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Assessment of decision making following traumatic brain injury

And

Clinical Research Portfolio

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Volume I

Table of Contents **Page**

Chapter 1 **3-34**
Systematic Literature Review
Quality of assessment instruments for impulsivity following traumatic brain injury: a systematic review.

Chapter 2 **35-74**
Major Research Project
Assessment of decision making following traumatic brain injury

Chapter 3 **75-76**
Advanced Clinical Practice 1, Reflective Critical Account (abstract only)
Feeling out of depth as a "specialist trainee"; reflections on personal and professional development in a neuropsychology setting.

Chapter 4 **77-78**
Advanced Clinical Practice 2, Reflective Critical Account (abstract only)
Stepped care: caring for all?

Appendices

Appendix 1.1 Journal publication guidelines **79-80**
Appendix 2.1 Research ethics committee letter **81-83**
Appendix 2.2 R&D approval letters **84-88**
Appendix 2.3 Participant injury information **89-90**
Appendix 2.4 UPPS Impulsive Behaviour Scale **91-92**
Appendix 2.5 Participant Information Sheet **93-95**
Appendix 2.6 Participant Consent Form **96**
Appendix 2.7 Major Research Proposal **97-115**

Chapter 1

Systematic literature review

Quality of assessment instruments for impulsivity following traumatic brain injury: a systematic review.

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Abstract

Impulsivity is a common problem following traumatic brain injury (TBI) and thus frequently needs to be assessed. The aim of this paper is to identify and systematically review evidence relating to the development and validation of instruments used to measure impulsivity in people who have suffered a TBI. Following a systematic search of relevant databases along with the reference sections of identified papers, eight papers were identified for inclusion in the final review, relating to seven separate impulsivity instruments. Instruments were systematically evaluated based on their characteristics (e.g. number of items and scales, answer format), development (e.g. a priori considerations, identification of items), and measurement properties (e.g. validity, reliability). On the basis of the review, the European Brain Injury Questionnaire (EBIQ) and the Brain Injury Rehabilitation Trust (BIRT) Impulsivity Questionnaire (BIQ) are recommended for measuring impulsivity in a TBI population. The review also highlights the lack of literature in the field and methodological limitations in the current evidence.

Keywords: Traumatic brain injury, impulsivity, systematic review.

INTRODUCTION

Many survivors of traumatic brain injury (TBI) experience severe and enduring chronic cognitive deficits such as impaired attention, memory, executive functioning and slowed information processing (Salmond, Menon, Chatfield, Pickard, and Sahakian, 2005). In addition, there are a number of other difficulties, commonly referred to collectively as 'personality changes', that often follow traumatic brain injury and these include irritability and impulsivity, difficulty delaying gratification, difficulty regulating emotion (Cattran, Oddy, Wood, and Moir, 2011), a lack of judgement, and the tendency to make risky or poor decisions (Salmond et al., 2005). The frontal lobes of the brain have long been recognized as playing an important role in the cognitive processes involved in decision making (Shallice and Burgess, 1991). This explains why difficulties in this domain of cognition are so common following TBI given the vulnerability of the frontal lobes to the decelerative forces involved in many traumatic injuries (McHugh and Wood, 2008). Changes in the ability to make decisions and regulate behaviour can have a devastating impact on survivors' lives, leading to them withdrawing from social interactions and a breakdown in pre-existing relationships, as well as affecting the ability to return to employment (Yody et al., 2000).

One of the most commonly reported of these neurobehavioural changes is "impulsivity" (Dixon et al., 2005). However, this term lacks a consistent objective operational definition in the TBI research literature. One definition of impulsiveness is "as a predisposition towards rapid, unplanned reactions to internal or external stimuli without regard to the negative consequences of these reactions to the impulsive individual or to

others" (Moeller, Barratt, Dougherty, Schmitz, and Swann, 2001, p.1784). Recent research in relation to the development of behavioural tasks for measuring impulsivity have conceptualized it as selecting sooner smaller reinforcers over a larger delayed reinforcer (Dixon et al., 2005). Other authors have emphasized both the difficulty reaching a single, unified definition for impulsivity and also the need to regard it as a multifaceted construct (Rochat, Beni, Billieux, Annoni, and Van der Linden, 2011). Given the importance of impulsivity both in a TBI population and in other populations such as personality disorder, substance abuse and in forensic settings (Whiteside and Lynam, 2001) it is surprising that such inconsistencies in definitions exist.

Although changes such as increased impulsive behaviour and deficits in decision making are well recognized following TBI, systematic investigation of their precise nature has been limited. While traditional neuropsychological tools are well suited to investigating the functioning of the various cognitive domains, the nature of the tasks limit their utility in assessing more detailed aspects of decision making (Salmond et al., 2005). Individuals with such changes may perform normally on standard neuropsychological assessment despite experiencing difficulties in daily life (Eslinger and Damasio, 1985). Studies investigating personality or behaviour changes, including impulsivity, in head injury survivors have tended to rely on rating scales or questionnaires (Salmond et al., 2005). However the nature of the individuals' difficulties (e.g. lack of insight) may limit the reliability of their responses on such questionnaires thus restricting the researcher to rely on reports from significant others. Often a significant other is not available however, and when they are, their responses may also be susceptible to bias (Dyer, Bell, McCann, and

Rauch, 2006). Due to these potential limitations of questionnaire measures, paradigms have been developed, specifically with the aim of characterizing the changes such as increased impulsivity that are not well captured by standard neurological assessment. Such behavioural tools attempt to measure impulsivity by simulating real-time decision-making.

Aims

The purpose of the current review was to conduct a systematic review of evidence relating to instruments for measuring impulsivity that have been developed or validated for use in a TBI population. This review focuses on measures that have been specifically developed to examine at least one aspect of impulsivity. It will not review tests which are sometimes described as capturing impulsive behaviour but for which there is no specific published research findings relating to validation of the test as a measure of impulsivity. The aim is to help investigators and clinicians select adequate instruments for the assessment of impulsivity in a TBI population. Similar systematic reviews have been carried out to evaluate quality of life measures for use in palliative care (Albers et al., 2010), assessment scales for disorders of consciousness (Seel et al., 2010), and self-efficacy instruments for patients with chronic diseases (Frei, Svarin, Steurer-Stey, and Puhan, 2009).

METHODS

Search strategy

Several search strategies were used to find published studies on the measurement of impulsivity in the TBI population. Firstly relevant articles were identified by a search of the following electronic databases: Ovid Medline 1946-2011; Journals@Ovid Full Text Aug 18 2011; Embase1980-2011; CINAHL Plus; PsycINFO; Psychology and Behavioural Sciences Collection. Reference sections of relevant papers were examined to identify further articles of relevance.

The following search terms were used: "Impulsiv$ and head injury", "Impulsiv$ and brain injury", "Impulsiv$ and traumatic brain injury", "Impulsiv$ and acquired brain injury", "Decision making and head injury", "Decision making and brain injury", "Decision making and traumatic brain injury" and "Decision making and acquired brain injury". The citations and abstracts of all the papers identified by the search strategies were read. This allowed the exclusion of irrelevant studies and the more detailed consideration of studies that potentially met the inclusion and exclusion criteria. When examination of the abstract suggested relevant content, the full publication was obtained and examined before a final decision was made about its inclusion or exclusion.

Inclusion criteria

1) Types of studies: Studies that aimed to develop or validate an instrument designed to measure impulsivity. Validation included any assessment of validity,

internal consistency, or test-retest reliability. Only studies reported in peer-reviewed journals were included.

2) Types of instruments: Instruments which state explicitly that they measure impulsivity. Can be questionnaires, rating scales or behavioural measures.

3) Participants: Adults, age 18-65 who have sustained a brain injury of any severity. Studies were included if they involved either only TBI participants or TBI participants plus participants with other forms of acquired brain injury (ABI). TBI is defined as damage to the brain resulting from external mechanical force, such as rapid acceleration/deceleration or impact. ABI is defined as non-traumatic injury derived from either an internal or external source (e.g. stroke, brain tumours, infection).

Exclusion criteria

1. The use of an impulsivity instrument in samples that do not include participants with TBI.

2. Studies using an impulsivity instrument with a focus other than development or validation of that instrument. For example, studies using an impulsivity assessment instrument to measure outcome in an intervention study, studies examining prevalence, or studies comparing patients with healthy controls without comparison against another measure of impulsivity.

3. Review articles and case studies were excluded, as were studies that were not available in the English language.

4. Test manuals reporting data not otherwise reported in a peer-reviewed journal.

Instrument evaluation

After instruments and studies were identified, the characteristics of the instrument were recorded and they were further analysed for information on their development and validation. This process was guided by Kirshner and Guyatt (1985), who published a methodological framework for assessing health indices, and Terwee et al. (2007) who proposed quality rating criteria for measurement properties of health status questionnaires. Similar systematic reviews which have examined the development and validity of an assessment instrument for a specific population were also considered (Frei et al., 2009). Other published guidelines for conducting systematic reviews were considered when constructing the quality rating criteria for this systematic review (COSMIN Checklist; Mokkink et al., 2006). The PRISMA Statement also provided guidance (Moher, Liberati, Tetzlaff and Altman, 2009).

Characteristics of instrument

Aim of instrument

Based on Kirshner and Guyatt (1985), studies reporting on the development or validation of an instrument were examined to identify how the primary aim of the instrument was described. Aims can be classified as "evaluative" (detection of changes in impulsivity over time, often for evaluation of treatments), "discriminative" (detection of differences in impulsivity between participants e.g. identifying people who are considered to be impulsive), "predictive" (prediction of future health outcomes, for example, return to employment or need for full time care or support), and "planning" (planning of treatment,

e.g. detection of impulsivity to target rehabilitation accordingly). If the aim was not explicitly described by the author prior to development but could be identified from the context, it was classified as "not clearly described, but presumably...". If the aim of the instrument could not be identified at all it was classified as "not described".

Questionnaire or behavioural measure

Impulsivity instruments can take the form of questionnaires/scales or behavioural measures.

Number of subscales and items

Information was extracted on the number of subscales within the instrument and number of items within each subscale.

Patient version and/or carer version & answer format

It was recorded whether the instrument was completed by the patient themselves or completed on their behalf by a close relative or carer. Answer format was also noted, for example Likert scale, or visual analogue scale 0-100.

Definition of impulsivity

Due to the variance in definitions of impulsivity, it was noted whether a definition of impulsivity was provided. This was scored as 'yes', 'part' or 'not given'. If a clear definition was not provided, however a general explanation of the consequences and impact on life of impulsivity was given, then this item was categorized as 'part'.

Assessment of head injury severity

It was recorded whether information was provided on the severity of the head injury sustained by study participants, e.g.Glasgow Coma Scale (GCS), Post Traumatic Amnesia (PTA).

Development of instruments

A priori consideration

It was recorded whether the authors explicitly reported on a priori considerations upon which development of the instrument were based. These relate to considerations specific to a TBI population, such as administration format and time taken to administer.

Identification of items

Information was recorded relating to how the items for the instrument were identified. Sources were recorded as experts (e.g. through interviews with clinical experts, supplementation or adaptation of existing items through experts), patients, patients' relatives, and literature. Literature was further clarified as a systematic literature search, an unsystematic search, and no literature search, but adaptation of an existing, specific instrument.

Selection of items

Information was recorded on how items were selected for the final instrument. This approach could be data driven (e.g. using statistical criteria such as factor analysis), patient approach, (e.g. estimation of frequency or importance of the items in the population), and an expert approach (e.g. estimation of relevance of the items by clinical experts).

Development of subscales

It was recorded how subscales were developed or defined. For example, were they defined a priori, as judged by a clinical expert or defined by a statistical approach such as factor analysis.

Measurement properties

Validity

Approaches to assess validity that were conducted after completion of the instrument development were examined. Methods of validation were extracted and categorised as correlation approaches (e.g. assessment of correlations with other impulsivity instruments), face validity (e.g. rating through experts), Item Response Modelling Approach (e.g. Rasch Analysis) or confirmatory factor analysis.

Internal consistency reliability

Information was extracted relating to the assessment of internal consistency, for example by the use of Cronbach's alpha.

Test-retest

Any approaches to assess test-retest reliability were recorded. This may include Pearson correlation coefficient, t-tests, or intra-class correlation coefficients.

Data extraction strategy

Data was extracted by the author and also by a second independent rater. There was a 99% inter-rater agreement. Disagreements were resolved via discussion.

Methods of analysis and synthesis

The results of the data extraction are described in structured tables according to the categories described above. The aim of this compilation was to summarise the characteristics, development, and validation of existing instruments which aim to assess impulsivity in patients following traumatic brain injury. Consistent with the methodology of Frei et al. (2009), the data were then synthesized in a narrative form,

with the aim of identifying those instruments that are likely to be most effective at assessing impulsivity in people who have suffered a TBI. .

RESULTS

The search strategy yielded a total of 1845 papers (Figure 1). The titles and abstracts were screened, and 1781 papers were excluded as irrelevant based on the inclusion and exclusion criteria described in methods section. The main search was supplemented by manual searches from the reference lists of the retrieved articles, which yielded 20 further papers. Of the 84 full text articles examined, 8 met the inclusion criteria concerning the measurement of impulsivity. Most of the excluded studies did not include any participants with TBI. Other studies were excluded due to being review papers, case studies or not available in English. The search thus yielded 8 papers for the final review. Seven separate impulsivity measures were utilized within these papers.

