to titles and abstracts. Search limiters were used in EBSCOhost to return articles that were written in the English language, peer reviewed articles and included participants whose injury occurred beyond the age of 16. There were no time limits placed.

The following inclusion criteria were applied to the studies to inform eligibility.

i. The study must use adults with an acquired brain injury, 16 or above.
ii. The study includes a measure of social communication

iii. The study must have completed an educational intervention specifically for social communication.

The following exclusion criteria that were applied to inform eligibility.

i. Studies not in English, due to the author being unable to read other languages
ii. Reviews, as the present paper sought primary sources
iii. Case studies, to ensure quality control
iv. Studies on children
v. Not peer-reviewed, to ensure quality control

Results of the Systematic Search Strategy.

Five hundred and sixteen articles were identified from the initial database searches. A hundred and eighty-six were duplicates, leaving 336 for screening.

Firstly, the abstracts were read and compared against the inclusion criteria. This then identified 35 papers for a complete review. Of these, 10 were identified as appropriately fitting the inclusion criteria. See Figure 1 for a flow diagram of the article selection process. The author also examined the reference sections of papers that were eligible. However, no relevant articles were found. Of these 10, three of them had a lack of information hence the authors were contacted to ask if the data could be provided; two replied however they no longer had the data available. Thus leaving 7 studies to include in the analysis. More detailed information about the three studies is discussed below in the results section. Table one describes the study characteristics of the 7 identified studies including; type of intervention, sample size, design, measure of social communication, length of follow up, type of brain injury and quality rating.

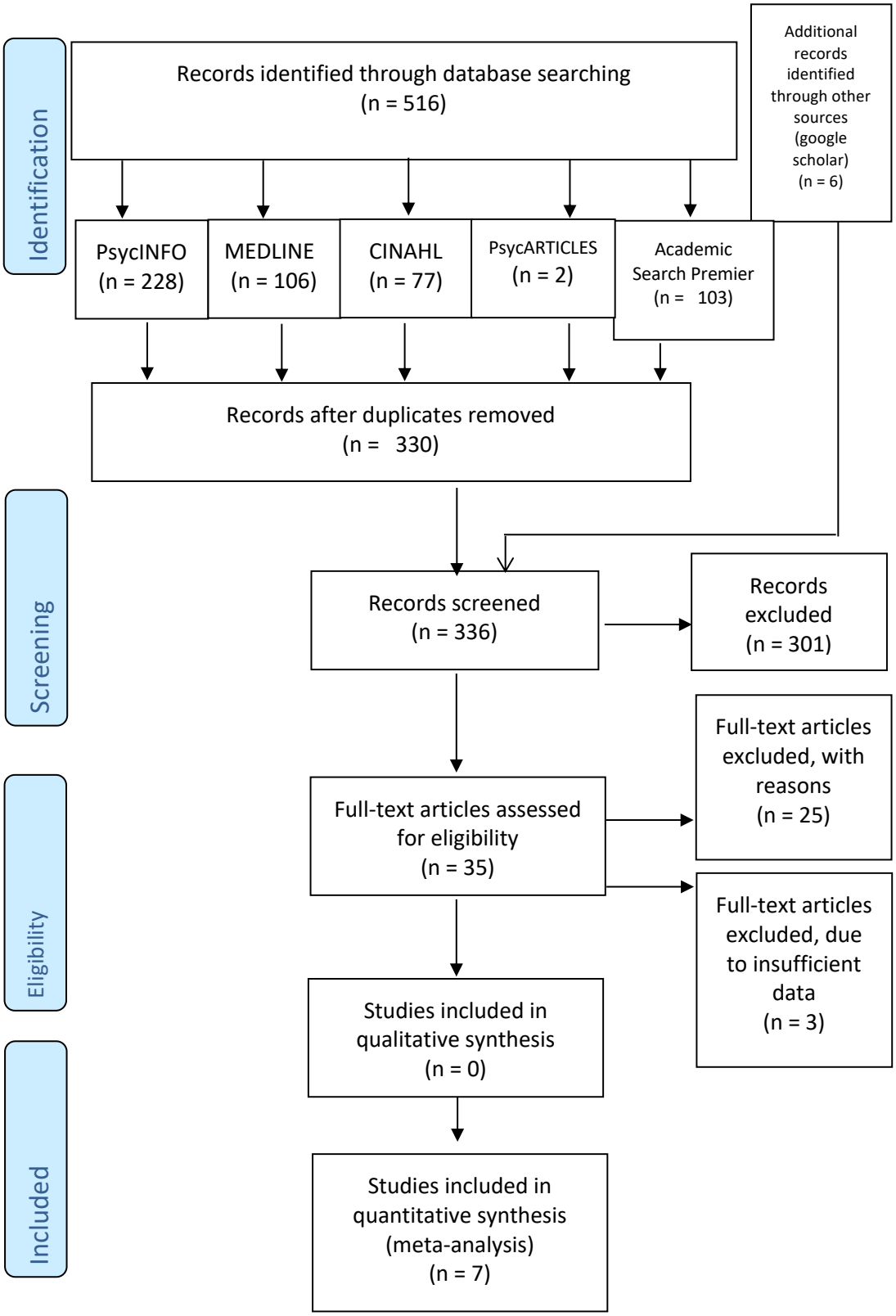


Figure 1 Flow diagram of the article selection process

Table 1. Study characteristics.

Study	Intervention	Sample Size	Design	Measure of Social Communication (& length of follow up)	Type of Brain Injury	Time since injury (Years)	Quality Rating
Braden et al. (2010)	Group Intervention to improve Social Communication skills	33	Cohort	Profile of Pragmatic Impairment in Communication Social communication skills Questionnaire Adapted La Trobe Communication Questionnaire (6 months)	Traumatic Brain Injury (does not report injury severity)	1	23
Bosco et al. (2018)	Cognitive Pragmatic Treatment	19	Cohort	Communication Activities of Daily Living Assessment Battery for Communication (3 months)	Traumatic Brain Injury (Severe)	1	21
Dahlberg et al. (2007)	12 weekly group sessions to improve social communication	52	Randomised Control Trial	Social communication Skills Questionnaire Adapted (3, 6 and 9 months)	Traumatic Brain Injury	1	27
Douglas et al. (2019)	Communication specific coping intervention.	13	Cohort	Communication Specific coping scale The Discourse Coping Scale The La Trobe Communication questionnaire (1&3 months)	Traumatic Brain Injury (Severe)	2	20

Gabbatore et al. (2015)	Cognitive Pragmatic Treatment	15	Cohort	Assessment battery for communication (3 months)	Traumatic Brain Injury (Severe)	1	22
Harrison-Felix et al., (2018)	13 weekly group interactive sessions with structured and facilitated group interactions to improve social competence	179	Randomised Control Trial	Profile of pragmatic Impairment in Communication La Trobe Communication Questionnaire (3 months)	Traumatic Brain Injury (Mild - Severe)	6 months	24
Togher et al. (2016)	Training people with a TBI and their communication partners	29	Non-Randomised Control Trial	La Trobe communication Questionnaire (6 months)	Traumatic Brain Injury (Moderate to Severe)	9 months	24

Assessment of methodological quality

The papers were then checked against the Downs and Black (1998) checklist, which was specifically developed for assessing the quality of healthcare interventions. The checklist scrutinises how well the studies report data, their external and internal validity, selection bias and power. The checklist provides a score out of 28 for 27 items. The scores are then used to determine the quality of the study. An 'excellent' quality study should achieve between 26-28; 'good' between 20-25; 'fair' between 15-19; and 'poor' less than 14.

A total of 7 studies were analysed against the Downs and Black checklist (1998). The results are reported below. Due to the limited number of studies it was not possible to accurately check the inter-rater reliability of the scores with another researcher (Bujang & Baharum, 2017).

Data Analysis

A meta-analysis was performed to analyse the data using R software (R Core Team, 2019) and the meta package (Schwarzer, 2007). The meta-analysis was performed on the studies which met the inclusion criteria and included the appropriate data required for a meta-analysis. For Togher, McDonald, Tate, Rietdijk, and Power (2016) the study had three non-randomised groups and of those two were selected to be used in the meta-analysis. The group that included training partners and the control group were used. This was included because training partners included an element of education and were different from the other interventions that were being included. The means and standard deviations of the scores pre and post intervention were used to calculate the study effect size (Standardised Mean Difference) for the cohort studies. For randomised controlled trials, control and intervention group means and standard deviations were used to calculate the study effect size (Standardised Mean Difference).

Three assumptions were made before undertaking the meta-analysis. The randomised controlled trials were combined with cohort studies. It was assumed that the interventions versus control difference in the randomised controlled trials were estimating the same effect as the change over time in the cohort studies. A second assumption that was made was that as the studies were using different ways to measure the same construct, they would be combined in the meta-analysis using standardised differences. This approach makes the assumption that the populations the studies came from are equally variable (Higgins, Altman & Sterne, 2011). Thirdly, a random-effects meta-analysis was used because this does not assume that the true effect is the same in all study populations as suggested by Borenstein, Hedges, Higgins and Rothstein (2011).

Results

Participants

There were 235 participants who were included in the meta-analysis who completed an intervention. Of those, 80 were from cohort studies and 155 were from controlled trials. The mean number of participants per cohort study was 20.00 (SD = 9.02). The mean number of participants for control studies was 51.67 (SD = 43.89). The number of participants in each group ranged from 13 (Douglas et al., 2019) to 33 (Braden et al., 2010) in the cohort studies. In the controlled trials it ranged from 13 (Togher et al., 2016) to 90 (Harrison-Felix et al., 2018).

There was a total of 129 control participants that were included in the meta-analysis from the three controlled trials (Togher et al., 2016; Harrison-Felix et al., 2018; Dahlberg et al., 2007). The mean average control participants per controlled study was M = 43.00 (SD = 40.29). The lower range was 13 (Togher et al., 2016) and the highest was 90 (Harrison-Felix et al., 2018). Therefore, illustrating there was a quite a range between the number of participants taking part in the studies.

All of the studies included in the review used adult participants; the youngest participant was 16 (Douglas et al., 2019) and the eldest participant was 61 (Braden et al., 2010). The average age of participants that took part in the intervention groups was 37.33 (SD = 6.36) and in the control groups was 41.56 (SD = 4.15). This ranged from a mean average age of 27.54 (SD = 10.51) (Douglas et al., 2019) to 44.75 (SD = 14.52) (Harrison-Felix et al., 2018). Thus, highlighting that there was not a large difference in age across the studies that were included. In the control group the mean average age varied from 38.1 (SD = 15.1) (Togher et al., 2016) to 46.66 (SD = 12.05) (Harrison-Felix et al., 2018).