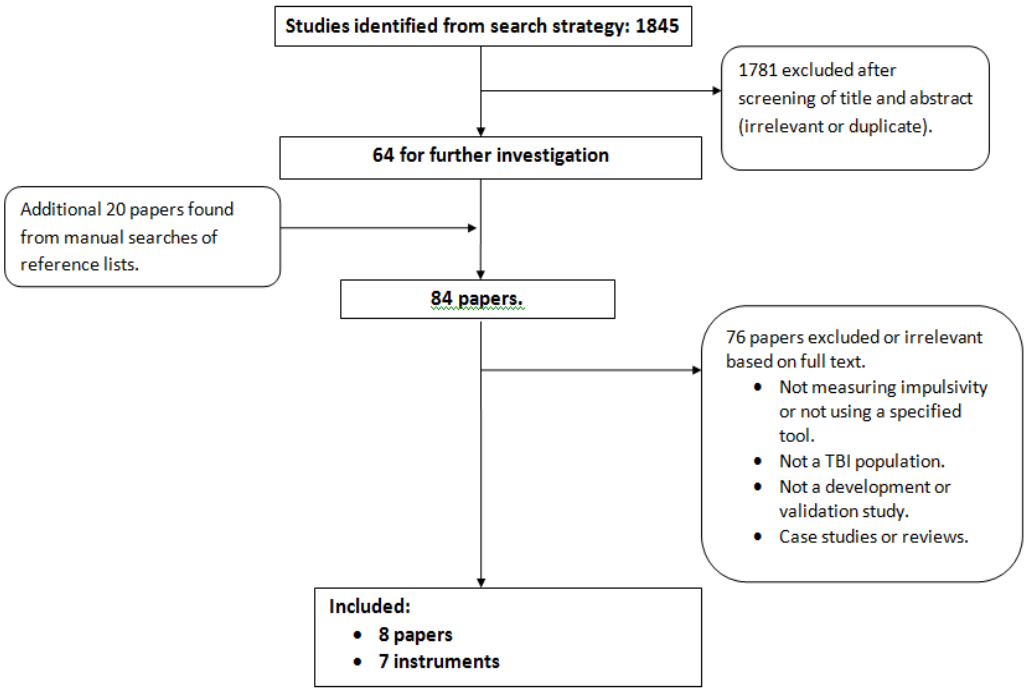

Figure 1: Flow diagram of search strategy

The tools for measuring impulsivity were of two types – most were questionnaire measures and one behavioural measure was identified (see Table 1). Table 1 also provides information relating to the percentage of each sample whose brain injury had occurred due to a TBI. The majority of studies included a 100% TBI population, however studies relating to EBIQ and BIQ had mixed samples of TBI and ABI.

Table 1: Impulsivity measures

Impulsivity measure	Study (% of sample TBI)	Questionnaire or behavioural measure	Developed for TBI population
EuropeanBrainInjury Questionnaire (EBIQ)	Teasdale et al. 1997 (29%) Sopena et al. 2007 (50%) Bateman et al. 2009 (77%)	Questionnaire	Yes
BIRT Impulsivity Questionnaire (BIQ)	Cattran et al. 2011 (76%)	Questionnaire	Yes
Key Behaviour Change Inventory (KBCI)	Kolitz et al. 2003 (100%)	Questionnaire	Yes
Barratt Impulsiveness Scale 11. (BIS-11)	Votruba et al. 2008 (100%)	Questionnaire	No
Impulsivity Rating Scale	Votruba et al. 2008 (100%)	Questionnaire	No
UPPS Impulsive Behaviour Scale (short form)	Rochat et al. 2010 (100%)	Questionnaire	Yes
Temporal Discounting paradigm	McHugh & Woods, 2008 (100%)	Behavioural	No

Characteristics of the instruments

See Table 2 for a summary of the characteristics of all the impulsivity instruments.

Aim of the instrument

Other than simply 'measuring impulsivity', none of the papers reviewed included a clear description of any other purpose or aim of the impulsivity instrument under development/validation. Thus of the four categories of potential use considered in this review, all instruments might be characterised as discriminative, in that they are aimed at identifying the presence or absence of impulsivity problems in patients who have suffered a TBI.

Questionnaire or behavioural instrument

Six of the seven instruments which have been developed to assess impulsivity in a TBI population, or have some evidence of validation for that population were questionnaire measures. One (the Temporal Discounting task) is a behavioural task.

Number of items and subscales

There was substantial variation in the number of items and subscales across the impulsivity instruments. Some instruments which aim to provide a wider assessment of potential impairment following TBI have a number of scales and the impulsivity scale is one within this larger battery of assessment, e.g. the EBIQ and the KBCI. Several other instruments have only one subscale, e.g. BIRT Impulsivity Questionnaire (BIQ: 32 items). Other instruments break impulsivity down into different subscales. The UPPS (Urgency, Premeditation, Perseverance and Sensation Seeking) Impulsive Behaviour Scale (short form) includes four impulsivity subscales: urgency, premeditation, perseveration and sensation seeking (16 items).

One paper (Votruba et al., 2008) did not provide detailed information on the characteristics of the impulsivity scales used in their study: the Barratt Impulsivity Scale-11 (BIS-11) and the Impulsivity Rating Scale (IRS). Instead they refer to the original development/validation studies that were undertaken outwith the area of traumatic brain injury. The BIS-10 was redesigned to form the BIS-11 by Patton, Stanford and Barratt (1995) through principal component analysis (PCA) in a sample of 412 undergraduate students. The PCA produced a 30 item self-report questionnaire, with six first-order

factors: attention, motor, self-control, cognitive complexity, perseverance, and cognitive instability, and three second order factors: motor impulsiveness, non-planning impulsiveness and cognitive impulsiveness (Stanford et al., 2009). The IRS has one scale, with 7 items (Lecrubier, Braconnier, Said, and Payan, 1995).

The Temporal Discounting task (McHugh and Wood, 2008), the only behavioural task included in this review, involves nine blocks of trials. The duration of the whole assessment ranges from 15-25 minutes. It is unclear from the paper how many items/choices are involved within each trial. Participants are asked to choose between a larger reward available after a delay, or a smaller reward which is available immediately. Both options are presentedon a computer screen at the same time and the participanthas to choose between them. The monetary amounts vary ($1 to $1000), as do the time delays (1 week to 10 years).

Patient and/or carer version & answer format

The Temporal Discounting task is a behavioural task and therefore cannot have a relative or carer version. This section will therefore only refer to the remaining six instruments.

Four out of the six instruments have versions for both the patient and relative or carer (e.g. EBIQ, BIQ, IRS and UPPS Impulsive Behaviour Scale). The KBCI is completed by a well known other, and the BIS-11 is completed by the patient.

Five of the six instruments are scored using a Likert scale. Answer format is not recorded for the KBCI.

Definition of impulsivity

Within the papers that outline the development or validation of the impulsivity measures, data were extracted on whether a definition of impulsivity was provided. One paper (McHugh and Wood, 2008) gave a clear definition of impulsivity and a further two papers (Votruba et al., 2008;Rochat et al, 2010) gave information relating to the consequences of problems with impulsivity and how such problems can affect future outcomes. These two papers were categorised as giving a "part" definition.

Assessment of head injury severity

The majority of papers (five out of eight) provided assessment information on the head injury, allowing the reader to understand the severity of the head injury sample used in the study. The only papers not to provide this information are the three papers relating to the development and validation of the EBIQ (Bateman, Teasdale, and Willmes, (2009); Teasdale et al., (1997); Sopena, Dewar, Nannery, Teasdale and Wilson, (2007)), which provide data on type of injury, but not severity.

Table 2: Characteristics of impulsivity instruments

Instrument	Study	Aim of instrument	Questionnaire or behavioural measure	No. of items and subscales	Patient &/or carer version and answer format	Definition of impulsivity	Assessment of head injury severity
EBIQ	Teasdale (1997)	Not described but presumably discriminative.	Questionnaire	8 subscales plus global scale. 1 impulsivity subscale. 13 items.	Both. 3 point Likert scale.	No	Not described.
BIQ	Cattran (2011)	Not described but presumably discriminative.	Questionnaire	32 items	Both. 4 point Likert Scale	No	Assessed – GCS, PTA, contusional injury.
KBCI	Kolitz (2003)	Not described but presumably discriminative.	Questionnaire	8 subscales, 1 impulsivity subscale. 8 items per subscale	Carer version. Format not reported.	No	Assessed - LOC
IRS	Votruba (2008)	Not described but presumably discriminative.	Questionnaire	1 scale, 7 items	Both. 5 point Likert scale.	Part	Assessed – GCS, PTC.
BIS-11	Votruba (2008)	Not described but presumably discriminative.	Questionnaire	3 impulsivity subscales, 10 items per scale.	Patient. 4 point Likert Scale	Part	Assessed – GCS, PTC.
UPPS Impulsive Behaviour Sc.	Rochat (2010)	Not described but presumably discriminative.	Questionnaire	4 impulsivity subscales. 4 items each.	Both. 4 point Likert Scale	Part.	Assessed – PTA. Moderate to severe.
Temporal discounting	McHugh & Wood (2008)	Not described but presumably discriminative.	Behavioural	n/a	Patient	Yes	Assessed – GCS. Mod to severe.

Development of impulsivity instruments

Three of the seven instruments were developed specifically for use with a TBI population (EBIQ, BIQ and KBCI). Three instruments were developed for other populations and subsequently studies have been carried out to validate them for a TBI population (BIS-11, IRS, Temporal Discounting). For one instrument, the UPPS Impulsive Behaviour Scale, a shortened version has been adapted and validated for a TBI population.

In this section only the four instruments developed specifically for a TBI population (EBIQ, BIQ and KBCI), and the UPPS which was specifically adapted for a TBI population will be included. See Table 3 for a summary of these results.

A priori considerations

A priori considerations were specified in two studies. In Teasdale et al. (1997) this was included in the method section under "The EBIQ: construction and scale reliability" (p. 546). They outlined tailoring the instruments to the specific requirements of a brain injured population, for example making it brief to avoid exertions and tiring effects, and avoiding double negative questions which could be problematic for people with dysphasia. In Rochat et al. (2010) the aim was to validate a shorter version of the UPPS Impulsive Behaviour Scale, in order to make it more appropriate for a TBI population. They also noted the importance of developing caregivers' rating and aimed to validate this too.

Identification of items

Methods of item identification differed across the studies. The most comprehensive method was employed by Kolitz, Vanderploeg, and Curtiss (2003) who identified items via interviews with patients with TBI, their family members and carers, as well as through consultation with TBI rehabilitation specialists. They also used professional literature to identify behaviours reported to affect outcome following TBI. It is unclear if this was a systematic or unsystematic search. Similarly, a literature search was carried out for development of the BIQ (Cattran et al., 2011), in addition to using clinical experience. Again it is not specified what form this search took. The EBIQ was developed and validated by Teasdale et al. (1997) however they do not explain how items were identified for the instrument. They report that preliminary French results have been outlined elsewhere therefore item development may have been discussed there. For the short version of the UPPS Impulsive Behaviour Scale, the items were selected from the original, longer version of the questionnaire. Overall, experts and patients were only involved in the development of one instrument. Two studies used literature to inform their choice of items, however it was unclear if these were systematic searches.

Selection of items

For two out of the four instruments a data driven approach was used for item selection. For the BIQ (Cattran et al., 2011) item reduction was performed based on range, facility index, discrimination and correlation coefficients between the items. For the UPPS Impulsive Behaviour Scale (Rochat et al., 2010), the four items were selected which loaded most strongly onto each of the four factors of the scale. An expert driven

approach was used for one measure (KBCI) and selection of items was not reported for the EBIQ.

Development of subscales

For one measure this criteria is not applicable as it only contains one scale (BIQ). For the UPPS Impulsive Behaviour Scale the scales were retained from the original, longer version of the questionnaire. For the EBIQ, Teasdale et al. (1997) describes using principle component analysis to derive the scales and the scales of the KBCI were derived by experts.

Table 3: Development of instruments for TBI population

Instrument	Study	A priori considerations	Identification of items	Selection of items	Development of subscales
EBIQ	Teasdale et al. (1997)	Yes	Developed by authors. Possibly reported in French paper.	Not described.	Principle Component Analysis.
BIQ	Cattran et al. (2011)	No	Relevant literature and clinical experience.	Data driven. Item reduction based on range, facility index, discrimination and correlation coefficients between items.	n/a
KBCI	Kolitz et al. (2003)	No	Via patients, family, carers, TBI specialists and literature.	Expert approach.	Experts
UPPS Impulsive Behaviour Scale	Rochat et al. (2010)	Yes	Adapted from longer version	Data driven. 4 items most strongly loading onto the four existing factors/subscales.	Same scales as full version.

Validation of impulsivity instruments

See Table 4 for the main results relating to the psychometric properties of the instruments.