Of the participants that were included in the meta-analysis 63.87% of the intervention group were male and 36.12% were female. In the control group 75.65% were male and 24.35% were female. However, one study, Togher et al. (2016) did not report information about gender.

Of the studies that were included three included information about ethnicity. Harrison-Felix et al (2018) study contained 66.67% of participants who were white, 21.11% of participants who were black and 12.22% who were other. Braden et al. (2010) also reported information regarding ethnicity; 96.67% of the participants were white and 3.3% were African Americans. Further, Dahlberg et al. (2007) reported 92.20% of their intervention group were white, 3.80 were African American and 3.80% were Hispanic. Their control group was 84.60% white, 7.70% African American and 7.70% Hispanic.

The other four studies did not report ethnicity data however the interventions were undertaken in countries in which the population is principally white in ethnic origin. Two studies (Bosco et al., 2018) were conducted in Italy. Two studies were conducted in Australia (Togher et al., 2016; Douglas et al., 2019) and two studies were conducted in America (Braden et al., 2010; Harrison-Felix et al., 2018).

Four of the studies used participants who had a severe traumatic brain injury, two used participants who had a moderate to severe brain injury (Togher et al., 2016; Dahlberg et al., 2007) one used participants who had a mild, moderate or severe brain injury (Harrison-Felix et al., 2018)

The average time post injury for the intervention group was 7.88 years (SD = 0.93) and for the control group was 9.91 (SD = 0.30). One study (Harrison-Felix et al., 2018) did not include data for the period of time since a brain injury.

Exclusion & Inclusion criteria

The inclusion criteria across the studies was broadly similar. The studies required that participants have some level of communication difficulty and a traumatic brain injury. Six out of the seven studies excluded participants who had previous/present drug and alcohol addiction, neuropsychiatric illness, or any that had a previous head injury.

Interventions

The aim of all studies included in the meta-analysis was to improve social communication skills in some way. There was a range of interventions that had been used, which are outlined below.

Cognitive Pragmatic Treatment was used by Bosco et al. (2018) and Gabbatore et al. (2015). Cognitive Pragmatic Treatment focusses on improving several communication modalities, theory of mind and cognitive components such as awareness and executive functioning. It consists of a total of 24 sessions and each session emphasises one particular aspect of communication. Two sessions are provided a week and the treatment lasts for 12 weeks. Each session is 1.5 hours. As part of the program there are rehabilitation activities which are completed in groups of 5 five participants led by a psychologist.

Group Interactive Structured Treatment used by Braden et al. (2010) and Harrison-Felix et al. (2018). This consists of a 13-week treatment with 1.5-hour sessions. Group members receive the Group Interactive Structured Treatment workbook and are given weekly homework to complete. Topics include an orientation meeting, skills of a great communicator, starting conversations, keeping conversations going, assertiveness, social boundaries, conflict resolution, closure and celebration.

A replicable group treatment program was used by Dahlberg et al. (2007). It is made up of 12 weekly group sessions for 1.5 hours in a living room type setting. The program is based on the book '*Social Skills and Traumatic Brain Injury'*. Group members are given copies of a workbook and asked to share with family or a significant other. Group size is limited to 8 participants to allow time for individual participation. The treatment is based on four components. Firstly, the use of group leaders from various clinical backgrounds. The second is emphasis on individual goal setting. The third was the group process to encourage interaction and fourthly the focus was on the generalisation of skills, which is done through involving family and friends and weekly homework to be completed in the community or at home.

Communication Partner Training used by Togher et al. (2016). This involves participants attending a group session which lasts for 2.5 hours a week and also having an individual session for 45-60 minutes for ten weeks. Participants are provided with voice recorders and are trained to record their conversations. During the treatment they are given conversational tasks to complete at home with their communication partner. Individual sessions involve goal setting, feedback on home-based tasks, problem-solving of any issues, practise and troubleshooting related to any new strategies introduced in the group session. The group sessions included a review of home-based tasks using tape-recorded examples of interactions which were taken from the previous week.

Lastly, a Communication-specific coping intervention was used by Douglas et al. (2019). This involves a structured intervention programme that incorporates the procedures and principles of cognitive behavioural therapy and context-sensitive social communication therapy. The Communication-specific coping intervention tries to better participants' use of productive communication coping strategies. The treatment is made up of three parts. Firstly, the facilitation of self-awareness of coping strategies; secondly, skill development practice in scenarios that are personally relevant and lastly the evaluation of performance through video. The intervention is delivered by a speech therapist over a six-week period with two sessions per week.

The main differences between the interventions was the length of time, the facilitators' profession, the use of homework and whether communication partners were included. All the interventions contained an element of group work and education.

The studies used three different types of measures to examine social communication; La Trobe communication questionnaire (Douglas, O'Flaherty & Snow, 2000), Assessment Battery for Communication and the Social Skills questionnaire (Sacco et al., 2008) and the Social Communication Skills Questionnaire – Adapted (McGann, Werven, & Douglas, 1997). The La Trobe communication questionnaire is used to measure difficulties following a brain injury in aspects of initiation and conversational flow, disinhibition and impulsivity, conversational effectiveness and partner sensitivity. It was used by four of the studies included in the review. The Assessment Battery for Communication is used to evaluate of communicative abilities in patients with neuropsychological and psychiatric disorders, such as aphasia, right hemispheric damage, closed head injury, autism and schizophrenia. It consists of 5 scales, investigating comprehension and production of linguistic and extralinguistic acts, paralinguistic expressions, appropriateness with respect to discourse and social norms, and management of conversation. This measure was used by two of the studies. The Social Communication Skills Questionnaire – Adapted was used only by Dahlberg et al., 2007 and was developed for social skills group participants with TBI, to establish the participants' level of understanding of social communication and their degree of insight regarding communication behaviours. Additional questions were added to the original instrument to capture all the topics presented in the treatment program, and a scoring system was added to make it suitable for measurement. The adapted tool was completed by the subjects, family members, or significant others to measure perception of improvement in the participant's skills at the 5 data collection points.

Excluded studies

Three studies needed to be excluded as they did not have the relevant data, which included standard deviations and follow up means, required to be included in the meta-analysis. The studies and their results are briefly summarised below. Please see Appendix S for a detailed table of characteristics.

Appleton et al., 2011 conducted a non-randomised pilot study investigating an inpatient multi-disciplinary social communication and coping skills group intervention. This is a 4-week program which consist of 3 1-hour sessions a week and is facilitated by a speech therapist and clinical psychologist. The study found that participants improved between baseline and 3 months post intervention in terms of greater informativeness and efficiency of connected speech.

Mcdonald et al., 2008 completed a randomised control trial comparing a social skills program with waitlist controls. The intervention involved a 12-week social skills treatment with 3-hour group sessions which concentrated on shaping social behaviour and remediating social perception; the intervention also included 1-hour individual sessions to address other issues such as mood. The study found that treatment effects after social skills training in people with an acquired brain injury are modest and limited to direct measures of social behaviour.

Finch, Cornwell, Copley, Doig and Fleming (2017) performed a pilot study in which they evaluated whether a metacognitive, goal-based intervention improved social communication skills of adults with a TBI. The intervention was completed over 8 weeks in which participants attended 2 1-hour therapy sessions per week. One of the sessions was an individual session in which they learnt communication skills and the other was a group session in which they had the chance to practice the skills they had learnt. The study concluded that a goal driven, metacognitive approach to intervention may assist individuals with TBI to achieve their personal social communication goals.

Quality Assessment

A quality assessment of the studies included in the meta-analysis found that the studies included were generally of good quality. The highest score that a study could attain was 28 however none of the studies achieved this. The average rating was 23.00 (SD = 2.31). The lowest score was 20 (Douglas et al., 2019) and the highest score was 27 (Dahlberg et al., 2007). Of the studies that were included, four or the seven were cohort studies this consequently has an impact on the quality of the studies. A weakness of cohort studies is

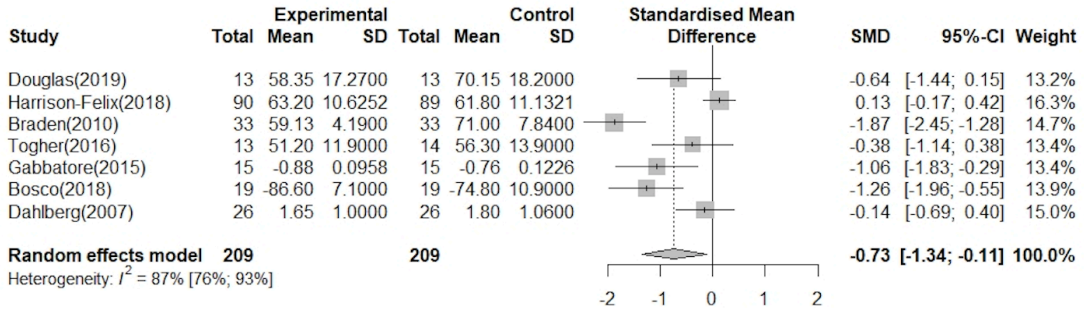
that it is difficult to know whether the outcomes are due to the intervention or other confounding variables. Further, Douglas et al., 2019; Bosco et al., 2018, Gabbatore et al., did not blind the participants from the intervention they were having, nor did they attempt to blind them from the main outcomes of the intervention. Thus, they had low internal validity which led to a low score.

However, the samples used were representative of the population being studied, there was good external validity and reporting. As the majority of the studies included in the meta-analysis were cohort studies, this limited the strength of the meta-analysis.

Meta-Analysis

The results of the meta-analysis are illustrated in Figure 2.

Figure 2. Meta-analysis and forest plot for social communication improvement.



The meta-analysis shows that interventions for social communication difficulties following a brain injury improve social communication in adults with a brain injury (standardised mean difference from random effects model = -0.73, 95% CI (-1.34, -0.11), p=0.02)). The I-squared statistic is 87.1% CI (75.6% - 93.1%) suggesting that a considerable part of the variation in effect sizes is due to study heterogeneity rather than chance. This is to be expected given the range of impairment that may occur following a brain injury thus creating a diverse study population.

It is important to note that from the studies used in the meta-analysis, those that were controlled trials did not find statistically significant results (Dahlberg et al., 2007; Harrison-Felix et al., 2018). In contrast, the cohort studies, bar Douglas et al. (2019), did find statistically significant results (Braden et al., 2010; Bosco et al., 2018; Gabbatore et al., 2015). These three cohort studies made up 42.1% of the weighting of the meta-analysis.

Discussion

Social communication is an area that individuals with a brain injury persistently struggle with; they find communicative exchanges stressful (Bracy & Douglas, 2005) and others, including partners and employers describe it as one of the most challenging aspects following a brain injury (Bootes & Chapporo, 2010). The meta-analysis was the first systematic meta-analytic literature review to specifically investigate the effectiveness of educational interventions designed for social communication difficulties following a brain injury. The review found evidence for the use of educational interventions for improving social communication subsequent to a brain injury, the present meta-analysis produced a statistically significant effect, which is consistent with findings from previous studies (Finch et al., 2016). However, the evidence in the present review is more ambiguous, as it did not show a clear effect in contrast to Finch et al. (2016) who had qualitatively found that behavioural interventions were helpful in improving social communication.

The meta-analysis found the largest effect size for Group Interactive Structured Treatment (Braden et al., 2010). However, Felix et al., 2018 also evaluated Group Interactive Structured Treatment and had the smallest effect size. Although, there was a common theme in those studies that assessed Cognitive Pragmatic Treatment (Gabbatore et al., 2015; Bosco et al., 2018) as the two studies showed consistently large effect sizes. Therefore, giving evidence for the use of Cognitive Pragmatic Treatment to improve social communication skills.

Overall, the meta-analysis demonstrated that the current educational interventions designed to improve social communication show mixed results and thus at the present moment it is

difficult to conclude, with reasonable certainty, whether it is helpful to implement educational interventions specifically for social communication difficulties.

An important finding of the present study is that the controlled studies that were included in the meta-analysis did not find a significant difference pre and post intervention (Harrison-Felix et al., 2018; Togher et al., 2016; Dahlberg et al., 2007), in contrast to the cohort studies (Braden et al., 2010; Bosco et al., 2018; Gabbatore et al., 2015). Randomised controlled trials are considered to be the gold standard for assessing the effectiveness of therapeutic interventions (Abel & Koch, 1999). In comparison cohort studies are regarded as having a lower quality of evidence (Guyatt et al., 2011), this is due to their inability to control for confounding variables (Te Morenga, Mallard & Mann, 2013). This has important implications for the research. It may be that when confounding variables are controlled in randomised control trials, the effects of interventions to improve social communication are not significant. The consequence of this is that it weakens the conclusions that can be drawn from the meta-analysis. A possible explanation for the lack of randomised controlled trials in this area may be due to the fact that a lot of the research in the area is in the preliminary evidence stage. However, it is also likely to be impacted by the heterogeneity of brain injury samples thus leading to, at present, more single case and cohort designs when studying this participant group.

Furthermore, the present review highlighted the limited number of studies within this field, despite the impact that difficulties with social communication can have on one's quality of life (Sohlberg et al., 2019). Lack of research within this field prevents evidence-based practice and does not allow for clinicians to select the best treatment for the individual patient. This is further supported Kelly, Mcdonald and Frith (2017) who found that 78% of clinicians described not having the tools to fully assess and consequently treat difficulties with social communication subsequent to a brain injury. Therefore, a key outcome from the review is the need for the further research, that looks at treatments for social communication difficulties.

Quality of Studies

All the studies in the meta-analysis were in the 'good' category as defined by the Downs and Black (1998) quality checklist. For most of the studies their weakness laid in them being cohort studies. The implication of this is that it is possible that the changes seen in the outcome measures are due to reasons other than the intervention. Further, as highlighted, some studies showed low internal validity, due to not blinding participants to the intervention or outcome. This may have led to some placebo effects.

There were only two studies that had randomised participants, Dalberg et al. (2007) and Harrison-Felix et al. (2018). However, a strength of all of the studies was that they used well validated and reliable tools, either the La Trobe Communication Questionnaire or the Assessment Battery of Communication, to measure social communication.

Limitations

The review is subject to some limitations. Firstly, a limitation of the current systematic literature review is that it looked at numerous interventions. Some studies completed 13-week group interventions (Braden et al., 2010) whereas others provided 1-1 sessions and then separate time with communication partners (Douglas et al., 2019). There was a large variety in the interventions that were included and there was a limited number of studies. This makes it difficult to draw robust conclusions from the meta-analysis. Further, due to the limited number of studies that could be included in the meta-analysis it was not possible to use a funnel plot to assess the effect of potential publication bias (Egger, Smith & Phillips, 1997).

Moreover, another limitation of the present meta-analysis is that the majority of the studies that were included in the review excluded participants with any neuropsychiatric illness. However psychiatric illnesses are consistently present at an elevated rate following a brain injury (Rogers & Read, 2007). This therefore impacts upon the ecological validity of the included studies and consequently the meta-analysis as a whole. Therefore, it would be

important for future research to investigate how effective social communication interventions are with a more representative sample of participants.

Clinical Implications

The systematic literature review highlights that educational interventions specifically for social communication deficits subsequent to a brain injury are helpful at improving communication abilities. In particular, it is recommended that services designed specifically for people with a brain injury think about the potential benefits, as highlighted in the present study, of setting up groups that are intended to help people with their social communication skills. All of the interventions that were included in the present systematic review had a component of group work. However, it is understood that group work requires a number of individuals at the same level of ability which can require extensive logistical planning and thus may not be feasible within many rehabilitation services. Despite this, group work could be seen as a more cost-effective treatment compared to individual sessions that are offered.

Furthermore, from the studies included in the meta-analysis, the intervention that requires the least amount of time and uses only one therapist is the Communication-specific Coping program (Douglas et al., 2019). It is delivered by a speech therapist over a six-week period with two sessions per week. This therefore is recommended to services as the least time-consuming intervention. Douglas et al. (2019) found the intervention to improve social communication however the present meta-analysis did not find it to significantly improve communication. More research into Communication-specific Coping program would be helpful to better understand the impact that it may have, as at present it was only the one study that was included.

However, the educational interventions with consistently large effect sizes was the Cognitive Pragmatic Treatment (Gabbatore et al., 2015; Bosco et al., 2018). This is treatment run by a Psychologist over 12 weeks, with a group meeting twice a week.

Therefore, based on the current meta-analysis findings this is the treatment that would be recommended. It would be advantageous if future research investigated the key ingredients that helped to make Cognitive Pragmatic Treatment successful over other interventions that were included. This is important as often interventions are tailored to individuals, due to the heterogeneity of brain injuries, therefore understanding what makes the treatment successful will help inform clinicians and allow them to create personalised treatment plans.

It is important to recognise that improving communication impacts on social reintegration into schools, workplaces and in the home environment (Kelly et al., 2017). It may have far reaching effects which help to improve overall wellbeing, as it can lead to increased meaningful participation in the community, reduced socially inappropriate behaviour and improved positive experiences of social interactions (Rigon, Turkstra, Mutlu & Duff, 2018). However, there were only a limited number of studies included in the review, of which the majority were cohort studies which makes it difficult to establish whether the changes that occurred were due to the interventions used in the study or other factors. However,

Future Research

The meta-analysis highlights the need for an increase in interventions that have been evaluated to help improve social communication. It would be useful in the field for future studies to investigate the efficacy of different interventions using randomised controlled trials. This would help to solidify the understanding of the efficacy of specialised interventions specifically for social communication. At the present moment, although the research shows a positive impact of educational interventions, the data is limited.

The present review aimed to investigate social communication interventions for people proceeding an acquired brain injury. However, the literature that was found was largely focussed on social communication interventions following a traumatic brain injury. Despite this, individuals following a stroke and other acquired brain injuries struggle with social

communication (Hewetson, Cornwell & Shum, 2018). A potential area for future research could be to investigate how social communication interventions may improve communication subsequent to an acquired brain injury.

Conclusion

In summary, the meta-analysis demonstrates that there is evidence for clinicians to use educational interventions designed to improve social communication skills for individuals after a brain injury. However, the majority of the studies included lacked a control group. The systematic review highlights a considerable gap in the literature in regard to interventions designed to help people following a brain injury, despite social communication being an area that people persistently struggle with following a brain injury (Struchen et al., 2008). Future research needs to specifically evaluate a greater range of intervention for social communication difficulties.

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Part two: Empirical Paper

This paper is written in the format for submission to the Journal of Neuropsychology.

Please see Appendix C for ‘‘Author Guidelines’’

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The Impact of Executive Functioning and Social cognition on Decision Making following an Acquired Brain Injury.

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Abstract

Acquired Brain Injury (ABI) is a rapidly growing health concern (Menon & Bryant, 2019). One of the consequences of an ABI is changes in decision making. The present study aimed to investigate social and economic decision making abnormalities in those with an ABI compared to neurologically normal controls using the Ultimatum Game. Secondary to this, the study also aimed to explore the underlying cognitive moderator variables in social and economic decision making. The cognitive constructs that were selected were: executive functioning in the domains of inhibition and planning, and social cognition. Thirty individuals with an ABI and thirty controls completed social cognition and executive functioning tests and a decision making task. This was the first study to show that those with an ABI have markedly different social and economic decision making in the Ultimatum Game compared to controls and this correlated with aspects of executive functioning.

Keywords: executive functioning; social cognition; decision making; acquired brain injury; ultimatum game

Introduction

An acquired brain injury (ABI) is a term that captures traumatic brain injury, stroke, aneurysm, brain tumour, vestibular dysfunction, and anoxic or hypoxic brain injury (Ciuffreda, Kapoor, Taub, Bartuccio & Maino, 2012). ABI is a rapidly growing health concern, resulting in approximately 1000 hospital admissions each day in the UK (Menon & Bryant, 2019). The consequences of brain injury to both the individual and their family and friends can be catastrophic. It can affect social cognition and executive functioning, as well as social, economic (Koenigs & Tranel, 2007) and moral (Rowley, Rogish, Alexander & Riggs, 2018) judgements and decision making.

In particular, decision making following a brain injury is markedly different compared to pre-injury (Koenigs & Tranel, 2007). People who have suffered from a brain injury often have reduced capacity to make decisions (Shaver et al., 2019). They may lack financial capacity (Sunderaraman, Cosentino, Lindgren, James & Schultheis, 2019) and may also have impaired medical decision making (Triebel et al., 2012). A brain injury may also cause individuals to decide against their best interests (Lennard, 2016). As a result of this it can cause losses in social standing, family and friends. Although the adverse consequence of changes in decision making are well documented following a brain injury, the cognitive processes that moderate them are not well known.

The Somatic Marker Hypothesis theory of decision making was proposed by Damasio, Tranel and Damasio (1991). This provided a framework for decision making which included the profound influence of emotion (Bechara & Damasio, 2005). The Somatic Marker Hypothesis states that when one makes a decision it requires the assessment of the value of the choices available using both cognitive and emotional processes. As time passes, emotions and their consequent bodily changes, called ‘somatic markers’, become associated with particular emotions and outcomes. Thus, emotionally laden signals, somatic markers, assist cognitive processes in implementing decisions. Furthermore, the theory propositions that the somatic marker signals are controlled by emotion circuitry in the brain, in particular in the ventromedial prefrontal cortex (Bechara, Tranel & Damasio,

2000). This position stands in contrast to purely cognitive models of decision making in the rationalist tradition (Kohlberg, 1969).