Validity

All of the instruments assessed validity and four followed a correlational approach. Three papers used other methods to validate the tool, one being Bateman et al. (2009), who used a Rasch Analysis Approach for the EBIQ, and Kolitz et al. (2003) who used experts to determine face validity. Confirmatory factor analysis was carried out on the UPPS Impulsive Behaviour Scale (Rochat et al., 2010) to validate the shorter version, which was designed for a TBI population.

Internal consistency reliability

Four out of the seven instruments tested internal consistency. All used Cronbach's alphas and found good internal consistency for some, if not all of the derived measures (EBIQ: patient version 0.47 – 0.90, Carer version 0.54 – 0.92; BIQ: patient version 0.92, carer version 0.95; KBCI: 0.82 – 0.91 and UPPS Impulsive Behaviour Scale: patient version 0.67 – 0.86, carer version 0.73 – 0.92).

Test-retest reliability

Test-retest reliability was only addressed for two of the impulsivity instruments. This was addressed by Sopena et al. (2007) for the EBIQ for a patient version and also a relatives version; scores ranged from correlation coefficients of 0.55 to 0.90 with a

median of 0.76. Cattran et al. (2011) only reported results for the self-rated version of the BIQ (0.88).

Table 4: Impulsivity instrument properties

Instrument	Study	Validity	Internal consistency reliability	Test-retest reliability
EBIQ	Teasdale et al. (1997)	Not assessed	Cronbach's coefficient alphas.	Not assessed
EBIQ	Sopena et al. (2007)	Not assessed	Not assessed	Pearson correlations
EBIQ	Bateman et al. (2009)	Item Response Modelling Approach. Rasch Analysis	Not assessed	Not assessed
BIQ	Cattran et al. (2011)	Correlational approach. Correlations with BIS-11.	Cronbach's alpha	Pearson correlation
KBCI	Kolitz et al. (2003)	Face validity. Expert panel	Cronbach's alpha	Not assessed.
IRS	Votruba et al.(2008)	Correlational approach. Correlation with behavioural observation	Not assessed	Not assessed
BIS-11	Votruba et al. (2008)	Correlational approach. No correlations found	Not assessed	Not assessed
UPPS Impulsive Behaviour Scale	Rochat et al. (2010)	Confirmatory factor analyses.	Cronbach's alpha.	Not assessed
Temporal Discounting	McHugh & Wood (2008)	Correlational approach. Correlations with BIS-11.	Not assessed	Not assessed.

DISCUSSION

The current review demonstrated that for measuring impulsivity following TBI, three instruments have been specifically designed for this purpose. The EBIQ and the KBCI are larger assessment instruments which assess a variety of changes which may have occurred due to brain injury. They include an impulsivity scale within these larger assessments. The BIQ is a scale developed solely to measure impulsivity. The UPPS Impulsive Behaviour Scale, a questionnaire developed solely to measure impulsivity has been adapted into a short version to make it suitable for a TBI population. A further three papers report evidence of validity of measures not specifically designed for TBI populations, but which have been used with this group.

All studies reported that the primary aim was to provide a measure of impulsivity, with the implication that those with impulsivity problems can be discriminated from those without such problems. No other specific aims (e.g. predicting everyday functional problems, planning rehabilitation, evaluating interventions) for use of the tests were reported.

The format of the impulsivity instruments differ greatly depending on whether it was developed specifically for this population. Instruments designed for a TBI population tend to have a single subscale relating to impulsivity. This is the case when measuring impulsivity alone (e.g. BIQ) and also when impulsivity is one subscale among others (EBIQ and KBCI). Instruments originally designed for other populations, such as the BIS-11 and the UPPS Impulsive Behaviour Scale tend to favour more detailed analyses of the trait, breaking impulsivity down into subscales. This may be reflective of the

differences between the nature of impulsivity in different populations. Instruments such as the BIS-11 and the UPPS Impulsive Behaviour Scale were developed to assess personality and behavioural constructs of impulsivity (Stanford et al. 2009) and in the case of the UPPS Impulsive behaviour Scale, was actually developed using a model of personality (The Five Factor Model of Personality (FFM); McCrae and Costa, 1990). It could be argued that the needs and requirements of an impulsivity assessment instrument following brain injury are different (e.g. assessments needing to be shorter and simplified and able to highlight specific areas which can be addressed in rehabilitation). However, given the complex nature of the construct of impulsivity it is also possible that single scale instruments are failing to detect differences in forms of impulsivity and so may not be as good as predicting specific problems in everyday functioning. However, this remains to be determined empirically.

It is evident from the instruments and papers examined that there is an increasing drive to develop instruments which do not rely on the patient self report alone and this is evident through the number of instruments which have relative and carer versions in addition to a patient version. It is also evident through the development of behavioural tasks which tap into real life behaviours and thus do not rely on questionnaire and rating scales at all.

A major issue across the literature relating to the assessment of impulsivity in general is the lack of a consistent definition of the construct being examined. This was not further clarified by the present review. Only one paper gave a definition of impulsivity and another 3 gave information relating to the consequences of problems with impulsivity and how such problems can affect future outcomes. If research is going to seek to understand

the problematic area of impulsivity following TBI then it is imperative that a clear definition of the construct being measured is provided to ensure there is a shared, or at least explicit, understanding of the construct.

An important part of the test development process is a priori consideration of issues relevant to assessment of people in the target population, with clear reporting of how the issues are addressed in the design of the test instrument. This was not done for the majority of the instruments developed for the measurement of impulsivity in a TBI population. However it was considered and reported by Teasdale et al. (1997) while developing the EBIQ and by Rochat et al. (2010) when adapting the UPPS Impulsive Behaviour scale for a TBI population. Teasdale et al. (1997) specified that the EBIQ was tailored to the specific needs of a brain injured population, by making it brief to avoid excessive exertion and the wording of questions was considered to avoid unnecessary complexities. Similarly Rochat et al. (2010) identified the importance of a short questionnaire and also the importance of creating a carers version due to possible lack of insight from patients in this population. Methods of item selection differed greatly across studies, however the most sound methodology was carried out by Kolitz et al. (2003) who utilised patient knowledge, families, carers, TBI specialists and also relevant literature. They continued to use an expert driven approach for selection of items and development of subscales.

In relation to validation of the instruments, two instruments had all areas addressed: the EBIQ and the BIQ. Both instruments had good validity, internal consistency and test-retest reliability. The KBCI has gained good evidence in relation to validity and internal

consistency reliability but more research is needed in relation to test-retest reliability. Evidence is beginning to gather for instruments such as IRS, BIS-11, UPPS Impulsive Behaviour Scale and the Temporal Discounting Task, which were developed for other populations but could be useful measures in a TBI population.

Limitations of this review should be acknowledged. Other assessment measures that may be argued to measure impulsivity exist, however measures were only reviewed in the current paper if they have been developed or validated in a samples that included participants with TBI. Notable absences are the Iowa Gambling Task (IGT) a behavioural decision making task, the Cambridge Gambling Task and Bangor Gambling Task, both latter two being tasks developed as improvements on the IGT. Although these tasks have been used to assess decision making and more specifically, impulsivity in a TBI population (Salmond et al., 2005; Newcombe et al., 2011; Rogers et al., 1999), studies using these tasks have not specifically examined their validity in this population and as a consequence they were not included in the current review. As noted, studies that simply compared a patient group with a healthy control group were not included as this methodology cannot draw any conclusions that are specific to the construct of impulsivity, as they are limited to simply detecting that brain injury impairs performance on the task. The review was also limited to measures that have been designed specifically to measure impulsivity, and where research had been carried out to validate the instrument as a measure for that specific purpose. Therefore tasks such as the Stroop test, the Trail Making test and the Continuous Performance test, although mentioned as part of other studies and potentially being affected by impulsivity, were not formally rated within this review.

Overall, on the basis of this review, considering the suitability of instruments to measure impulsivity in a TBI population, and taking into account evidence relating to the psychometric properties of the instruments examined, the EBIQ and BIQ are cautiously recommended. A number of other instruments clearly hold promise, particularly those that aim to examine more detailed forms of impulsivity, but further validation work with these is required. However this review highlights the lack of literature relating to the assessment of impulsivity in a TBI population and the methodological limitations occurring in the evidence which does exist. A particular issue is the lack of evidence relating to 'ecological validity', i.e. evidence that the instruments designed to measure impulsivity actually predict impulsive behaviour in everyday life. More research is needed to inform and strengthen the evidence base for measures of impulsivity following TBI so that stronger, more informed decisions regarding implications for everyday functioning and rehabilitation priorities can be made.

REFERENCES

Albers, G., Echteld, M. A., de Vet, H. C. W., Onwuteaka-Philipsen, B. D., van der Linden, M. H. M., &Deliens, L. (2009). Evaluation of quality life measures for use in palliative care: a systematic review. *Palliative Medicine, 24*, 17-37.

Bateman, A., Teasdale, T. W., &Willmes, K. (2009). Assessing construct validity of the self-rating version of the European Brain Injury Questionnaire (EBIQ) using Rasch Analysis. *Neuropsychological Rehabilitation, 19*, 941-954.

Cattran, C. J., Oddy, M., Wood, R. L., &Moir, J. A. (2011). Post-injury personality in the prediction of outcome following severe acquired brain injury. *Brain Injury, 25*, 1035-1046.

Dixon, M. R., Jacobs, E. A., Sanders, S., Guercio, J. M., Soldner, J., Parker-Singler, S., Robinson, A., Small, S., Dillen, J. E. (2005). Impulsivity, self-control, and delay discounting in persons with acquired brain injury. *Behavioral Interventions, 20*, 101-120.

Dyer, K. F. W., Bell, R., McCann, J., & Rauch, R. (2006). Aggression after traumaticbraininjury: Analysingsociallydesirableresponsesandthenatureof aggressive traits. *Brain Injury, 20*, 1163-1173.

Eslinger, P. J., &Damasio, A. R. (1985). Severedisturbanceofhighercognition after bilateral frontal lobe ablation: patient EVR. *Neurology, 35*, 1731-1741.

Frei, A., Svarin, A., Steurer-Stey, C., &Puhan, M. A. (2009). Self-efficacy instruments for patients with chronic diseases suffer from methodological limitations – a systematic review. *Health and Quality of Life Outcomes, 7*, 86-95.

Kirshner, B., &Guyatt, G. (1985). A methodological framework for assessing health indices. *Journal of Chronic Diseases, 38*, 27-36.

Kolitz, B. P.,Vanderploeg, R. D., &Curtiss, G. (2003). Development of the key behaviors change inventory: A traumatic brain injury behavioral outcome assessment instrument. *Archives of Physical Medicine & Rehabilitation, 84*, 277-284.

Lecrubier, Y., Braconnier, A., Said, S., &Payan, C. (1995). The impulsivity rating scale (IRS): preliminary results. *European Psychiatry, 10*, 331-338.

McCrae, R. R., & Costa, P. T. (1990). *Personality in adulthood.* New York: Guilford.

McHugh, L., & Wood, R. L. (2008). Using a temporal discounting paradigm to measure decision-making and impulsivity following traumatic brain injury: A pilot study. *Brain Injury, 22*, 715-721.

Moeller, F. G., Barratt, E. S., Dougherty, D. M., Schmitz, J. M., Swann, A. C. (2001). Psychiatric aspects of impulsivity. *American Journal of Psychiatry, 158*, 1783-1793.

Moher, D., Liberati. A., Tetzlaff. J., Altman. D. G., The Prisma Group. (2009) Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. *PLoS Medicine, 6*, 1-6.

Mokkink, L. B., Terwee, C. B., Knol, D. L., Stratford, P. W., Alonso, J., Patrick, D. L., Bouter, L. M., & de Vet, H. C. W. (2006). Protocol of the COSMIN study: COnsensus-based Standards for the selection of health Measurement Instruments. *BMC Medical Research Methodology,* 6, 1-7.

Newcombe, V. F. J., Outtrim, J. G., Chatfield, D. A., Manktelow, A., Hutchinson, P. J., Coles, J. P., Williams, G. B., Sahakian, B. J., &Menon. (2011). Parcellating the neuroanatomical basis of impaired decision making in traumatic brain injury. *Brain, 134*, 759-768.

Patton, J. H., Stanford, M. S., &Barratt, E. S. (1995).Factor structure of the Barratt Impulsiveness Scale.*Journal of Clinical Psychology, 51*, 768-774.

Rochat, L., Beni, C., Billieux, J., Azouvi, P., Annoni, J. M., & Van der Linden, M. (2010). Assessment of impulsivity after moderate to severe traumatic brain injury.*Neuropsychological Rehabilitation, 20*, 778-797.

Rochat, L., Beni, C., Billieux, J., Annoni, J., & Van der Linden, M. (2011). How impulsivity relates to compulsive buying and the burden perceived by caregivers after moderate-to-severe traumatic brain injury. *Psychopathology, 44*, 158-164.

Rogers, R. D., Everitt, B. J., Baldacchino, A., Blackshaw, A. J., Swainson, K. W., Wynne, K., … Robbins, T. W. (1999). *Neuropsychopharmacology, 20,* 322-339.

Salmond, C.H., Menon, D.K., Chatfield, D.A., Pickard, J.D., &Sahakian, B.J. (2005). Deficits in decision-making in head injury survivors. *Journal of Neurotrauma, 22,* 613-622.