If the somatic marker system is impaired, a patient may struggle to make advantageous decisions in real life due to impairments in the emotional mechanisms that rapidly signal the prospective consequences of an action and assist accordingly in the selection of an advantageous response. Deprived of this emotional signal, these patients may rely overly on a dispassionate cost-benefit analysis of numerous and often conflicting options involving both immediate and future consequences (Greene, Morelli, Lowenberg, Nystrom & Cohen, 2008). This demonstrates that, based on this theory decision making subsequent to an ABI may be particularly impacted by one's ability to regulate, and inhibit, emotions; in other words, emotional regulation.

Ultimatum Game and Decision Making

Koenigs and Tranel (2007) investigated decision making behaviour in patients who had suffered from ventromedial prefrontal cortex damage, using the Ultimatum Game (UG). In the UG, two players are given the opportunity to split a sum of money. One player is deemed the proposer and the other, the responder, although the proposer is in fact a stooge. The proposer makes an offer as to how this money should be split between the two. The second player, the responder, can either accept or reject this offer. If it is accepted, the money is split as proposed, but if the responder rejects the offer, then neither player receives anything. In either event, the game is over.

The UG is conceptualised as a social, as well as economical, decision making task. This was demonstrated by Van't Wout, Kahn, Sanfey and Aleman (2006) who found increased skin conductance activity, an index of affective state, when the participant believed a human conspecific to be giving the offers, as opposed to computer generated offers. Thus, highlighting that the game measures an important aspect of social decision making. Social decision making is defined as; the ability to select the most optimal course of action from different alternatives in complex social environments (Sanfey, 2007).

The standard economic solution to the UG is for the proposer to offer the smallest sum of money possible to the responder and for the responder to accept this offer, on the reasonable grounds that any monetary amount is preferable to none. However, studies have shown that most accepted offers are around 50% the total amount (Sanfey, Rilling, Aronson, Nystrom, & Cohen, 2003). Furthermore, offers lower than 20% of the total have a high chance of being rejected (Sanfey et al., 2003). For example, when splitting £10, the proposer may offer £2 to the responder and keep £8 to himself. In this situation there is a high chance of this offer being rejected. This demonstrates that neurologically normal participants are motivated to turn down a monetary reward, despite these decisions being economically self-harmful, from a rationalist viewpoint.

One explanation for the rejection of fair offers in neurologically normal individuals, is due to their preferences for fairness (Fehr & Gintis, 2007). The responder sacrifices the monetary gain in order to punish the proposer (Frith & Frith, 2008), with the intention to enforce cooperation for the whole group. An alternative view to this is that the individual may reject unfair offers due to spiteful motives (Jensen, 2010) suggesting they are concerned about their relative standing and thus prefer having an outcome where both themselves and the proposer receive nothing, rather than one that leaves them below the proposer. Therefore, objecting to unfairness has been advanced as a fundamental adaptive mechanism by which one can assert and maintain their social reputation (Nowak, Page & Sigmund, 2000). In attempting to explain these findings researchers have appealed to the role of emotions. This is supported by evidence which has shown activation of brain regions, involved in emotional processing such as the anterior insula, when one is given an unfair offer (Sanfey et al., 2003).

Koenigs and Tranel (2007) found that patients with ventromedial prefrontal cortex damage were even more likely than neurologically normal controls to reject unfair offers in the UG. The researchers proposed that this was may be due to impairment in emotional regulation or in cognitive flexibility in those who have ventromedial prefrontal cortex damage. However, there is as yet little experimental data to lend support or refutation to this hypothesis. Nor is it clear whether ventromedial prefrontal cortex lesioned patients are

unique in their abnormal responding, or if in fact these decision making processes are disrupted across the gamut of ABI. This study was designed to address these related questions directly for the first time.

Executive Functioning

An aspect of cognition that is relevant to decision making is executive functioning (Del Missier, Mäntylä, & De Bruin, 2012). Executive functioning is an overarching term that includes several subcomponents including, cognitive flexibility, inhibition, planning and the capacity to engage in purposive goal directed behaviour (Wood & Worthington, 2017). There is a complex interaction between cognition and emotion within executive functioning. One approach which some authors have advanced is the division of executive functioning into hot and cold processes (Fonseca et al., 2012). Hot components are conceptualised as those processes that encompass emotions whereas cold components demand planning and the use of rationality (Chan, Shum, Toulopoulou & Chen, 2008). Hot executive functioning primarily relies upon circuitry in the orbitofrontal cortex or the ventromedial prefrontal cortex (Gazzaniga & Ivry, 2013). However, cold executive functioning involves the lateral prefrontal cortex including the dorsolateral prefrontal cortex (Nejati, Salehinejad, & Nitsche, 2018).

Executive dysfunction is a common consequence of an ABI and may result in impaired attention, poor response inhibition, and the inability to anticipate the consequences of actions (Mcdonald, Flashman & Saykin, 2002). Planning is particularly affected (Dennis, Guger, Roncadin, Barnes, & Schachar, 2001). Planning is defined as the ability to select and organise the stages and elements required to achieve a goal (Lezak, Howieson, Bigler & Tranel, 2012). It is a multidimensional activity that necessitates complex cognitive demands (Grafman, 1999). Following a brain injury, individuals show difficulties on tests of executive performance involving planning (Dennis et al., 2001). Planning may be relevant to the social and economic decision making required during the UG, as it could plausibly cue participants to consider the future positive or negative consequences of their decision in a 'cold', cognitive way.

An additional constituent of executive functioning that individuals struggle with following a brain injury is inhibitory control (Rochat, Beni, Annoni, Vuadens, & Van der Linden, 2013). Inhibitory control is defined as the ability to concentrate on a task and suppress interfering information or unwanted responses in favour of more controlled processing (Xu et al., 2017). Subsequent to a brain injury, poor inhibition can result in numerous difficulties with behaviour including poor decision making (Rochat et al., 2013). The literature highlights that there exists a link between executive functioning and decision making however the research is fragmented and various conclusions have been drawn dependent on the decision making task used (Del-Missier et al., 2012). Inhibition may be relevant to the social and economic decision making required during the UG, as it may require inhibition of initial emotional responses to unfair offers to be overrode, so that greater cognitive control can be exercised.

Social Cognition

Another component of cognition that is relevant to decision making is social cognition (Frith & Singer, 2008). Social cognition is described as critical to the understanding of human experience (Keysers & Gazzola, 2006). Social cognition underpins our ability to understand the behaviour of others and to respond appropriately in social settings (Lieberman, 2007). Deficits in social cognition are typical subsequent to ABI (Kosty & Stein, 2013). Individuals show difficulty in interpreting social situations, and have trouble understanding and integrating subtle social and emotional cues that are necessary for the interpretation of events (Cicerone & Tanenbaum, 1997). Disorders of social cognition are strongly correlated to functional outcomes. Following a brain injury, individuals face difficulties with the recommencement of social and work roles and may consequently become socially isolated (Tomberg, Toomela, Ennok & Tikk, 2007). Further, they may find it increasingly challenging to keep friendships or relationships with work colleagues (Williams & Wood, 2013).

One important aspect of social cognition is theory of mind; the ability to understand other people's intentions and beliefs (Milders, Ietswaart, Crawford & Currie, 2006). It has been

advanced that deficits in theory of mind subsequent to a brain injury may underlie impairment in individuals who have experienced an ABI (Milders, Fuchs & Crawford, 2003) which include; difficulty appreciating sarcasm (Martin & McDonald, 2005); lower empathy (Shamay-Tsoory, Tomer, Goldsher, Berger & Aharon-Peretz, 2004) and poor social insight (Santoro & Spiers, 1994). Despite the impact of theory of mind deficits and social cognition it is not an aspect that is routinely assessed subsequent to a brain injury (Kelly, Mcdonald & Frith, 2017). Social cognitive impairments have been found to be significant predictors of lower social and vocational participation for individuals with a moderate to severe brain injury (Westerhof-Evers, Fasotti, van der Naalt & Spikman, 2019). Accordingly, this indicates the importance social cognition plays in the difficulties that individuals with a brain injury face.

The involvement of theory of mind in the decision making process following a brain injury has been implied. In the UG, evidence has shown that there exist behavioural and neural differences between trials that consist of a human proposer vs computer generated offers (Rilling, Sanfey, Aronson, Nystrom & Cohen, 2004). In addition, Poletti, Enrici and Adenzato (2012) found that neural systems supporting decision making overlap with the components of neural circuitry sub-serving affective theory of mind. Thus, indicating theory of mind may play a role in decision making post brain injury.

In summary, the current study intends to investigate social and economic decision making abnormalities on the UG in those with an ABI, compared to neurologically normal controls, in order to extend the evidence in this area. Secondarily, the study also aims to explore the underlying cognitive moderator variables in decision making as measured by the UG, both in the whole sample as well as in the ABI group alone. The cognitive constructs selected were: executive functioning in the domains of inhibition and planning, and social cognition. This has not been empirically tested to date and these constructs were investigated due to their theoretical relevance, as outlined above.

Research Questions

The research will investigate the following questions:

1. Is social and economic decision making different between those with an ABI compared to neurologically normal controls?
2. Is there a relationship between the tendency to reject unfair offers and cognitive skills in the areas of planning, inhibition or theory of mind?
3. Following ABI, does theory of mind or executive functioning, inhibition or planning aspects, significantly predict the tendency to reject unfair offers?

Hypotheses

It is hypothesised that there will be a significant difference in decision making in the UG in the ABI group compared to controls. Specifically, the ABI group will be more likely to reject unfair offers, when fair offers have been controlled for, compared to controls. This is expected as previous evidence (Koenigs & Tranel, 2007) had found that those with ventromedial prefrontal cortex damage were more likely to reject unfair offers compared to neurologically normal participants and there is reason to believe that the mechanisms which may underlie this difference may be common to ABI populations more generally.

Further, it is hypothesised that tendency to reject unfair offers in the UG for ABI will correlate negatively with scores on the executive functioning and social cognition tests. More specifically, the more likely an individual is to reject unfair offers, whilst controlling for fair offers, then the poorer their scores on the inhibition, planning and theory of mind. This is expected as evidence has shown inhibition and planning components of executive functioning to play a vital role in decision making (Del Missier et al., 2012) and is an aspect that has been shown to be affected proceeding a brain injury (Dennis et al., 2001). Further, social cognition is another aspect that is often altered following a brain injury (Kosty & Stein, 2013) and it has been shown to be an important part of decision making, in particular aspects of theory of mind (Frith & Singer, 2008).

Methods

Design

A mixed design was employed in which thirty participants were placed in one of two groups; an ABI group or a control group. Both groups had two conditions; fair and unfair offers.