Seel, R. T., Sherer, M., Whyte, J., Katz, D. I., Giacino, J. T., Rosenbaum, A. M., ... Zasler, N. (2010). Assessmentscales for disorders of consciousness: evidencebasedrecommendations for clinicalpractice and research. *Archives of physical medicine and rehabilitation, 91,* 1795-1813.

Shallice, T. & Burgess, P. (1991). Deficits in strategy application following frontal lobedamage in man. *Brain,144,* 727-741.

Sopena, S., Dewar, B. K., Nannery, R., Teasdale, T. W., & Wilson, B. A. (2007). The European Brain Injury Questionnaire (EBIQ) as a reliable outcome measure for use with people with brain injury. *Brain Injury, 21,* 1063-1068.

Stanford, M. S., Mathias, C. W., Dougherty, D. M., Lake, S. L., Anderson, N. E., & Patton, J. H. (2009). Fifty years of the Barratt Impulsiveness Scale: An update and review. *Personality and Individual Differences, 47,* 385-395.

Teasdale, T. W., Christensen, A., Willmes, K., Deloche, G., Braga, L., Stachowiak, F., Vendrell, J. M., Castro-Caldas, A., Laaksonen, R. K., &Leclercq, M. (1997). Subjective experience in brain injured patients and their close relatives: A European Brain Injury Questionnaire study. *Brain Injury, 11,* 543-563.

Terwee, C. B., Bot, S. D. M., de Boer, M. R., van der Windt, D. A. W. M., Knol, D. L., Dekker, J.... de Vet, H. C. W. (2007).Quality criteria were proposed for measurement properties of health status questionnaires. *Journal of Clinical Epidemiology, 60,* 34-42.

Votruba, K. L., Rapport, L. J., Vangel, J., S.J, Hanks, R. A., Lequerica, A., Whitman, D., Langenecker, S. (2008). Impulsivity and traumatic brain injury: The relations among behavioral observation, performance measures, and rating scales. *Journal of Head Trauma Rehabilitation, 23*(2), 65-73.

Whiteside, S. P &Lynam, D. R. (2001). The Five Factor Model and impulsivity: using a structural model of personality to understand impulsivity. *Personality and Individual Differences, 30,* 669-689.

Yody, B. B., Schaub, C., Conway, J., Peters, S., Strauss, D., Helsinger, S. (2000). Applied behaviour management and acquired brain injury: approaches and assessment. *Journal of Head Trauma Rehabilitation, 15,* 1041-1060.

Chapter 2

Major Research Project

Assessment of decision making following traumatic brain injury

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Lay Summary

Impulsive behaviour is a common feature in patients who have had a traumatic brain injury (TBI). Although these behaviours impact on many areas of life including relationships and work, there has been a lack of research on impulsivity and it is particularly limited in the TBI literature. The aim of this study was to examine a new virtual reality task, the Secret Agent task, to see if it can be used to measure impulsivity in a group of participants who have suffered a traumatic brain injury. 30 individuals with a TBI completed the Secret Agent task, along with the Iowa Gambling task and the Urgency, Premeditation, Perseverance and Sensation Seeking (UPPS) Impulsive Behaviour Scale. A carer version of the UPPS Scale was also completed by someone close to the person. No relationships were found between the main impulsivity measures, however a number of near significant relationships were found between subscales of the UPPS Scale and the Secret Agent task. TBI individuals were compared to another group of adults without TBI on measures of impulsivity. The TBI group ignored food during the Secret Agent task significantly more often than the control group. We cannot conclude from these findings that the Secret Agent Task does measure impulsivity in people after a TBI, however there are some signs from the data that it could be a useful measure and more research would be suggested.Explanations for the results are discussed, including the suitability of the SA task for a TBI population.

Abstract

Impulsive behaviour is a well recognised feature in patients following traumatic brain injury (TBI). Despite the prevalence of these behaviours and their social and economic costs, there has been a lack of research on the construct of impulsivity and it is particularly sparse in the TBI literature. The objective of this study was to examine the validity of a new virtual reality task, the Secret Agent (SA) task, in measuring impulsivity in a group of participants with TBI. Individuals with TBI (n = 30) completed the SA task, along with the Iowa Gambling task and the Urgency, Premeditation, Perseverance and Sensation Seeking (UPPS) Impulsive Behaviour Scale. Correlational analyses were carried out between all the measures. A carer version of the UPPS Scale was also completed by a significant other. No significant correlations were found between the main impulsivity measures, however a number of medium effect size correlations with borderline significance were found between subscales of the UPPS Scale and the SA task. TBI individuals were compared to a community sample of age-matched controls on impulsivity. The TBI group ignored food during the SA task significantly more often than the control group. Explanations for these results are discussed, including the nature of the SA task and its suitability for a TBI population. There are indications from the data that the SA task could be a useful measure and further research is indicated.

Keywords: Impulsivity, Traumatic Brain Injury, Secret Agent Task, Iowa Gambling Task, UPPS Impulsive Behaviour Scale.

INTRODUCTION

Impulsive behaviour is a well recognised feature in patients following traumatic brain injury (TBI) (Hornack, Rolls & Wade, 1996; Kolitz, Vanderploeg& Curtiss, 2003; McAllister 2008) and has important implications for rehabilitation and patient safety. Impulsive persons with TBI are more likely than non impulsive patients to demonstrate irritable or aggressive behaviour and poor decision making abilities (McAllister, 2008; Wood, 2001). In addition to negatively impacting rehabilitation processes and increasing the cost of healthcare, such behaviours also impact more broadly on social outcomes following the TBI, such as interpersonal relationships and employment (Wood, 2001).

Despite the prevalence of these behaviours and their social and economic costs, there has been a lack of research on the construct of impulsivity and it is particularly sparse in the TBI literature (Rochat et al. 2010). Whiteside and Lynam (2001) noted the inconsistencies among conceptualisations of impulsivity and sought to add clarity to the construct. Their study, in a non-TBI population, examined the multidimensional aspect of impulsivity by using a well-established, comprehensive model of personality: the Five Factor Model (FFM) of personality as assessed by the Revised NEO Personality Inventory (NEO-PI-R; Costa and McCrae, 1992) which measures higher order factors of personality. Whiteside and Lynam (2001) argued that that although some impulsivity traits result in similar overt behaviours (e.g. acting without forethought), their aetiologies may be different. They conducted a factor analysis on several widely used measures of impulsivity and the facets of the NEO-PI-R related to impulsivity and found a four factor solution. The four components of impulsivity they identified were labelled urgency (the tendency to experience strong reactions, frequently under conditions of negative affects);

(lack of) premeditation (the tendency to think and reflect on the consequences of an act before engaging in that act); (lack of) perseverance (the ability to remain focused on a task that may be boring or difficult); and sensation seeking (the tendency to enjoy and pursue activities that are exciting, and openness to trying new experiences). They then selected the items with the highest loadings on each factor to create the UPPS Impulsive Behaviour Scale. Each of the four factors of impulsivity strongly correlated with a specific factor of the NEO-PI-R.

A pilot study by McHugh and Wood (2008) has contributed to the sparse research in a TBI population. They found that self-reported impulsivity, as assessed by the Barratt Impulsiveness Scale-11 (BIS-11; Patton, Stanford and Barrett, 1995), a scale containing three impulsivity factors (non-planning, motor and attentional impulsivity), was higher in patients with TBI than in control participants. Furthermore, using a temporal discounting task, they found that (1) the value of rewards decreased more steeply in patients with TBI than in control participants when the delay to obtain the reward increased and (2) impulsivity was related to a preference for a smaller reward that could be obtained immediately rather than a larger reward that could be obtained after a delay (McHugh and Wood, 2008).

Research by Votruba et al. (2008) examined the relationships between a number of impulsivity measures in a TBI population and highlighted the need to measure impulsivity in a variety of ways, not relying on rating scales alone. Rating scales are based on retrospective recall of behaviours by either the patient, clinician or carer, and therefore they are susceptible to a variety of biases and distortions associated with faulty

recall. Efforts have been made to develop tasks which tap into real-life aspects of behaviour and thus have more ecological validity. Whilst there have been a number of definitions of ecological validity, in a neuropsychological context it was defined by Sbordone (1996) as "the functional and predictive relationship between the patient's performance on a set of neuropsychological tests and the patient's behaviour in a variety of real-world settings" (p.16).

The Iowa Gambling Task (IGT, Bechara, Damasio, Damasio and Anderson, 1994; Bechara, Tranel and Damasio, 2000) is a behavioural task believed to model real-life decision making and be consistent with construct of cognitive impulsivity (Thomason, German and Morris, 2009). It simulates in real time, real-life decisions, relative to factors such as reward and punishment. The task goal is to maximise the profit from a loan of play money. Subjects are required to make a series of 100 card selections from one of four card decks (A, B, C & D) and each selection is followed by a reward and a penalty. The reward/penalty schedules are predetermined: Deck A and B yield high immediate rewards but carry a risk of much higher long-term penalties, which will results in total loss in the long run (disadvantageous decks); Decks C and D yield low immediate rewards but smaller long-term penalties, which will result in long-term gain (advantageous decks). Repeatedly choosing from the disadvantageous decks would indicate risky or impulsive decision making (Malloy-Diniz, Fuentes, Borges Leite, Correa and Bechara, 2007).

Research carried out in relation to decision making, inhibitory control, and the brain structures involved in these functions have utilised reward-choice paradigms such as the

IGT. Studies indicate that patients with ventromedial prefrontal lesions are unable to use somatic cues to guide decision making on the basis of recent experience or in conditions of uncertainty (Bechara,Damasio, Damasio and Lee, 1999; Bechara, Damasio and Damasio, 2003). This is in line with the somatic marker hypothesis which states that the experience of emotion is tied into the decision making process and somatic markers are integrated automatically and unconsciously by the ventromedial frontal lobes (Buelow&Suhr, 2009). Poor performance on the IGT has been associated with lesions involving the ventromedial prefrontal cortex (Bechara et al, 1994; Bechara, Tranel, Damasio and Damasio, 1996, Bechara et al.,1999) or amygdala (Bechara et al., 1999, 2003). Some lesion studies suggest the involvement of more extensive structures including the dorsolateral prefrontal cortex for the IGT (Fukui,Murai, Fukuyama, Hayashi, and Hanakawa, 2005). MacPherson, Phillips, Della Sala, and Cantagallo (2009) questioned the characterisation of the IGT as mainly tapping emotional functions mediated by the VMPFC. The IGT is a task which draws upon a number of complex processes such as consideration of options, noticing and learning outcome probabilities, choice of strategy, and avoidance of risk. MacPherson et al. (2009) postulate that impairment on the IGT is unlikely to be specific to VMPFC dysfunction.

Although the IGT is a frequently used tool to assess decision making, and has been applied in various clinical populations, Buelow&Suhr, (2009) highlight the lack of literature regarding construct validity or reliability of the IGT. The developers of the IGT did not define the construct of decision making beyond “risky” or “real world” decision making and this has not been clarified subsequently. However evidence suggests that the IGT assesses “hot” decision making processes, as emotional processing is associated with

performance on the task and is consistent with the somatic marker hypothesis. However more research is needed with regard to the IGT's ecological validity in terms of its relation to real-world decision making. There is a lack of data regarding the reliability of the IGT. Studies involving repeat assessments have shown improved performance on repeated administrations of the task e.g. learning effects (Buelow&Suhr, 2009). Reliability of the measure is not addressed in the clinical manual (Bechara, 2007). There is a need for more research into such existing measures and also into the development of new tasks which can tap into real-life aspects of behaviour.

A recently developed virtual reality procedure termed the Secret Agent task (also called The Spook task; Young, Gudjonsson, Carter, Terry, and Morris, 2012) attempts to provide an ecologically valid measure of impulsivity/risk taking. The Secret Agent (SA) task is a behavioural decision-making tool which measures a broad range of risk-taking and moral behaviours. The participant is told that s/he is a 'secret agent' and has been parachuted into enemy territory. The mission is to deliver a message to another secret agent at the end of the game. The participant is asked to try to respond as they would in normal life when having to make important decisions and, in order to encourage this, the game requires the participant to multi-task under pressure (by having to maintain an 'Energy' score during the task). The four constructs measured in the task are: risk taking (e.g. risk of injury, loss to others); antisocial behaviour; altruism; and impulsivity. The task has been piloted in board game format with a group of 30 forensic male inpatients detained in a medium secure unit (Young et al. 2012).

In summary, efforts are being made to improve the assessment of impulsivity and to develop tasks which tap into real-life aspects of behaviour and thus have more ecological validity. Research has highlighted the importance of measuring impulsivity using a variety of modalities (Votruba et al., 2008) and not to rely on questionnaire measures alone. Questionnaires measuring impulsivity often rely on the individual having a reliable informant who can provide information on both their current level of functioning and their pre-morbid functioning, however these responses can be prone to rater biases and not all patients will have a reliable informant. Using behavioural tools provides additional evidence and information to support the formulation process, by offering the clinician the opportunity to observe any difficulties first hand. Behavioural measures provide a means of illustrating to the patient the nature of their difficulties via feedback of their own performance on the task, instead of relying on indirect feedback from relatives. They also provide an objective and engaging means of measuring change over time within a rehabilitation setting. In the SA task a virtual reality environment is used to create a format that allows for an interactive environment that should enhance motivation and increase engagement with the assessment process.