Participants were recruited from the Headway Charity Group, Brain Injury Rehabilitation Trust and local stroke and brain injury community groups. The inclusion criteria necessitated that they must have experienced an ABI, be a least 6 months post injury, must be proficient in English, and must be 18 years of age or older. The exclusion criteria for all the participants was; lack capacity to consent to take part; unable to comprehend or produce speech to the levels necessary for the tasks; evidence of degenerative disease; uncorrected visual impairments; and unable to press buttons on a keyboard.

The healthy controls must not have experienced an ABI and had the same exclusion criteria as above. Demographic data is shown in Table 1. All participants that took part in the study gave informed consent. Ethical approval for the study was given by a local NHS ethics committee.

Procedure

Firstly, participants completed the demographics information form.

Participants then completed the UG. The UG was used as a measure of social and economic decision making. Participants responded to a series of twenty-two trials of the UG. In each of the trials the participant first viewed a picture of the person making an Ultimatum offer, the proposer, with their name next to it. On the same screen they viewed the offer, a take it or leave it spilt of £10. Following this, participants then viewed a screen that read "Accept or "Reject". The participants had infinite time to consider the offer and press the key. On

the final screen the participant viewed the outcome of their response e.g. "You both get £0" if the offer was rejected. In between screens there was an inter-trial interval, a fixation cross, for 3 seconds.

The participants received 22 offers from 22 different proposers. All the participants received the same offers in a fixed random order. Offers were determined by a previous study by Koenigs and Tranel (2007). There were two offers of £5 (proposer keeps £5), two offers of £4 (proposer keeps £6), six offers of £3 (proposer keeps £7), six offers of £2 (proposer keeps £8) and six offers of £1 (proposer keeps £9). In total, there was 18 unfair offers presented and 4 fair offers. The fair and unfair offers were predetermined by previous research (Guth et al., 1982). Guth et al. (1982) used a group of 10 neurologically normal adults who were instructed on the rules of the UG and consequently asked to make subjective judgements of each of these amounts as fair or unfair. The modal response was that £5 and £4 offers were fair UG responses and £3, £2 and £1 were unfair. Koenigs and Tranel (2007) based their fair and unfair offers on the Guth et al., (1982) study. Therefore, we considered the £5 and £4 offers to be fair and the £3, £2, and £1 offers to be unfair.

The UG was presented on the open source software 'Open Sesame' version 3.2.8 (Mathôt, Schreij & Theeuwes, 2012). The pictures that were used were gathered from google and included 11 males and 11 females.

Executive functioning

Participants then completed two subtests from the Delis Kaplan Executive Functioning Test (Delis, Kaplan & Kramer, 2001), Colour-word interference and the Tower test. Colour-word interference was used as a measure of inhibition. The Tower test was used as a measure of planning. Both tests show good validity and reliability (Delis, Kramer, Kaplan & Holdnack, 2004).

For Colour word interference participants completed the four conditions of Colour-word interference. Condition 1: Colour Naming. Participants were instructed to name the 50

colours. Condition 2: Word Reading. Participants were instructed to read the words on the page. Condition 3: Inhibition. Participants were instructed to name the colour of the ink that the letters are printed in. There were 50 words which were written in a different colour ink to the word that was written. Condition 4: Inhibition/Switching: In this task participants were asked to name the colour of the ink of 50 words however if the word was inside a box then they were asked to read the word and not the colour of the ink. This task was timed; if participants took longer than 180 seconds the task was terminated. Responses were scored depending on the number of seconds it took to complete the task. Only scores from condition 3 were used in the data analysis. This test has moderate test-retest reliability (r = 0.62).

Participants then completed the Tower Test. On this task, participants had to make a tower using different disks. There were three pegs and the disks would be placed in a specific order and the participant had to rearrange the disks to match the tower shown in a picture. There was a total of nine towers to build. The rules specified that participants were not allowed to place bigger disks on top of smaller disks, and they must only move one piece at a time. The aim of the Tower Test was to move the disks to the create the desired tower in the least number of moves as possible. For the first three trials participants had thirty seconds to complete the tower, for the next trial they had sixty seconds, for the next two trials they had a hundred and twenty seconds. For trial seven they had a hundred and eighty seconds and for the final two trials they had two hundred and forty seconds to complete. If participants went past the time limit, then the trial was terminated. If participants had more than three failed disks, then the task was terminated. Participants could score a maximum of 30 on the achievement score. This test has moderate test-retest reliability (r = 0.44).

Social Cognition

Participants were then presented with the Reading the Minds Eyes test (Baron-Cohen, Wheelwright, Hill, Raste & Plumb, 2001), see Appendix P. This test was chosen as a measure of theory of mind functioning. It has been shown to have convergent validity evidence with other theory of mind measures (Kirkland, Baker, Johnson, Peterson & Pulos, 2012) and moderate test-retest reliability (Khorashad et al., 2015).

Thirty-six grey scale photographs of people's eyes and the area around them are shown. Each photograph is surrounded by four adjectives and the participant was instructed to choose the word that best describes what the person in the photograph is thinking or feeling. Responses were coded as correct or incorrect which equalled a maximum score of 36.

Mood

Lastly, participants completed the Hospital Anxiety and Depression Scale (Zigmond & Snaith, 1983) which consists of 14 items and was a measure of depression and anxiety. The HADs shows good validity and reliability (Bjelland, Dahl, Haug, Neckelmann, 2002).

Data Analysis

Research Question 1

The proportion of fair offers rejected was controlled for by subtracting this from the proportion of unfair offers for all participants. The means of these differences in the ABI and control groups were then compared by an independent samples t-test. This test was then repeated after controlling for age and gender in a general linear model.

Research Question 2

Pearson correlations were computed to assess the relationship between social and economic decision making with social cognition, Reading the Mind's Eye, and executive functioning, Colour-word Interference and Tower Test.

Research Question 3

A multiple regression analysis investigated how the ABI group performed on the social and economic decision making task and executive functioning and social cognition. The dependent variable was the proportion of rejected unfair offers whilst controlling for fair

offers. The independent variables were the scores from the inhibition task, Colour-word interference, and planning aspect, Tower test, of executive functioning and the score from the Reading the Mind's Eye social cognition test. Non-significant independent variables were removed from the regression model.

Power Analysis

A calculation using GPower Version 3.1.9.2 software (Faul, Erdfelder, Lang & Buchner, 2008) showed that with 30 participants in each group and using a repeated measures analysis of variance for a univariate outcome measure and a 5% significance level, allows an effect size of 0.18 that could be detected with 80% power. An interaction is being tested for between the control group and the brain injury group by the offer type. The correlation between the two repeated measures is assumed to be 0.5 for this interaction, a conventional figure for a medium correlation.

Results

Thirty participants with an ABI were recruited and thirty controls. There was a significant difference in age *($t = 5.192$, $p < .001$)*, years in education ($t = -3.956$, $p < .001$) between the two groups but not in HADS scores ($t = 1.584$, $p = .119$). Demographic data for the participants is shown in Table 1.

General Linear Model

Participants with an ABI had a higher rejection rate of unfair offers when controlling for the fair offer rejection rate (M = .5037., SE = .067) compared to controls (M = .3352, SE = .071). Further, when additionally controlling for age and gender the adjusted difference in group means is .260 (SE = .121). This difference was significant t (56) = 2.19, $p = .038$. Thus, when age and gender are controlled for, participants with an ABI are more likely, than controls, to reject unfair offers.

Whole Sample Correlation

Neither theory of mind, measured using the Reading the Minds Eyes, significantly correlated with the social and economic decision making *(r* = -.038, *p* = .774). Nor the planning component of executive functioning, measured using the Tower test, significantly correlated with the social and economic decision making (*r* = -.114, *p* = .087). However, there was a significant relationship between social and economic decision making and the scores on inhibition measured using Colour-word interference (*r* = -.273, *p* = .037) (see Table 2).

Multiple Regression, ABI Group

The planning component of executive functioning did not significantly predict decision making in the UG (t = -.521, *p* = .607). Further theory of mind did not significantly predict decision making in the UG (t = 1.095, *p* = .284). However, inhibition was significant, so a further regression analysis was run to predict social and economic decision making with only inhibition in the model (F (1,27) = 5.80, *p* .023), with an R^2 of .177 and inhibition parameter estimate = 0.042 (SE = .017). Therefore, illustrating that inhibition is a significant predictor of decision making in the UG in participants with an ABI (see Table 3).

Table 1. Demographics of ABI participants and Controls

	ABI	Controls	*Total*	*t*	*p*
Number of Participants	30	30	60		
Years Post Injury Mean (SD)	11.03 (12.48)	-	-		
Type of Brain Injury (*n*)					
Stroke	21				
Traumatic Brain Injury	7				
Encephalitis	1				
Anoxic Brain Injury	1				
Mean Age (SD)	53.87 (12.13)	34.97 (15.83)	44.42 (16.92)	5.192	.000***
Min-Maximum	30-73	22-71	22-73		
Gender %					
Male	56.67	30.00	63.33		
Female	43.33	70.00	36.67		
Years in Education Mean (SD)	12.20 (2.26)	14.77 (2.74)	13.48 (2.81)	-3.956	.000***
Employment Status %					
Employed	10.00	80.00	45.00		
Unemployed	56.66	13.34	35.00		
Retired	16.67	3.3	10.00		
Student	0	3.3	1.67		
Volunteer	16.67	0	8.33		
Total HADS score Mean (SD)	6.93 (4.61)	5.07 (4.43)	5.98 (4.58)	1.584	.119

* $p \leq .05$; ** $p \leq .01$; *** $p \leq .00$

Table 2. *Pearson product moment correlations between cognitive variables and responses in the UG in the whole sample.*

		Proportion of Rejected Unfair Offers *(controlling for fair offers)*
Colour word interference – inhibition	r	-.273*
	p	.037
	BCa 95% CI	-.499, -.049
Tower test - Planning	r	-.114
	p	.387
	BCa 95% CI	-.353, .090
Reading the Mind's Eye	r	-.038
	p	.774
	BCa 95% CI	-.305, .213

* $p \leq .05$. BCa bootstrap 95% Confidence Interval's reported

Table 3. *Multiple Regression Analysis examining the associations between proportion of rejected unfair offers whilst controlling for fair offers with theory of mind and executive functioning (planning and inhibition)*

	B	*SE*	t	*p*
Colour word interference – inhibition	-.042	.017	-2.407	.023
Tower test - Planning	-.012	.023	-.521	.607
Reading the Mind's Eye	.012	.011	1.095	.284

B: unstandardized regression coefficients; SE: standard errors.

Discussion

The objective of the current study was to investigate decision making abnormalities in the UG in those with an ABI compared to neurologically normal controls, in order to extend the evidence in this area. Secondary to this, the study also aimed to explore the underlying cognitive moderator variables in social and economic decision making as measured by the UG both in the whole sample as well as in the ABI group alone. We found that those with an ABI showed a self-harmful tendency to reject offers based on their unfairness at a higher rate than neurologically normal controls. Further, this tendency correlated with performance on the inhibition aspect of executive functioning. However, there was no relationship between social and economic decision making and the planning aspect of executive functioning or social cognition as was hypothesised.

The UG creates a dilemma for individuals between resisting unfair treatment and waiving financial gain, or the reverse. Those with an ABI were more likely to reject unfair offers. This is consistent with the hypothesis that there will be a significant difference in decision making on the UG in the ABI group compared to controls; those with an ABI are more likely to reject unfair offers compared to controls. This finding fits with Koenigs and Tranel (2007) who found that those with a ventromedial prefrontal cortex damage showed a significant increase in the number of unfair offers rejected compared to controls. This is the first study to demonstrate this effect in a population of individuals with brain injuries of multiple aetiologies. Therefore, demonstrating that those with an ABI show markedly different social and economic decision making within the UG.

The present study aimed to find cognitive factors that are best predictive of decision making in the UG. The results from the study showed that planning does not correlate with decision making in the UG in the whole sample. An explanation for his could be due to planning being a cold executive function (Chan et al., 2008) whereas the UG could be argued to be more related to hot executive functions as it involved affective decision making (Poland, Monks & Tsermentseli, 2016). This is supported by evidence showing that brain regions associated with emotions, for example the anterior insula, become activated during presentation of unfair offers (Sanfey et al., 2003). Further, Van't Wout et

al. (2006) found skin conductance activity, a measure of autonomic index of affective state, was higher for unfair offers and was associated with the rejection of unfair offers in the UG. This may mean, that the present study was unable to find a relationship between planning and decision making due to the UG tapping into emotive aspects.

This is further supported by evidence from Kirk, Downar and Montague (2011) who examined how experienced Buddhist meditators responded to offers in the UG. They selected meditators because they have the capability to disconnect their emotional behaviour from their actual behaviour and consequently are able to assess a reward on its own value (Ochsner & Gross, 2005). The study found that meditators were less likely to reject unfair offers compared to controls. Further, they found that the dorsolateral prefrontal cortex showed an increase in activation correlating with a reduction in the number of offers rejected. In comparison, the control group showed greater activation in the anterior insula, a region linked to emotions (Wicker et al., 2003). Subsequently, this additionally supports that the reason planning may not have correlated with decision making is due to the UG engaging the emotional regulation part, anterior insula, more so than planning aspects.

This is additionally reinforced by evidence that demonstrates that hot executive functioning primarily causes activation in the ventromedial prefrontal cortex (Gazzaniga & Ivry, 2013). The ventromedial prefrontal cortex has been found to activated during the UG (Tabibnia, Satpute & Lieberman, 2008). In comparison, planning activates the dorsolateral prefrontal cortex (Sanfey et al., 2003). However, the dorsolateral prefrontal cortex does play a role in the decision making process during the UG. Activation in the dorsolateral prefrontal cortex is linked to executive control (Miller & Cohen, 2001). Thus, in the UG the activation may be due to the cognitive demands of the task such as attempting to amass as much money as possible. Therefore, demonstrating that cold executive functioning is also a substantial aspect of the UG but in the present study we were unable to capture the executive control elements that may have impacted on the social and economic decision making process.

However, the inhibition component of executive functioning did correlate with decision making in the UG. Thus, suggesting that inhibition is an important component of decision

making in the UG. This fits with previous findings such as Sanfey et al., (2003); they found the prefrontal cortex, which is responsible for inhibitory processing, predicted acceptance or rejection of unfair offers in the UG. In addition, it is consistent with Sütterlin, Herbert, Schmitt, Kubler and Vogele (2011); they found that inhibitory capacity, as anticipated by heart rate variability, predicted decision making patterns in the UG. Therefore, in line with previous research, inhibition plays a pivotal role in decision making in the UG. The present study found that the better one's ability to inhibit the more likely they are to accept an unfair offer.

The acceptance of unfair offers correlating with better inhibition scores could be due to the ability of one to be able to inhibit their emotional response to the unfair offer. This corroborates with previous evidence which has highlighted that emotions are related to rejection rates in the UG (Hewig et al., 2011) and is further supported by evidence from Tabibnia et al. (2008) who found that when participants tolerate unfair treatment for monetary gain it involves a pattern of activation which seems like suppression of negative affect. Additionally, individuals who accept the most unfair offers show greater cognitive control than those who accept the fewest unfair offers (De Neys, Novitskiy, Geeraerts, Ramautar & Wagemans, 2011). This may mean that those who are better able to inhibit their initial emotional response are more likely to accept unfair offer and thus make the highest monetary gain.

Furthermore, it would in addition fit with the Somatic Marker Hypothesis (Damasio et al., 1991), as it supports the idea that somatic markers, which are emotionally laden signals, are influencing decision making in the UG. The somatic markers may be activated when participants received an unfair offer and in those that were less able to inhibit their initial emotional response it may have resulted in rejection of unfair offers.

There was no relationship between the decision making on the UG and theory of mind. This does not support the second hypothesis as it was predicted that from those with an ABI the more likely an individual is to reject unfair offers, whilst controlling for fair offers, then the poorer their scores on tests of social cognition. One explanation for why theory of mind did

not correlate with decision making could be due to the version of the UG that was used. Evidence has found theory of mind to correlate with performance on the UG when the traditional UG is used, in which players are also proposers. It has been found that autistic adolescents proposed fewer fair offers, and this was associated with poorer theory of mind (Woodcock, Cheung, Marx & Mandy, 2019). This demonstrates that the Reading the Mind's Eye may have correlated with performance if a more complex version of the UG was used.

Additionally, a limitation of using the Reading the Mind's eye test was that some of the participants did not know the semantics of the terms, for example the word *despondent,* thus making it difficult for them to be able to apply all options to the eyes that were shown. Therefore, the test makes it difficult to tease apart the social cognition aspect from those that are taxing on other cognitive domains such as verbal comprehension (Baker, Peterson, Pulos & Kirkland, 2014).

The study found that inhibition was a successful predictor of decision making following an ABI. This finding is novel and has not been demonstrated previously. It corroborates with previous findings that have shown poor inhibition skills to result in disadvantageous decision making (Rochat et al., 2013). The results could be taken to suggest that proceeding a brain injury individual's emotional response to unfairness may override the financial gain, thus subsequently leading to a rejection of unfair offers.

Limitations

The present study attempted to investigate whether social and economic making is different in people who have experienced an ABI. However, social decision making is a difficult concept to measure accurately within a research study. There were no real-life consequences for the decisions that participants made within the UG and this raises the question as to the extent that the game measures social decision making. Further, as there was no human interaction during the game this could have impacted upon decision making (Van't Wout et al., 2006). This raises concerns about the internal reliability of the UG used in the present study to measure social decision making. Further, there is a cash effect that

exists within the UG (Shen & Takahashi, 2013). Shen and Takahashi (2013) found that responders rejected unfair offers less frequently in sessions where there was real money compared to points or tokens. This brings into question the ecological validity of the UG.

Another limitation of the present study is that some participants made judgements about the trustworthiness of the faces during the task and based their responses on this. The design of the study could be improved by including some questions about what was influencing the participants' decisions during the task.

Clinical Implications

The study demonstrates the role that inhibition plays in decision making following a brain injury which has important implications in clinical practice. It highlights that it may be an essential aspect that should be assessed regularly following a brain injury as it impacts on social and economic decisions. As the study showed, following an ABI individuals are more likely to act in ways that may be construed as less economically advantageous. Further, it may be useful to take into consideration when deliberating financial capacity decisions. Inhibition may play a role in one's ability to manage their daily allowance as well as bigger financial decisions such as the sale of a house or car subsequent to a brain injury.

A key clinical implication of the study is that it helps to improve the understanding of the impact of inhibition difficulties following a brain injury. Understanding the impact of it is a necessary step in the development of effective treatment as it allows clinicians to create rehabilitation programs that are targeted to individuals for their specific difficulties with social and economic decision making.

Future Research

There are numerous suggestions that can be made for potential future research. It would be valuable to focus on building on additional factors that may influence decision making

proceeding a brain injury. Furthermore, creating a decision making model would help to add to an informed understanding; consequently leading to the conception of interventions that may help those who have experienced a brain injury to improve their decision making.

Conclusion

In summary, the present study is the first to demonstrate how individuals who have experienced an ABI are more likely to reject unfair offers in the UG compared to those who have not experienced a brain injury. The study showed that those who have experienced an ABI have markedly different social and economic decision making compared to neurologically normal controls. Moreover, it has shown that one of the cognitive predictors of this is the inhibition component of executive functioning. The conclusions drawn from the study can add at a theoretical level to the components that affect decision making post brain injury. The findings have clinical implications when thinking about elements that may affect financial capacity decisions and psychological assessments. Future research in this area should focus on exploring other cognitive aspects that affect decision making and thus contribute to building the understanding of decision making subsequent to a brain injury.

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Appendix A – Reflective Statement

A sense of joy came from starting to write this reflective statement as it meant that I was near the end of my three-year research journey. I wasn't sure how to start writing which feels comparable to when I began the research almost three years ago. I endeavored to reflect accurately on the process, highlighting the ups and downs that come with completing research, allowing the reader an accurate insight into the process.

Where do I Start?

In my mind, a fourth-year doctoral trainee, I genuinely believed the biggest obstacle I would face would be thinking of a topic. I thought that once I knew what my topic was then everything would be okay. I was scared that my own lack of creativity would hinder me for the next three years of the course. Reflecting back on the process I think that was the smaller of the obstacles that I faced.

I had not experienced many clinical groups. I was unsure about the direction my research would take and where my interests lied. I knew for certain that I wanted to complete a quantitative piece of work. I had my assumptions about the ambiguity of qualitative research and my lack of experience in ever having completed it.

Coming across a very interactive brain injury teaching session where individuals from a variety of backgrounds came to the university and spoke about their experiences. It was heart breaking to hear. It was made even more difficult by the fact that it has such long-term consequences with what seemed like little hope of ever being '*normal'* again. My interest grew from there. I did not know specifically what I wanted to research but I knew I wanted to do something to help this group of individuals in some way.

Meeting with my supervisors, we thought about different potential avenues that we could explore. I realised, through some initial researching, that my thesis would need to be based at a very theoretical level due to the literature that was currently available, the research budget and time constraints of a doctorate. This was a little disheartening because I wanted

to be able to actually change something. In hindsight, and through the research process I have come to realise and appreciate the importance of theoretical papers as they are the building blocks for future interventions.