The aim of this study was to examine whether the SA task is sensitive to impulsivity in a group of participants with traumatic brain injury. We hypothesised that: (1) Scores on the UPPS Impulsive Behaviour Scale will correlate with scores on the SA task. Specifically, subscales of the UPPS Impulsive Behaviour Scale will map onto Secret Agent subscales; Urgency **and** (lack of) premeditation on the UPPS Impulsive Behaviour Scale will correlate with the Impulsivity subscale on the SA Task, and sensation seeking

will correlate with risk taking on the Secret Agent Task. (2) Scores on the Iowa Gambling Task will correlate with scores on the SA task.

METHOD

A cross-sectional design was used to investigate whether results from the two behavioural tasks significantly correlated with each other and with performance on the questionnaire measure of impulsivity in individuals with traumatic brain injury. A close relative completed a carer version of the same questionnaire and was asked an additional question relating to whether they perceive the participant to be more impulsive since their brain injury. Other exploratory analyses were carried out to investigate correlations between different measures and subscales. Presentation of the computer tasks were counterbalanced across participants.

The study was submitted to and approved by the West of Scotland Ethics Committee. A copy of the letter confirming favourable opinion for the research to progress is provided in Appendix 2.1, as are the appropriate letters confirming R&D approval from NHS Greater Glasgow & Clyde, NHS Ayrshire & Arran, and NHS Lothian (all in Appendix 2.2).

Participants

Participants were recruited from a variety of brain injury services across CentralScotland (Glasgow, Edinburgh and Ayrshire). Information about the study was provided to staff and to potential participants, explaining the purpose of the study. They then had the option to participate.

Inclusion: Participants were adults (age 18-65 years) with TBI, ranging from mild to severe. The minimum requirement for severity was to have suffered an injury to the head resulting in loss of consciousness, loss of memory for events after the injury (post-traumatic amnesia, PTA) or a period of confusion following the injury. Participants were at least six months post-injury.

Exclusion: Individuals had no history of learning difficulties and no disturbance of perceptual, language or motor disorders that could affect their performance on the computer task or the impulsivity questionnaire. Also excluded were individuals with history of psychiatric disorder, drug or alcohol abuse, previous neurological conditions, and history of physical aggression.

Measures

Clinical Measure of severity of injury

Measures of severity of injury were obtained from records, including length of loss of consciousness (LOC), Glasgow Coma Scale (GCS) and length of Post Traumatic Amnesia (PTA), if available (see Appendix 2.3). If appropriate a retrospective PTA measure was gained based on the participant's recollection of post-injury events. In addition, the Speed and Capacity of Language Processing Test (SCOLP; Baddeley, Emslie, &Nimmo-Smith, 1992) was administered to provide an indication of change in cognitive processing performance compared to pre-injury estimates. The SCOLP consists of two separate measures: The *Speed of Comprehension Test* allows the rate of information processing to be measured, and the *Spot-the-Word Test* provides a

framework for interpreting the results of the first test. The SCOLP therefore provides a means of estimating the impact of a brain injury on speed of processing, thus providing an additional estimate of the severity of the injury. It is sensitive to the effects of closed head injury, normal aging, Alzheimer's disease, schizophrenia, and to a wide range of drugs and stressors, including alcohol.

Standardised Neuropsychological Tests

Standardised neuropsychological test measures were administered to all participants in order to describe the sample. The WTAR (The Psychological Corporation, 2001) was administered in order to provide information on pre-morbid level of functioning. The Repeatable Battery for Assessment of Neuropsychological Status (RBANS, Randolph 1998) was administered in order to provide information on general neurocognitive deficits. It is a brief battery measuring immediate and delayed memory, attention, language, and visuospatial skills. If the RBANS had been administered in the last month then it was not repeated and previous results were used.

To examine for anxiety and depression, participants completed the Hospital Anxiety and Depression Scale (Zigmond&Snaith, 1983).

Measures of impulsivity

Questionnaire

The questionnaire measure used was the Urgency, Premeditation, Perseverance, and Sensation Seeking (UPPS) Impulsive Behaviour Scale (Whiteside and Lynam, 2001). A full copy of the questionnaire is provided in Appendix 2.3. This measures the

multidimensional aspect of impulsivity. This scale has high internal consistency (Whiteside and Lynam, 2001) and studies support the construct validity of the four impulsivity-related traits (Whiteside and Lynam, 2001; Whiteside, Lynam, Miller, and Reynolds, 2005). This questionnaire was administered to the participant along with an adapted version for relative. Research has shown that it is important not to rely on patients' point of view of changes or impairment alone because patients' anosognosia could constitute a threat to validity (Rochat et al., 2010).

Behavioural

The Secret Agent task (previously referred to as the *Spook Task*; Developed by Young, et al. 2012) is a computerised behavioural decision-making tool, which measures participants' reactions to scenarios involving risk-taking, altruistic and antisocial ethical dilemmas, and food. As noted, the participant is told that s/he is a 'secret agent' and his/her mission is to deliver a message to another secret agent. Participants move through scenarios and are faced with choices. The participant is asked to try to respond as they would in normal life when having to make important decisions. An overall points total starts at a fixed level and decreases according to both the time taken to move through scenarios and the decisions made. Energy also starts at a fixed level and decreases throughout the game. Energy levels can be increased by choosing to stop for food in the food scenarios. There are 12 risk taking scenarios, where the participant is given the option of taking the low, medium or high risk route. If the participant chooses medium or high risk routes then they lose points from total score. A risk-taking score is calculated by awarding a score of two points for choosing a high risk route, one point for a medium

risk route and 0 points for a low risk route. The higher the score, the higher the risk taking of the participant. There are 12 ethical scenarios in total and these can be altruistic or antisocial in nature. Altruistic ethical dilemma scenarios for example may be deciding whether to save a rabbit caught in a trap and lose time or leave the rabbit to die, and antisocial scenarios, might involve deciding whether to take protective clothing from a ranger's hut when it is raining, which could then leave the ranger without the protective clothing needed for a mountain rescue. Food scenarios involved deciding whether to stop for a specified food or not. There were 8 food scenarios.

Impulsivity is measured in two ways on the SA task:

(1) Whether participants stop to take food. This is the number of times they stop for food, with an additional sub-measure of the amount of time they spend with their energy below a threshold.

(2) How quickly the participant makes a choice of the low, medium or high risk route. This is scored based on the number of times the participant selects an action option before the options have been fully explained to them.

Iowa Gambling Task (Bechara et al., 1994).The IGT is a computerised behavioural task which was developed to simulate real-life financial decisions (Bechara et al., 1994). It is a method of testing the ability to sacrifice immediate rewards in favour of long term gain (Tchanturia et al. 2007). It is also strongly influenced by emotional factors related to rewards and penalties (Bechara, 2004). The task goal is to maximise the profit from a loan of play money, as described in detail earlier.

Procedures

Once participants had been identified as suitable for the study they were provided with a participant information sheet to give them more information on what participation involved (see Appendix 2.5). If they agreed to participation they attended on one occasion, the session lasting approximately 2 hours. They were met in the location from which they were recruited, and the session was carried out in a quiet clinic room. Prior to starting, written consent was obtained for participation (Appendix 2.6) and participants were made aware that they could stop the session at any time or have break. Participants sat at a table and tests were set down in front of them. Tests were administered in a set order, with the order of the computer tasks being counterbalanced to prevent bias caused by feedback during tasks. This involved half of participants completing the SA task first and half completing the IGT first. The computer tasks (SA task and IGT) were carried out on a laptop computer. All other measures were administered using paper and pen format.

At the end of the session the participant was provided with the questionnaire and consent form to be completed by a relative or close other. The purposes of this were explained and stamped addressed envelope was provided for its return.

Justification of sample size

McHugh and Wood (2008) used a temporal discounting paradigm and the Barrett Impulsivity Scale (BIS II; Patton et al. 1995) to measure decision making and impulsivity following TBI. They found that the TBI group (n = 34) demonstrated more impulsive

decision making than controls. They found a significant negative correlation between the delayed discounting task and the score on the BIS II ($r=-0.34$, $p<0.001$), indicating that steeper discounting of the larger reward by participants was related to higher levels of impulsivity as measured by BIS II. Few studies compare performance of a brain injured sample on specific measures of impulsivity and performance on a virtual reality (VR) task. However, there are studies of relevance in studies which relate to global executive function. Knight, Alderman and Burgess (2002) found medium-large effect sizes ($r=0.46$ and -0.46) between performance measures of the Multiple Errands Test (MET-HV) and DEX scores with 20 research participants and 20 controls. Lamberts, Evans and Spikman(2010) found medium effect size ($r=0.31$) between informant DEX scores and performance on Executive Secretarial Task (EST) in patient group which consisted of 35 brain injured participants.

The MET-HV and EST are considered "naturalistic" assessment measures as opposed to virtual reality (VR) measures. Given the increased methodological rigour entailed in VR methodology, there is reason for assuming that the correlation between a specific VR measure such as the Secret Agent Task and impulsivity ratings as measured by other established impulsivity measures in a head injured sample could provide a medium-large effect size in the present study. Therefore an effect size of $r=0.45$ was estimated for the current study. Using the G-Power statistical package (Faul, Erdfelder, Buchner, and Lang, 2009) and based on previous findings, it was calculated that if a medium- large effect size ($r=0.45$) is present, undertaking a one-tailed correlation, with power at 0.80 and alpha error at 0.05, a total of 29 participants are required.

Missing values

Missing values on the UPPS Impulsive Behaviour Scale were dealt with by calculating the average for the scale and adding this on to account for the missing value. Other missing values were accounted for using the "pairwise" missing value function in SPSS. This means that all available data is included in analysis; only the specific missing values are removed and not all the data for that individual.

Data analysis

Correlational analyses were carried out between subscales of interest in the UPPS Impulsive Behaviour Scale, the IGT and the SA task. According to Cohen's (1988) classification, a correlation of 0.10 corresponds to a small correlation, 0.3 is considered a medium correlation, and 0.50 corresponds to a large correlation.

A net score for the IGT was calculated by subtracting the number of cards chosen from the disadvantageous decks (Decks 1 and 2) from the number of choices made from the advantageous decks (Decks 3 and 4). A negative score indicated that the participant was choosing the cards disadvantageously, whereas a positive score indicated that they were choosing the cards advantageously. Previous research (Buelow and Suhr, 2009) has indicated that early decisions on the IGT are made 'under ambiguity' and are therefore not representative of true decision making or impulsivity. For this reason only the decisions made in the last half (last 50 out of 100) of the task were included in analysis. Data on total time to complete task and total money earned was also examined.

The impulsivity subscale from the SA task was calculated by combining data on the number of times participants stopped for food and the number of scenarios on which they attempted to answer before the instructions had finished. In order to combine these they were converted into z scores. The z score for the number of food stops was reversed so that high scores on both indicted high impulsivity.

RESULTS

Sample characteristics

30 participants with traumatic brain injury between 21 and 65 years of age where recruited. The mean age of the sample was 42. For a summary of the sample demographics see Table 1. Further details relating to injury information can be found in Appendix 2.3.

Table 1: Descriptive statistics for demographics and injury-related characteristics.

	N (%)	Range	Mean	SD
Age	30	21-65	42.0	13.2
Gender	27 male (90) 3 female (10)	n/a	n/a	n/a
Severity of injury (GSC, PTA, LOC)	1 mild (3.3) 1 moderate (3.3) 20 severe (66.7) 8 unknown (26.7)	Mild-severe	n/a	n/a
Time since injury	30	6 month – 21 year	59.31 month	
WTAR (Estimated IQ)	30	50-120	94.5	19.6
SCOLP (Scaled score discrepancy)	28	-4 – 9	1.3	3.0
RBANS (Total scale score)	30	49 – 112	74.1	14.8
HADS - depression	30	0 – 18	6.3	4.3
HADS – anxiety	30	0 – 20	8.2	5.7

Continuous variables were checked for normality using the Kolmogorov-Smirnov test. IGT net score and IGT total time were not normally distributed therefore non parametric tests were used for analyses with these variables. Descriptive statistics for the main measures can be found in Tables 2 and 3. Scores on the UPPS Impulsive Behaviour Scale ranged from 77.4 to 131 (mean=102.9) for the patient version and 86.3 to 133 (mean = 108.1) for the carer version. The scores for the impulsivity subscale from the SA task represent z scores and range from -2.04 to 2.37 (mean = 0.00). The IGT net score ranged from -50 to 30 (median = 0.00).

Table 2: Descriptive statistics for parametric data

	N	Minimum	Maximum	Mean	SD
UPPS Total Score	30	77.4	131.0	102.9	14.7
UPPS Total Score Carer Version	14	86.3	133.0	108.1	16.2
Secret Agent Impulsivity Subscale	30	-2.04	2.37	0.00	1.12

Table 3: Descriptive statistics for non-parametric data

	N	Minimum	Maximum	Median	Interquartile Range
IGT net score	30	-50	30	0.00	1.12

Hypothesis: Scores on the UPPS will correlate with scores on the Secret Agent Task.