My choice for the final topic was the result of an amalgamation of meetings. At times during these meetings I would feel lost, there were lots of theoretical constructs which I was only just coming to grips with. However, after many meetings it felt like the final topic grew and became to the eventual topic of what influences decision making.

Systematic Literature Review

The systematic literature review was a piece of work that I looked forward to completing. I knew that my empirical paper was not focussed on interventions, which was my initial hope, so I thought I could really focus on this in the literature review. I was eager about this, I felt that I could create a review that would influence which interventions clinicians choose. In hindsight, this was optimistic, but I hope the work I did complete does influence clinicians working with individuals following a brain injury.

I had seriously underestimated the amount of time that it takes. It was all consuming, trying to find a literature topic, then the right question, and then collecting papers only to find that the review had already been done two years ago. This happened a few times. I thought I had an amazing idea, I would then go full steam ahead, only to later find that it had been done. The piece of work that I was most looking forward to I began to dislike. After some time, I eventually came up with a question looking at social communication interventions following a brain injury. I was so excited to finally have a question to approach. I began gathering the studies together and examining them against my inclusion criteria. I had found the enjoyment again in writing up my systematic literature review. The challenge of finding an appropriate question had been accomplished and I looked forward with excitement to gathering my data and doing a meta-analysis. Having written the paper over many months and reflecting upon it, I feel a sense of accomplishment at having completed

and produced a good quality review. I hope the time and thought that went into it comes across in the quality of the writing.

Recruitment

Whilst doing my SLR, in the background of that I was also going through ethics, which although seemed very long I eventually got it and was able to begin recruitment. I did not appreciate the time that recruiting participants would take but thankfully I am someone who likes to always start early, or at least on time. I began recruitment by emailing local groups and asking whether I could come along and share my research and ask whether anyone would be willing to volunteer. This often was fruitless, and my frustration and panic would slowly grow over a few months. I would send numerous emails to no avail; the odd glimmer of hope would shine through when someone would ask whether I had ethical approval. I would send the documentation to them and then nothing.

However, once I was invited to speak at a group it became so much easier, people signposted me to various other groups that they were attending, and I was able to recruit more and more participants. I would sometimes travel for a couple of hours to pitch my study to a group and no one would volunteer and other times a participant would bring another person with a brain injury along. Things finally felt like they were going reasonably well. However, things cannot go smoothly for too long when you're trying to complete a doctorate. There was only one DKEFS in the department which I would occasionally have to return for another trainee to use it. In this process, a piece of the tower test, that was part of my study, went missing and was nowhere to be found. Now luckily the department were going to order a new DKEFS. However, it was out of stock. How can the DKEFS be out of stock? A question that ran through my mind whilst my recruitment was on hold.

After some time and getting a new DKEFs I was now able to recruit and restart my study. I was really excited to be able to start back again and it felt like there was a light at the end of the tunnel. Then, I lost the laptop charger which I had made my game on, a vital piece of the study. Again, I found my recruitment on hold and the panic inside me grew again. This

was easier to solve than the DKEFs problem as the psychology undergraduate department, thankfully, had a spare.

I could start recruiting again but by then I was out of the flow of things. I went back to emailing groups hoping that they would respond. It was the same cycle as before, where no one would email back. I decided at this point to contact the NHS sites that I had ethical approval to recruit from to ask whether they would be able to help me. There were no replies to my emails. I tried telephoning and I had what seemed to be a really positive phone call. However, this was all to no avail. I went back to third sector organisations. It felt like a mini miracle when a group leader allowed me to attend a social event, they were holding for people with brain injuries. Following this, after a couple of more months, I had completed my recruitment. What a relief. I am glad I started as early as I could, especially with the hiccups I faced.

Data Analysis

This stage felt good to be at. At this stage I felt a sigh of relief. This sense of relief grew even bigger when I was able to input data and have something concrete to interpret. This stage felt calm because all the answers to questions that I had could be found through books. I was not relying on other people. I strived to make sure I knew why I was doing every analysis, what assumptions were made and why. I was really grateful that the department had a statistician who was able to guide me through and help me when SPSS was not doing what I was telling it to.

Data analysis started off easy enough but got harder the deeper I got into it. I also realised I had made a small mistake, I had been collecting the data for mood using the Hospital Anxiety and Depression Scale however I had only taken total scores rather than individual scores for the depression and anxiety index, respectively. I was thrown into panic mode, do I go back to all my participants and repeat the measure, do I just retest a whole new set of participants, or do I leave it and acknowledge it was an honest mistake. I reported the total scores I had and acknowledge it was an honest mistake.

Interpretation of Data

I went back into panic mode when I got to this stage. I felt disappointed that some of my hypotheses were not supported by the data I had collected. I panicked because I had created hypotheses that were guided by the current literature but yet I could not find support for them. I had this sense of something had gone wrong, did I look in the wrong place, did I not understand something correctly, I was confused. Looking back, I realise it takes time and thought to consider the data you have and how to interpret it. Fitting into the current literature is challenging. However, research is about developing an understanding and I have come to appreciate that null results add to our understanding too.

Write up

I had mixed feelings when I got to this stage. Getting to this point was the work of the last three years. I worried I could not do the work I had done justice in the final write up. I was concerned that I was going to let all the participants who took the time to do my study down. Then I realised, surely, if anyone was going to do the write up well, it had to be me. I found my motivation and completed the write up of the empirical paper. Although, I remained in a state of constant anxiety and worry during the whole time. I knew that my research journey was coming towards an end, which I found slightly terrifying.

In hindsight, there is so much to learn when one delves into research, you begin to understand what is known and unknown and what can never be known. Reflecting on the last three years I think I underestimated that the time and thought that it takes to conduct a complete piece of research. I am excited to have completed this thesis and I am glad to be able to say, now that it is over, that I hope to continue research when I become a qualified clinical psychologist.

I felt privileged to have been able to complete this thesis. I am proud of the work that I have submitted. I think it is far from perfect, but it feels good enough. My biggest hope is that it in some ways it helps those who have suffered from a brain injury.

Appendix B – Epistemological Statement

The purpose of this statement is to outline explicitly the ontological and epistemological positions that were taken when conducting and writing up this thesis. It is important that as a researcher I am transparent about the philosophical premises on which my research processes are based and to make clear to readers how the thesis is shaped by my historical, cultural and philosophical background (Pring, 2000).

Epistemology is concerned with the nature and forms of knowledge (Cohen et al., 2007). Within this paradigm there is a constructivist view which argues that reality is subjective, and socially constructed by its participants (Krauss, 2005). In comparison, the positivism paradigm advances that phenomena have an independent existence which may be discovered through research. In its purest form it considers discoverable knowledge to be absolute and that which is not situated in a political or historical context (House, 1991). However, positivism has been subject to criticism (Popper, 1992). Post-positivism paradigms advance that there are multiple and competing views of science as well as multiple truths (Guba & Lincoln, 1994). Further, it states that researchers are affected by their social, political and cultural contexts and consequently are not value-free.

The objective of the research was to quantify social decision making following a brain injury and find the factors that impact upon it. The hope behind using quantifiable data was to be able to create a data set that was verifiable and find support for the hypothesis that were presented. This was guided by a positivist epistemological stance and the belief of the researcher that there exists an objective definition of what constitutes poor social decision making at the present moment. It is believed that it is possible, as forwarded by Auguste Comte (1798-1857), that the social world of people can be studied similar to the natural world.

Within the positivist paradigm it necessitates a methodology that is objective and tests hypothesis linked to general explanations (Sarantakos, 2005). In the present thesis a deductive approach was undertaken; hoping to identify which factors influence decision making. The methodology was seen as value neutral and the consequent knowledge that

was produced was also value neutral. It is important to acknowledge that although the scores from the various tests were analysed objectively, the development of the various tests inescapably involved subjective processes (Onwuegbuzie & Leech, 2005).

Ontology is concerned with the nature of social reality (Crotty, 1998). As the epistemological stance taken was positivism the logical ontological position that follows is of realism. Realism holds that objects exist independent of the knower (Cohen, Manion, & Morrison, 2007), consequently there is a reality that is discoverable independent of researchers (Pring, 2000). This was the stance taken however poor social decision making is a concept that is difficult to define objectively without the social and historical context which impacts on what constitutes it being poor. Nonetheless, within this thesis, the attempts to quantify it were felt to be important to help contribute and build a field of research to help further research and help those who struggle with similar difficulties.

I understood the limitations of using a positivist approach when studying an acquired brain injury population which is by its definition immensely diverse. The thesis may be seen to reduce the qualitative depth of the data that can be gathered as it solely focusses on that which can be empirically collected and analysed thus seemingly disregarding personal experiences in regard to decision making (Shadish, 1995). However, the principal concern for the research was to be able to make valid inferences from the particular to the general and subsequently contribute to the broad understanding of decision making after a brain injury. Further, it is acknowledged that even when taking a positivist approach there is an element of constructing data that exists and there still remains the possibility of potential bias.

In summary, a positivist stance was taken throughout this thesis however I was aware of the impact and the interplay that the concepts which were objectively measured were influenced by constructionism in their development. However, I do believe beyond this there is an objective reality that can be quantified and measured within limits and considered this whilst holding in mind the post-positivism paradigm and its critique of positivism.

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Appendix C – Author guidelines for submission to The Journal of Neuropsychology.

Please see Appendix D for correspondence from journal.

1. Submission

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Book

Bradley-Johnson, S. (1994). *Psychoeducational assessment of students who are visually impaired or blind: Infancy through high school* (2nd ed.). Austin, TX: Pro-ed.

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If the authors cannot or do not intend to make the data publicly available, a statement to this effect, along with the reasons that the data is not shared, must be included in the manuscript.

Finally, if submitting authors have any questions about the data sharing policy, please access the FAQsfor additional detail.

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Appendix D – Correspondence from Publisher

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Appendix E – Data Extraction Form

Article Info
Article Title
Authors
Year of Publication

Aim of the Study

Design

Participants

Sample Size
Age
Gender
Ethnicity
Location

Social Communication

Measure used

Brain Injury

Type of brain Injury
Time since brain injury
Severity of brain injury

Results

Appnndix F – Quality Checklist

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Appendix G – Completed Quality Checklist

Study	*Items*														
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Douglas et al., 2019	1	1	1	1	0	1	1	1	1	1	1	0	1	0	0
Bosco et al., 2018	1	1	1	1	0	1	1	1	1	1	1	1	1	0	0
Harrison-Felix et al., 2018	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1
Gabbatore et al., 2015	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
Braden et al., 2010	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1
Togher et al., 2016	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Dahlberg et al., 2007	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Reference

Downs, S. H., & Black, N. (1998). The feasibility of creating a checklist for the assessment of the methodological quality both of randomised and non-randomised studies of health care interventions. *Journal of Epidemiology & Community Health*, *52*(6), 377-384

Appendix H – Search Terms

The search was initially developed after I read around some literature that focussed on social cognition and the impact of it after a brain injury. I came across the Finch et al., 2013 review and although interesting I found that it was missing detailed and rigorous analysis as it had chosen to qualitatively review the papers. This was encouraging as it had shown positive effects and I wanted to find out whether this would continue to stand when using a meta-analysis.