Patient Version UPPS

Correlation analyses were carried out on the total score on the UPPS Impulsive Behaviour Scale and the Impulsivity subscale from the SA task. No significant correlation was found (r=0.122, p=0.522). Individual subscales from both tests were also examined. A medium correlation with borderline significance was found between Urgency (UPPS) and Impulsivity (SA), (r=0.342, p=0.064). See Table 4 for the main correlations. No significant correlation was found between lack of premeditation (UPPS) and Impulsivity (SA), (r=-0.132, p=0.488). A medium sized, non-significant correlation was found between sensation seeking (UPPS) and risk taking (SA), (r=0.324, p=0.081).

Other correlations were observed in the borderline significant range between scales of the UPPS and the SA task. A medium negative correlation was found between UPPS lack of premeditation and the total food score on the SA task (r=-0.356, p=0.054, n=30) and also between UPPS Urgency and total food score on the SA task (r=0.338, p=0.068, n=30). A high total food score is indicative of higher impulsivity e.g. maximum score of 16 gained by never stopping for food.

Carer Version UPPS

Carer versions of the UPPS were completed and returned by 14 out of the 30 participants. Correlational analyses were carried out on these versions of the questionnaire and the SA task, completed by the participant. Again, no significant correlation was found between the main measures from each measure (Total score on carer UPPS and the Impulsivity subscale on the SA task); r=0.096, p=0.745, n=14. Hypothesised correlations between subscales were also examined using the carer measures. The results did not demonstrate significant correlations; Urgency and lack of premeditation (Carer UPPS) with Impulsivity subscale from SA task; r=0.040, p=0.892 and r=0.076, p=0.797 (n = 14) respectively. It was also hypothesised that the sensation seeking scores from the UPPS would correlate with risk taking scores from the SA task; this was not found for the carer measures; r=-0.226, p=0.437, n =14.

Larger, albeit still non-significant correlations were found between other subscales of the SA task and total score on the carer version UPPS; specifically a medium to large correlation between carer total UPPS score and the total food score on the SA task (r=-0.402, p=0.154, n = 14), although not significant, and carer total UPPS score with total

number of scenarios answered early on SA task (r=0.434, p=0.121,n = 14), again non significant.

Table 4: Correlation matrix of significant/borderline significant impulsivity measures

	IGT net score	IGT money total	IGT total time	UPPS Urgency	UPPS Lack of premed	UPPS total score	SA food total	SA Impulsivity
IGT net score	**1.000**	**-**	**-**	**rho=0.42***	**-**	**rho=0.481***	**-**	**-**
IGT money total		**1.000**	**-**	**r=0.347**	**-**	**-**	**-**	**-**
IGT total time			**1.000**	**rho=0.383***	**-**	**-**	**-**	**-**
UPPS Urgency				**1.000**	**-**	**-**	**r=0.338**	**r=0.342**
UPPS Lack of premed.					**1.000**	**-**	**r=-0.356**	**-**
UPPS total score						**1.000**	**-**	**-**
SA food total							**1.000**	**-**
SA Impulsivity								**1.000**

*** p< 0.05**

Agreement/disagreement between self- and other- ratings on UPPS Impulsive Behaviour Scale

One large significant correlation was found between the sensation seeking subscale on the carer version and participants version of the UPPS; r = 0.566, p = 0.044, n = 13. None of the other subscales were approaching significance.

Hypothesis: Scores on the IGT will correlate with performance on the Secret Agent Task.

Due to normality assumptions not being met, Spearmans correlations were carried out. A small to medium, non-significant correlation was found between the IGT net score and the impulsivity sub scale from the SA task; rho=0.223; p= 0.236, n = 30. A similar small to medium but non-significant correlation was found for the impulsivity sub scale from the SA and total time taken on the IGT; rho=0.222, p=0.237, n = 30.

Additional analyses

Additional analyses were carried out between IGT scores and UPPS sub scales. Several significant medium to large correlations were found: IGT net score and UPPS Urgency (rho=0.42, p=0.020); IGT net score and UPPS total score (rho=0.481, p=0.007); and IGT total time taken and UPPS Urgency (rho=0.383, p = 0.037). Borderline significance was found for a medium correlation between IGT total money gained and UPPS Urgency (r=0.347, p=0.060). See Table 4 for the main correlations. When Bonferroni corrections were applied for these correlations, this lowered the criteria for significance to 0.003 resulting in these comparisons no longer achieving significance. However this approach clearly reduces statistical power considerably, and given the modest sample size, together with this being the first examination of this task with this population it may be viewed as too conservative, potentially leading to a genuine result being missed.

Carer impulsivity question

Carers or relatives were asked if the participant is more impulsive since their brain injury. This data was gained from 13 relatives, of which 9 reported that the participant in question was more impulsive since their brain injury. Independent sample t-tests or Mann Whitney tests (for IGT) were carried out for the main impulsivity measures however there were no significant differences on any of the impulsivity measures between the mean scores for those who were reported to be more impulsive versus not more impulsive (UPPS total score, p=0.100; UPPS Carer total score, p=0.220; S.A Impulsivity, p=0.227; IGT net score, p=0.877).

Discriminant Validity

Scores from the coding task from the RBANS did not significantly correlate with any measure of impulsivity. Total scores and subscales of the measures were examined. See Table 5 for main correlations.

Table 5: Discriminant validity; correlations between coding task on RBANS and measures of impulsivity

	RBANS coding raw score	**UPPS total score**	**S. A Impulsivity**	**IGT net score**
RBANS coding raw score	1.000	-0.055, p = 0.774	-0.346, p = 0.061	-0.028, p = .883

Relationship between cognitive ability and Impulsivity

No relationship was found between impulsivity and intellectual functioning, using the total scale score from the RBANS. See Table 6 for correlations and significance levels.

Table 6: Relationship between cognitive ability and measures of impulsivity

	SA Impulsivity	IGT net score	UPPS Lack of premed	UPPS Urgency	UPPS Sensation Seeking	UPPS Lack of perseverance	UPPS total score
RBANS total score	-0.298 p = 0.109	-0.159 p = 0.402	-0.075 p = 0.695	-0.308 p = 0.098	0.062 p = 0.743	0.206 p = 0.274	-0.111 p = 0.560

Control Group data

After analysing the data gained from the current study, the opportunity arose to gain additional data from the Broadmoor study (Young, Gudjonsson and Morris,In preparation), enabling the data from this study to be compared against a control group.

Data was obtained from the Secret Agent Broadmoor study to create a sample of community controls matched by age. An independent sample t-test was carried out to compare the control group with the TBI group on performance. In relation to impulsivity, the only data available from the Broadmoor study which was also applicable to the present study were number of times the participant chose from the disadvantageous deck on the IGT and the total food score for the SA task. The control group gained higher mean scores for the number of choices made from the disadvantageous deck. There was a significant difference between the control group and the TBI group on this measure ($p < 0.001$). In relation to the total food score from the SA task, there was also a significant difference between the groups ($p < 0.001$). The TBI group gained significantly higher mean scores than the control group, indicating that they ignored food more often. See Table 7 for results.

Normed data for the IGT was also gained from the professional manual (Bechara, 2007) and T-scores were calculated for the current TBI sample. The Kolmogorov-Smirnov test found that the data was not normally distributed (p=0.015). The median score for the TBI sample was 44.5, indicating that they performed slightly below the average (average T-score = 50) on this test.

Table 7: Independent t-tests for difference between TBI group and control group on measures of impulsivity

TBI	**Age Matched controls**					
Variable	**M**	**SD**	**M**	**SD**	**T**	**p**
IGT. No of choices from disadvan. Deck	25.00	8.69	53.70	16.32	8.5	0.000
SA Total food score	10.2	1.13	2.33	1.51	-22.81	0.000

DISCUSSION

The purpose of this study was to examine whether the Secret Agent (SA) task is sensitive to impulsivity in a group of participants with traumatic brain injury. This was done by comparing it to an existing valid and reliable questionnaire measure of impulsivity, the UPPS Impulsive Behaviour Scale (Whiteside and Lynam, 2001) and a behavioural task designed to simulate assess real-life decision making (Bechara et al., 1994) and believed to be consistent with constructs of cognitive impulsivity (Thomason et al., 2009).

No significant correlations were found between the impulsivity score on the UPPS Impulsive Behaviour Scale and scores on the SA task. However, a medium correlation in the borderline significant range was found between the Urgency subscale of the UPPS and the Impulsivity measure from the SA task. High scorers on urgency are likely to

engage in impulsive behaviours to alleviate negative emotions despite potential long-term detrimental consequences (Whiteside &Lynam, 2001). Items which represent urgency on the UPPS include 'It is hard for me to resist acting on my feelings' and 'When I get upset I often act without thinking' (Whiteside &Lynam, 2001, p. 628). The impulsivity subscale from the SA task was derived from the number of times the individual failed to stop for food and the number of scenarios where they tried to make their choice prematurely. It is therefore possible that the Urgency subscale from the UPPS and Impulsivity for the SA task are tapping into the same construct of impulsivity. During the SA task participants are under pressure to deliver a message and often may make decisions such as using an unsafe bridge in order to alleviate anxiety in the short term, despite potential harmful outcomes. Deciding not to stop for food could be one such decision. A medium positive correlation with borderline significance was found between the total food score from the SA and UPPS Urgency. High total food scores indicate that throughout the SA task the participant frequently chose not to stop for food. This indicates that rather than thinking through the consequences of continuing without food, and the consequences of continuing with insufficient energy, the impulsive participant refuses the offer of food and continues regardless. This concurs with our definition of impulsivity.

A medium, negative correlation in the borderline significant range was also found between SA food and UPPS lack of premeditation. Premeditation refers to the tendency to think and reflect on the consequences of an act before engaging in this act, therefore high scorers on this subscale would tend to act on the spur of the moment and not

consider the consequences (Whiteside and Lynam, 2001). It would have been expected that a positive correlation would have been found here, thus those scoring high on lack of premeditation (demonstrating a tendency not to think and reflect on consequences of an act before engaging in that act) would also have disregarded the need for food without consideration for the consequences. It could be hypothesised that the negative correlation (albeit of borderline significance) which was found may relate to the nature of the food measure and the primitive need for food. In other words even when individuals are found to lack premeditation using other measures this may not translate to decisions regarding food and they may actually act conservatively in relation to food. However, the total food score on the SA correlated positively with UPPS urgency, thus in the direction which would be expected. Scores from the carer version of the UPPS did not significantly correlate with any measures from the SA task, however, this may be due to the small sample size of carer feedback.

There was no evidence that scores from the IGT correlated with scores from the SA task. There could be several explanations for this result. This may be indicative of the lack of a precise definition as to what aspect of decision making the IGT measures (Buelow&Suhr, 2009). Evidence supports the IGT as a measure of decision making deficits, reflecting dysfunction of frontal lobe structures, however, there is a lack of research into the validity and reliability of the task and lack of a concise definition in relation to aspects of decision making which it measures. Therefore its validity as a clinical instrument has been called into question and the need has been highlighted for it to be used as one part of more comprehensive evaluation (Buelow&Suhr, 2009). This

result could also relate to the nature of the Secret Agent task. A pilot study (Young et al., 2012) found that risk taking and unethical problem solving were related to levels of criminality, impulsivity and sensation seeking in a forensic population, however, the present study sought to validate the SA task as a valid measure of impulsivity in a TBI population. The differences in the research population may be of relevance to the results found. Participants' feedback from the current study found the instructions were too lengthy for each scenario on the SA task. Where scenarios gave three choices on how to proceed, some participants reported that by the end of the third choice they had forgotten the first option and therefore made a random choice. This was a particular problem for participants with memory problems. Other participants reported that they made choices based on personal preferences e.g. not taking a shortcut over a river due to not liking water. Some participants also reported being confused by some aspects of the task, such as being told that they had certain skills but also being asked to make decisions like they would in everyday life. The task may need to be simplified to be suitable for a TBI population. Dixon et al. (2005) supports this notion and questions the suitability of some of the behavioural measures of impulsivity in terms of generality. Rather than complex decisions involving noticing patterns, making bets or choosing amounts of money, tasks could be more tailored to decisions likely to be made on a daily basis. For example, using a temporal discounting approach, a choice could be stated as "Would you rather go to physical therapy for 10 minutes today or 30 minutes tomorrow?" (Dixon et al. 2005, p. 118).