I used the search terms that were in the paper to help guide my search to see what was out there. The key words that were used as search terms in the paper were: intervention, therapy, treatment, and program combined with pragmatic disorder, pragmatic impairment, social communication disorder/impairment, conversation disorder/impairment, social disorder/impairment, cognitive-linguistic and cognitive-communication deficit; adult; and traumatic brain injury, head injury, and brain injury.

However, I felt that these were not enough to encompass all of the titles that may cover brain injuries. Further, I was not only looking at traumatic brain injury but more generally acquired brain injury. This led me to thinking about various acronyms and ways that brain injury could be written about. This is what gave me the final search terms which included stroke and other acquired brain injuries.

For social communication the words that were covered within the Finch et al., 2013 paper seemed to suffice so I stuck with those. I had to further think about different terms that could be used for intervention. This was important because initially I was trying to include all RCT's that did any type of intervention that focussed on social communication after a brain injury.

In summary the process took quite some time and upon reflection I was thankful that I started early to have the time to give thought to and create the search terms.

Appendix I – Confirmation of Research Ethics Committee Approval

[Removed for digital archiving]

[Removed for digital archiving]

[Removed for digital archiving]

[Removed for digital archiving]

[Removed for digital archiving]

Appendix J – Confirmation of Health Research Authority Approval

[Removed for digital archiving]

[Removed for digital archiving]

[Removed for digital archiving]

[Removed for digital archiving]

[Removed for digital archiving]

[Removed for digital archiving]

Appendix K – Documentation of Approval from Brain Injuries Rehabilitation Trust

[Removed for digital archiving]

[Removed for digital archiving]

Appendix L – Advertisement for Recruitment of Controls

UNIVERSITY OF HULL

Humber NHS Foundation Trust

Would you like to take part in a research study?

Title of the study – Social cognition and Executive Functioning following a Brain Injury.

We would like to invite you to take part in our research study that aims to look at people's social cognition and executive functioning.

What is normal decision making?

We would like to investigate more about how social cognition and decision making is impacted following a brain injury. But first we need to establish a baseline – how healthy adults perform on the same test.

We need volunteers to take part in the research study. It involves a decision making tasks and two tests of cognition.

Interested?

Please email at: t.zain@2016.hull.ac.uk

Who? You must be over the age of 18 and a native English speaker.

Where? At the University of Hull

Date. 06.05.2018. Version: 1

Appendix M – Participant Information Sheet

UNIVERSITY OF Hull

Participant Information Sheet

Title of the study: Social Cognition and Executive Functioning following a Brain Injury.

We would like to invite you to take part in our research study which is looking at peoples cognitive functioning following a brain injury. Before you decide if you want to participate we would like you to understand why this research is being done and would like you to understand what it will involve for you if you decide to participate. You can talk to others if you would like before you decide if you want to take part. ***The researcher will answer any questions you may have.***

What is the purpose of the study?

Social cognition is our ability to understand the behaviour of others and to respond appropriately in social settings. At the moment our understanding of social cognition following an acquired brain injury is limited. We would like to investigate more about how social cognition and decision making is impacted following a brain injury. We also want to look at whether decision making is impacted by executive functioning. Executive functioning is our ability to plan what we are doing and think about the next steps. By completing this study we will improve our understanding of how these areas relate to one another, which may result in changes in assessment and interventions approaches over time.

Why have I been invited?

This information is given to service-users who have had a brain injury. Staff members who have been involved in the care of people who have had a brain injury will give this information sheet to people who may fulfil the criteria to take part in the study or that may be interested in taking part.

Do I have to take part?

No, participation is completely voluntary. If you decide to take part you will be asked to sign a consent form to indicate that you agree to take part. You are free to withdraw from the study up to the point that the results are analysed and written up and you do not have to give a reason for this. Your decision will not affect your medical care or your legal rights.

What will happen if I decide to take part?

If you agree to take part please leave your contact details with a member of staff. Then you will be contacted by the researcher to arrange a meeting at a convenient place and time. You will be given information about the research by Tasmeah Zain (Trainee Clinical Psychologist) and you will have the chance to ask any questions. You will then be given a week to think about whether you would like to take part in the study. If you decide to do the trainee psychologist will contact you and arrange another time for you both to meet. This time you will be asked to sign a consent form and will be given three different task to do. The task should last around 60 minutes.

What will the tasks involve?
The tasks will involve two computer-based tasks. One of which will be a game that involves making decisions about money. The second task will be about emotions.

There will also be a practical task that looks at your ability to plan things.

This will take around 60 minutes in total.

What are the possible disadvantages and risks of taking part?

The tasks can be difficult and challenging for some people and may be frustrating. If you feel annoyed or upset when completing the tasks or if the researcher notices this, you will be able to choose whether to continue and the researcher will mention this to your keyworker/lead clinician.

What are the possible benefits of taking part?

There are no direct benefits from taking part in the study. However, it is hoped that the information you give us will help us to understand more decision making and cognitive ability following a brain injury.

What will happen if I decide I no longer wish to take part?

You are free to withdraw from the study before the results are analysed and the study is written-up without giving a reason. This will not affect your legal rights or the medical care that you receive.

What if there is a problem?

If you have a concern about the study you can contact the researcher or their supervisor who will do their best to answer your questions.

Will my taking part in this study be kept confidential?

Yes, all the personal information that you provide will be kept strictly confidential. Any information that could be used to identify you will not be used in the research. The people who will decide to participate will be given a code to protect their anonymity.

What will happen to the results of the study?
After the study is completed if you wish you will be given written feedback about the results of the study. Then the results will be written-up and submitted for publication in an academic journal. Your personal details and any identifiable data **will not** be included in the write-up.

How long will the data be kept?
The data will be kept at the University of Hull in a secure location for 10 years and will then be destroyed.

Who has reviewed the study?

The study is reviewed by an independent organisation which is called a Research Ethics Committee. The Research Ethics Committee protects the interest of people who participate in research.

If you have any further questions, comments or queries, please don't hesitate to contact Tasmeah Zain.

Thank you for taking the time to read this information.

Further information and contact details

Tasmeah Zain
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Dr Peter Fleming
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The University of Hull
Cottingham Road
Hull
HU6 7RX
Tel: 01482 464117
Email address: p.fleming@hull.ac.uk

If you are interested to take part in the study please leave your contact details on the space provided below. You will be contacted by the researcher to arrange a meeting at a convenient place and time.

Name:

.....
...

Address:

.....
...

.....
...

.....
...

.....
...

Telephone Number:

.....
...

Mobile Phone Number:

.....
...

Are there any times of the day that you prefer to be contacted?

.....
...

Do you have any further comments?

.....
...

.....
...

Signature:.....

Date:.....

05.07.2018/Version3

Thank you very much for your interest!

Appendix N – Participant Consent Form

UNIVERSITY OF HULL

Hull and East Yorkshire Hospitals NHS Trust

NHS Humber NHS Foundation Trust

CONSENT FORM

Title of Project: Social Cognition and Executive Functioning following an Acquired Brain Injury

Name of Researcher: Tasmeah Zain

Please initial boxes

1. I confirm that I have read and understand the information sheet dated 18/5/2012 (Version 1.1) for the above study. I have had the opportunity to consider the information. If I had any questions, they have been answered satisfactorily. ☐

2. I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason up to the point of data analysis without my medical care or legal rights being affected. ☐

3. I agree to take part in the interview part of the study and understand that my interview will be audio recorded. ☐

Name of participant	Date	Signature
_____	_____	_____
Name of researcher	Date	Signature
_____	_____	_____

Phase 2 Interview consent form
Version 1.1
Date 18.5.2012
IRAS ID 123456

Appendix O – Demographic Form

1. How old are you?

2. Gender

   ……..

3. What is the highest level of education you have completed?

4. Which of the following best describes your current employment?

- Employed
- Unemployed
- Retired
- Student
- Volunteer

(additional questions for those with an acquired brain injury)

5. What type of acquired brain injury do you have?

6. When did you get this injury?

Appendix P – Hospital Anxiety and Depression Scale (HADS)

[Removed for digital archiving]

Appendix Q – Reading the Minds Eyes (introduction and example)

Adult Eyes Instructions

For each set of eyes, choose and circle which word best describes what the person in the picture is thinking or feeling. You may feel that more than one word is applicable but please choose just one word, the word which you consider to be most suitable. Before making your choice, make sure that you have read all 4 words. You should try to do the task as quickly as possible, but you will not be timed.

Example

jealous panicked

arrogant hateful

Appendix R – Ultimatum Game Instructions and Example

In each of these games a sum of money (£10) has to be divided between two players.

In each game, one person acts as a PROPOSER of how to split the money; the other player is the RESPONDER and decides to accept the offer or reject

*If the RESPONDER accepts the proposal: the money is split as proposed.

*If the RESPONDER rejects the proposal: NO ONE receives money.

For this game you are the RESPONDER

You will first see a picture of your partner. Afterwards your partners offer of how to split the £10 will appear on the screen.

You have 10s to make your decision

If you accept the proposal, you and your partner will receive the proposed money.

If you reject the proposal, neither of you will receive any money

Accept the proposal by pressing the 'A' key

Reject the proposal by pressing the 'R' key

Example

Schematic of trial design. First row, Proposer name and picture. Second row, Offer, 4 s. Third row, subject decision: indefinite. Fourth row, Outcome 3 s. In this example the offer was rejected.

1. 

2. John has proposed that

   He gets £8

   You get £2

3. Accept or Reject?

4. You both get £0

Appendix S – Characteristics of Excluded Studies

Study	Intervention	Sample Size	Design	Measure of Social Communication (& length of follow up)	Type of Brain Injury	Time since injury (Years)
Dahlberg et al. (2007)	Twelve Weekly Group sessions	52	Randomised Control Trial	Profile of Functional impairment in Communication. (3, 6 and 9 month)	Traumatic Brain Injury (severe)	2
Douglas et al. (2019)	Communication -specific coping	13	Cohort	La Trobe Communication Questionnaire (3 months)	Traumatic Brain Injury (severe)	2
Togher et al. (2016)	Communication partner training	41	Non - Randomised Control Trial	La Trobe Communication Questionnaire (6 months)	Traumatic Brain Injury (severe)	9 months