Several significant correlations were found between the IGT and subscales of the UPPS Impulsive Behaviour Scale, although these were not significant following Bonferroni corrections. The primary measure of the IGT task is the net score which is the number of advantageous card selections minus the number of disadvantageous card choices. A negative score on the IGT therefore suggests more choices from the disadvantageous decks and, therefore, more risky behaviour. This study found a significant positive correlation between the net IGT score and both UPPS Urgency and UPPS total score, indicating that those who gained a high, positive score on the IGT (indicating non impulsive/risky) correlated with these UPPS measures. This result may reflect the lack of clarification in relation to what aspect of decision making the IGT actually measures and the complexity of the construct which it aims to measure. Although it has been utilized in a variety of populations and to assess differing aspects of decision making, it was originally developed as a behavioural measure of risky decision making (Bechara, 2007). It has been hypothesised that the decision making demonstrated during the IGT is consistent with the somatic marker hypothesis (Bechara, 2004) which states that the experience of emotion is tied to the decision making process. "Cold" cognitive reasoning is associated with rational processes such as considering risk/benefit ratios, and the ability to retrieve from memory, whereas "hot" decision making involves emotional and affective responses (Buelow&Suhr, 2009). The emotional experience or somatic marker that guides decision making may be unconscious and experienced as a "gut feeling". Somatic markers are integrated automatically and unconsciously by the ventromedial frontal lobes into conscious decision making processes (Dunn, Dalgleish and Lawrence, 2006). When neurological damage affects brain areas associated with "hot" decision

making processes, this can impair the "cold" decision making processes too (Buelow&Suhr, 2009). Evidence is consistent with the somatic marker hypothesis and the role of "hot" or emotional decision making during the IGT. Bechara et al. (1996) showed that healthy controls demonstrate an anticipatory electrodermal response prior to selecting a card from the disadvantageous or risky deck, however, individuals with ventromedial prefrontal cortex damage do not show this anticipatory response. Therefore in the present study it could be hypothesised that the IGT, rather than tapping into impulsivity, was in fact measuring a separate construct such as risk taking, as is consistent with the somatic marker hypothesis described above. Impulsivity relates to an inability to inhibit a response long enough to engage in further cognitive processes, however, risk taking suggests that a cognitive process or risk analysis has been engaged in but a risky choice or decision has been settled upon. In the current study however, no significant correlation was found between the IGT and the risk total score from SA task.

Zermatten, Van der Linden, d'Acremont, Jermann, and Bechara (2005) researched the links between the UPPS Impulsive Behaviour Scale and the Iowa Gambling Task in non TBI population (30 students). They found that lack of premeditation was correlated to disadvantageous decisions on the IGT. They concluded that lack of premeditation is related to decision making processes which are influenced by somatic (or emotional) markers as measured by the IGT. This study was carried out on a sample of undergraduate students, thus it can be presumed that this was a high functioning sample and not generalisable to a TBI population. It has been suggested that performance of the IGT could be related to intellectual functioning (Dixon et al., 2005; McHugh & Wood,

2008;Monterosso, Ehrman, Napier, O'Brien, and Childress, 2001). Dixon et al. (2005) used a temporal discounting task with a mixed group of severely injured TBI and stroke patients. Compared to a student control group, the brain injured patients chose sooner smaller rewards more often than controls. However, it has been suggested that the different levels of functioning between the two groups was so large that its clinical significance is complex (McHugh & Wood, 2008). It was proposed that the brain injured participants may not have understood the task, suggesting that the results were due to intellectual functioning rather than impulsive decision making. In the current study cognitive functioning was not found to be related to performance on any of the measures of impulsivity. Similarly, no relationship was found between intellectual functioning and impulsivity for a matched control group.

The matched control group was also utilised in order to compare the results from the TBI population with the results from an aged matched control group. The TBI population appeared to be more impulsive than the control group in relation to decisions made about stopping for food; the TBI group ignored food significantly more often than the control group. However in relation to performance on the IGT, the control group appeared to be more impulsive as they chose from the disadvantage deck significantly more often than the TBI group.

Although evidence has indicated that relatives' ratings of impulsivity may be more accurate than patients due to a lack of insight or awareness (Rochat et al., 2010), this may not always be an ideal way to assess behavioural changes in individuals with TBI. First

and foremost many individuals do not have a significant other who can provide this information, as was the case in the current study. Furthermore relatives' ratings can be prone to bias or inaccuracies. The present study compared the self- and other- ratings on the UPPS Questionnaire and found one significant positive correlation on the sensation seeking scale, however, due to the small sample size for the carers version this is not powerful data. Further studies should investigate this further however it adds weight to the argument for the development of valid behavioural measures which measure the behaviours in an ecologically valid way, therefore reducing the need for such questionnaires.

An additional issue to consider when assessing impulsivity in a TBI population relates to premorbid impulsivity. A premorbidly impulsive individual may have made impulsive decisions in the past which have led to the clinical problem (e.g. traumatic brain injury), as well as being associated with performance on tasks post-injury. There was some indication of premorbid impulsivity in the TBI sample employed in this study, as indicated by the nature of the incident leading to the TBI (see Appendix 2.4). For example participants described their injuries occurring due to accidents such as motorcycle accidents where excessive speed or risk was involved, or a lack of safety equipment such as a helmet. Interpretation of test performance as reflecting the consequence of the clinical problem therefore has to be carefully considered. The present study did make efforts to account for premorbid personality on performance by gaining this information from relatives of the participant, however responses were low in number meaning that these analyses lacked power.

A major consideration when considering the results from the present study are the findings from previous studies which have failed to find significant correlations between questionnaire and behavioural measures. In a TBI population, Votruba et al. (2008) investigated the intercorrelations between a number of tests and rating scales measuring impulsivity, and also accounted for whether these involved verbal or motor mode of expression. They found that verbal impulsivity was best assessed by rating scales and those scores were largely unrelated to performance tests, whereas motor impulsivity was best assessed by performance tests and was unrelated to rating scales, thus indicating that questionnaire measures and behavioural measures are tapping into separate constructs of impulsivity. Other studies have similarly failed to find any significant degree of correspondence between questionnaire and behavioural measures of impulsivity in non-TBI populations (Swann, Bjork, Moller, and Dougherty, 2002;Zermatten et al., 2005). This research could help us understand the results of the present study which sought to find a relationship between an impulsivity rating scale and several performance measures. Perhaps, due to the complex and multidimensional nature of impulsivity, it is not possible to measure it accurately using one assessment measure alone and instead it should be assessed in a range of ways (Votruba et al., 2008).

It is important to consider the limitations of this study. Although a power calculation was performed and the planned number of participants were recruited, this reflected only the minimum number of participants required to ensure sufficient power is achieved. It is possible that if a larger sample size was gained, borderline results may have met

significance. Generality of the results may be affected somewhat by the exclusion criteria employed in the study. Participants were required to be able to communicate verbally and be able to read, write and use a computer. This in turn excludes a significant proportion of more impaired TBI survivors. Furthermore, although the study aimed to include individuals across the whole spectrum of severity of injury, the majority of the sample had sustained a severe head injury and therefore was perhaps not representative of all patients living in the community with a TBI.

To summarise, it cannot be concluded on the basis of this study that the Secret Agent task provides a valid measure of impulsivity in the TBI population. However, this is a tentative conclusion and there are some indications from the data that it could be a useful measure and further research utilising a larger sample would be indicated . These results reflect the complexity of impulsivity as a construct and the need for more research in assessment measures in brain injury populations.

REFERENCES

Baddeley, A.D., Emslie, H.,&Nimmo-Smith (1992).*The Speed and Capacity of Language Processing(SCOLP) Tes*t. Bury St Edmunds: Thames Valley Test Company.

Bechara, A., Damasio, A. R., Damasio, H., Anderson, S. W. (1994). Insensitivity to future consequences following damage to prefrontal cortex. *Cognition, 50,* 7-15.

Bechara, A., Tranel, D., Damasio, H., &Damasio, A. R. (1996).Failure to respond automatically to anticipated future outcomes following damage to prefrontal cortex. *Cerebral Cortex, 6,* 215-225.

Bechara, A., Damasio, H., Damasio, A. R., & Lee, G. P. (1999).Different contributions of the human amygdala and ventromedial prefrontal cortex to decision making. *Journal of Neuroscience, 19,* 5473-5481.

Bechara, A., Tranel, D., Damasio, H. (2000). Characterization of the decision-making deficit of patients with ventromedial prefrontal cortex lesions. *Brain, 123,* 2189-2202.

Bechara, A., Damasio, H., Damasio, A. R.(2003). Role of the amygdala in decision making.*Annals of the New York Academy of Sciences, 985,* 356-369.

Bechara, A. (2004). The role of emotion in decision making: evidence from neurological patients with orbitofrontal damage. *Brain and Cognition, 55,* 30-40.

Bechara, A. (2007). *Iowa Gambling Task: Professional Manual*.Odessa, FL: PsychologicalAssessmentResources.

Buelow, M. T &Suhr, J.A (2009).Construct Validity of the Iowa Gambling Task.*Neuropsychology Review, 19*(1), 102-114.

Cohen, J (1988). Statistical Power Analysis for the Behavioural Sciences.(2nd Ed).

Costa, P. T., & McCrae, R. R. (1992). *Revised NEO Personality Inventory (NEO-PI-R) and NEO Five-Factor Inventory (NEO-FFI): Professional Manual.* Odessa, FL: Psychological Assessment Resources.

Dixon, M. R., Jacobs, E. A., Sanders, S., Guercio, J. M., Soldner, J., Parker-Singler, S., & Robinson et al. (2005). Impulsivity, self-control, and delay discounting in persons with acquired brain injury. *Behavioural interventions, 20,* 101-120.

Dunn, B. D., Dalgleish, T., & Lawrence, A. D. (2006). The somatic marker hypothesis: A critical evaluation. *Neuroscience and Biobehavioral Reviews, 30,* 239-271.

Faul, F., Erdfelder, E., Buchner, A., & Lang, A. G. (2009).Statistical power analyses using G*Power 3.1: Tests for correlation and regression analyses. *Behavior Research Methods,41,* 1149-1160.

Fukui, H.,Murai, T., Fukuyama, H., Hayashi, T., &Hanakawa, T. (2005). Functional activity related to risk anticipation during performance the Iowa gambling task. *NeuroImage, 24,* 253-259.

Hornack, J., Rolls, E. T., & Wade, D. (1996). Face and voice expression identification in patients with emotional and behavioural changes following ventral frontal lobe damage. *Neuropsychologia, 34,* 247-261.

Knight, C., Alderman, N., & Burgess, P. W. (2002).Development of a simplified version of the multiple errands test for use in hospital settings.*NeuropsychologicalRehabilitation, 12(3),* 231-255.

Kolitz, B. P., Vanderploeg, R. D., &Curtiss, G. (2003). Development of the Key Behaviours Change Inventory: A traumatic brain injury behavioural outcome assessment instrument. *Archives of Physical Medicine and Rehabilitation, 84,* 277-284.

Lamberts, K. F., Evans, J. J., &Spikman, J. M. (2010). A real-life, ecologically valid test of executive functioning: The Executive Secretarial Task. *Journal of Clinical and Experimental Neuropsychology, 32(1),* 56-65.

Malloy-Diniz, L., Fuentes, D., Borges Leite, W., Correa, H., &Bechara, A. (2007). Impulsive Behaviour in adults with attention deficit/hyperactivity disorder: characterisation of attentional, motor and cognitive impulsiveness. *Journal of the International Neuropsychological Society, 13*, 693-698.

McAllister, T. W. (2008). Neurobehaviouralsequelae of traumatic brain injury: Evaluation and management. *World Psychiatry, 7*, 3-10.

McHugh, L., & Wood, R. L. (2008). Using a temporal discounting paradigm to measure decision-making and impulsivity following traumatic brain injury: A pilot study. *Brain Injury, 22*, 715-721.

MacPherson, S. E., Phillips, L. H., Della Sala, S., &Cantagallo, A. (2009).Iowa Gambling Task Impairment is not specific to ventromedial prefrontal lesions. *The Clinical Neuropsychologist, 23*, 510-522.

Monterosso, J., Ehrman, R., Napier, K. L, O'Brien, C. P., & Childress, A. R. (2001). Three decision making tasks in cocaine-dependent patients: do they measure the same construct? *Addiction, 96*, 1825-1837.

Patton, J. H., Stanford, M. S., & Barrett, E. S. (1995). Factor structure of the Barratt Impulsiveness Scale. Journal of Clinical Psychology, 51, 768-774.

Randolph, C. (1998). Repeatable Battery for the Assessment of Neuropsychological Status (RBANS). San Antonio: Harcourt, TX: The Psychological Corporation.

Randolph, C., Tierney, M. C., Mohr, E., & Chase, T. N. (1998). The Repeatable Battery for the Assessment of Neuropsychological Status (RBANS): preliminary clinical validity. *JClinExpNeuropsychol, 20*, 310-319.

Rochat, L., Beni, C., Billieux, J., Azouvi, P., Annoni, J., & Van der Linden. (2010). Assessment of impulsivity after moderate to severe traumatic brain injury. *Neuropsychological Rehabilitation, 20*, 778-797.

Sbordone, R. J. (1996). Ecological validity: Some critical issues for the neuropsychologist. In R. J. Sbordone& C. J. Long (Eds.), *Ecological validity of neuropsychological testing* (pp. 15–41). Delray Beach, FL: GR Press/St. Lucie Press.

Swann, A. C., Bjork, J. M., Moller, & Dougherty, D. M. (2002). Two models of impulsivity: Relationship to personality traits and psychopathology. *Biological Psychiarty, 51,* 988-994.

Tchanturia, K., Liao, P., Uher, R., Lawrence, N., Treasure, J., & Campbell, I. C. (2007).An investigationof decision making in anorexia nervosa using the Iowa Gambling Task and skin conductance measurements. *Journal of the International Neuropsychological Society, 13,* 635-641.

The Psychological Corporation.(2001). *Wechsler Test of Adult Reading.* San Antonio, TX: Harcourt Assessment.

Thomason, K., German, E., & Morris, R. (2009). *Impulsivity, risk taking and moral behaviour investigated using virtual reality procedures in adults with ADHD.*(Unpublished research proposal). Kings College London, London.

Votruba, K. L., Rapport, L. J., Vangel, S. J., Jr., Hanks, R. A., Lequerica, A., Whitman, R. D., Langenecker, S. (2008). Impulsivity and traumatic brain injury: The relations among behavioural observation, performance measures, and rating scales. *Journal of Head Trauma Rehabilitation, 23,* 65-73.

Whiteside, S. P &Lynam, D. R. (2001). The Five Factor Model and impulsivity: using a structural model of personality to understand impulsivity. *Personality and Individual Differences, 30,* 669-689.

Whiteside, S. P., Lynam, D. R., Miller, J. D & Reynolds, S. K. (2005). Validation of the UPPS Impulsive Behaviour Scale: a four-factor Model of Impulsivity. *European Journal of Personality, 19,* 559-574.

Wood, R. L. (2001). Understanding neurobehavioral disability. In R. L. Wood & T. M. McMillan (Eds), *Neurobehavioural disability and social handicap following traumatic brain injury* (pp. 1-28). Hove, UK: Psychology Press.

Young, S.,Gudjonsson, G. H., Carter, P., Terry, R., & Morris, R. (2012).Simulation of risk-taking and its relationship with personality.*Personality and Individual Differences 53*, 294–299.

Young, S., Gudjonsson, G., & Morris, R. (In preparation).SPOOK: An empirical investigation of a computerised risk assessment tool 2008-2010. NIHR Research for Innovation, Speculation and Creativity Programme: Application RC-PG-0308-10215.

Zermatten, A., Van der Linden, M., d'Acremont, M., Jermann, F., Bechara, A. (2005). Impulsivity and decision making.The journal of nervous and mental disease, 193, 647-650.

Zigmond, A. S., &Snaith, R. P. (1983). The hospital anxiety and depression scale. *ActaPsychiatrScand, 67*, 361-70.

Chapter 3

Advanced Clinical Practice 1, Reflective Critical Account (abstract only)

Feeling out of depth as a "specialist trainee"; reflections on personal and professional development in a neuropsychology setting.

Julie L. Nellaney*

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Prepared in accordance with requirements for submission to the Clinical Rehabilitation.

Submitted in partial fulfilment of the requirements for the degree of Doctorate in Clinical Psychology (D.Clin.Psy)

Abstract

In this account I have reflected on my feelings of anxiety when beginning my specialist Neuropsychology placement. I quickly learned however that neuropsychology was not an alien discipline to me and I had transferable of skills which I could apply in this setting. Initially I had fears regarding missing out on time practicing in adult mental health however due to the complexity of the cases in Neuropsychology I have added to my generic skills in abundance. I am pleased with my decision to do a specialist Neuropsychology placement and have enjoyed it much more than I expected to. This 'journey' has been an important one for me in relation to learning how to deal with similar anxiety in future situations and also in building my confidence for my future as a clinician. Changes which are currently occurring within the profession of Clinical Psychology as a whole mean that as clinicians, Clinical Psychologists are going to be in a highly specialist role, treating only the most complex of cases. All clinical and applied psychologists will be involved in routine neuropsychological assessment and rehabilitation and this is a role that I want to ensure I am competent to take on.

Chapter 4

Advanced Clinical Practice 2, Reflective Critical Account (abstract only)

Stepped care: caring for all?

Julie L. Nellaney*

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Prepared in accordance with requirements for submission to the Clinical Rehabilitation.

Submitted in partial fulfilment of the requirements for the degree of Doctorate in Clinical Psychology (D.Clin.Psy)

Abstract

Adult mental health services are under significant pressures to increase capacity and reduce demand to psychological services. Until recently I had felt that this was a responsibility for others to bear; managers, service leads and professionals at board level. However at job interview I was asked to prepare a presentation on the topic and furthermore to discuss how I would implement such changes if I worked in that service. This triggered a period of reflection in relation to the reality of implementing changes at a service level by looking carefully at the service I was currently placed within and the lengths that they go to in order to increase access to services and cut waiting lists. I also reflected upon wider service issues and the way in which Clinical Psychologists are implemented within a stepped care model. Currently Clinical Psychologist's roles at the lower tiers of the stepped care are limited to providing training and supervision to other health professionals who are carrying out interventions at the lower intensity tiers of the service however I reflect upon the possibility that Clinical Psychologists could have a therapeutic role here too, if it were not for the restrictions due to time and finances. Finally, based on experience with a client, I reflect upon the impact of service changes on clients and the potentially detrimental impact of being allocated to a lower level of the service and requiring to be "stepped up".

Appendix 1.1: Journal Publication Guidelines

JOURNAL OF THE INTERNATIONAL NEUROPSYCHOLOGICAL SOCIETY

Instructions for Contributors

Aims and Scope:
The *Journal of the International Neuropsychological Society* welcomes original, creative, high quality research papers covering all areas of neuropsychology. The focus of articles may be primarily experimental, more applied or clinical. Contributions will broadly reflect the interest of all areas of neuropsychology, including but not limited to: development of cognitive processes, brain-behavior relationships, adult and pediatric neuropsychology, neurobehavioral syndromes, such as aphasia or apraxia, and the interfaces of neuropsychology with related areas such as behavioral neurology, neuropsychiatry, and cognitive neuroscience. Papers that utilize behavioral, neuroimaging, and electrophysiological measures are appropriate. Book reviews will also be published.

To assure maximum flexibility and to promote diverse mechanisms of scholarly communication, the following formats are available in addition to *Regular Research Articles: Brief Communications* are shorter research articles; *Rapid Communications* are intended for "fast breaking" new work, that does not yet justify a full length article, and which are put on a fast review track; *Neurobehavioral Grand Rounds* are unique case studies, which are published in tandem with an introduction by an expert in the field to put the case into a more global perspective; *Critical Reviews* are thoughtful considerations of topics of importance to neuropsychology, including associated areas, such as functional brain imaging, neuroepidemiology, and ethical issues; *Dialogues* provide a forum for publishing two distinct positions on controversial issues in a point-counterpoint form; *Symposia* consist of several research articles that are thematically linked; *Letters to the Editor* respond to recent articles in the *Journal of the International Neuropsychological Society;* and *Book Reviews*.

Critical Reviews, Dialogues, and *Symposia* may be invited by the appropriate Department Editor or proposed by individual authors. Such proposals should be discussed with the Editor-in-Chief or the Department Editor before submission. *Book Reviews* are invited by the Book Review Editor.

Originality and Copyright
To be considered for publication in the *Journal of the International Neuropsychological Society,* a manuscript cannot have been published previously, nor can it be under review for publication elsewhere. Papers with multiple authors are reviewed with the assumption that all authors have approved the submitted manuscript and concur with its submission to the *Journal of the International Neuropsychological Society.* **A Copyright Transfer Agreement,** with certain specified rights reserved by the author, must be signed and returned to the Editor by the corresponding author of accepted manuscripts, prior to publication. This is necessary for the wide distribution of research findings, and the protection of both author and the society under copyright law.

If you plan to include material that has been published elsewhere and is under copyright of a third party, you will need to obtain permission to re-use this material in your article. A form is provided for this purpose. Alternatively, many publishers use an online system for such requests. It is the responsibility of the authors to obtain permissions to re-use material from elsewhere.

Disclosure Form
The **Author Disclosure Form** must be signed by the corresponding author for all the manuscript's authors at the time the manuscript is submitted. This form includes an attestation that the manuscript is original and not under review in another journal, research was conducted in compliance with institutional guidelines, and any potential conflicts of interest have been reported. Such disclosure will not preclude publication, but it is critical because of the potential of negative or positive bias. Potential conflicts of interest include funding sources for the reported study (e.g., a test validation study financially supported by a test publisher, a study supported by an insurance company), personal or family financial interest in a test or product or with a company that publishes a test that is being investigated in the manuscript or competes with a test that is being investigated in the manuscript. Other conflicts include employment, consultancies, stock ownership or medicolegal work. For the latter, information about whether the author's medicolegal work is largely for one side should be reported. This list of potential conflicts is not all inclusive, and it is the responsibility of each author to ensure that all of their "potential conflicts" are reported in the Acknowledgment section of the paper. Authors should err on the side of full disclosure, and if authors are uncertain about what constitutes a relevant conflict, they should contact the editorial office (jins@unm.edu).

In addition to signing this attestation, compliance with institutional research standards for animal or human research (including a statement that the research was completed in accordance with the Helsinki Declaration http://www.wma.net/e/policy/17-c_e.html) should be included in the methods section of the manuscript, and funding sources and other potential conflicts of interest should be included in the acknowledgments.

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The *Journal of the International Neuropsychological Society* uses online submission and peer review. Paper submissions are not accepted. Authors who are not able to submit their manuscripts online are asked to contact the editorial office at: jins@unm.edu. The website address for submissions is: http://mc.manuscriptcentral.com/cup/jins, and complete instructions are provided on the website. Prior to online submission, please consult http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?db=mesh for 6 keywords or mesh terms that are different from words in the title. Accurate mesh terms will increase the probability that your manuscript will be identified in online searches. Please follow the instructions carefully to avoid delays. The menu will prompt the author to provide all necessary information, including the manuscript category, the corresponding author including phone number, fax number and e-mail address, and suggested reviewers.

The website will automatically acknowledge receipt of the manuscript and provide a manuscript reference number. The Editor-in-Chief will assign the manuscript for review to an Associate or Department Editor and at least two other reviewers. Every effort will be made to provide the author with a review within 6 to 10 weeks of manuscript assignment. *Rapid Communications* will be reviewed within 6 weeks. If the Editor requests that revisions be made to a manuscript before publication, a maximum of 3 months will be allowed for preparation of the revision, except in unusual circumstances.

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Manuscript Length
In order to increase the number of manuscripts that can be published in the *JINS*, please adhere to the following length requirements. Please provide a word count on the title page for abstract and for manuscript (not including abstract, tables, figures, or references). Manuscripts will be returned if they exceed length requirements.

Regular Research Articles: Maximum of 5,000 words (not including tables, figures, or references) and a 200 word abstract.

Brief Communications: Maximum of 2,500 words (not including abstract, tables, figures, or references) and a 150 word abstract, with a maximum of two tables or two figures, or one table and one figure, and 20 references.

Rapid Communications: Maximum of 1,000 words (not including abstract, tables, figures, or references) and a 150 word abstract, with a maximum of two tables or two figures, or one table and one figure, and 10 references.

Critical Reviews: Maximum of 7,000 words (not including abstract, tables, figures, or references) and a 200 word abstract. ***Critical Reviews* must be pre-approved by the Department Editor. Please e-mail your abstract to jins@unm.edu in order to receive prior approval.**

Short Reviews: Maximum of 2,500 words, a 100-word abstract, and 35 references. *Short Reviews* are conceptually-oriented snapshots of the current state of a research area rather than comprehensive reviews. We welcome descriptions of new or recent concepts and their applicability to neuropsychology, and proposals of novel ideas or approaches, particularly if they lead to testable hypotheses. Prose should be readily accessible to both students and seasoned scientists and clinicians. ***Short Reviews* are written by recognized experts in their field. Generally, they are submitted by invitation only, but occasionally an invitation may be issued on the basis of an unsolicited proposal.**

Dialogues: Maximum of 2,000 words for each segment (not including abstract, tables, figures, or references) and a 100 word abstract, with a maximum of two tables or two figures, or one table and one figure and 20 references. ***Dialogues* must be pre-approved by the Department Editor. Please e-mail your abstract to jins@unm.edu in order to receive prior approval.**

Symposia: Maximum of 5,000 words (not including abstract, tables, figures, or references) and a 200 word abstract. ***Symposia* must be pre-approved by the Department Editor. Please e-mail your abstract to jins@unm.edu in order to receive prior approval.**

Neurobehavioral Grand Rounds: Maximum of 5,000 words with an informative literature review (not including abstract, tables, figures, or references) and a 200 word abstract.

Letters to the Editor: Maximum of 500 words (not including table, figure, or references) with up to five references, one table, or one figure.

Book Reviews: Approximately 1,000 words.

Manuscript Preparation and Style

The entire manuscript should be typed double-spaced throughout using any word processing program. Unless otherwise specified, the guideline for preparation of manuscripts is the *Publication Manual of the American Psychological Association* (6th edition). This may be ordered from: APA Order Dept., 750 1st St. NE, Washington, DC 20002-4242, USA.

Pages should be numbered sequentially beginning with the Title Page. The Title Page should contain the full title of the manuscript, the full names and affiliations of all authors, a contact address with telephone and fax numbers and e-mail address, and the word count for abstract and for manuscript (excluding title page, abstract, references, tables, and figures). At the top right provide a short title of up to 45 characters preceded by the lead author's last name. Example: Smith-Memory in Parkinson's Disease. This running headline should be repeated at the top right of every following page.

The Abstract and Mesh terms (Keywords) on *page 2* should include a brief statement of the problem, the method, the key findings, and the conclusions. Six mesh or key words should be provided (see http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?db=mesh for list), and they should not duplicate words in the title.

The full text of the manuscript should begin on *page 3*. For scientific articles, including *Regular Research Articles, Brief Communications, Rapid Communications,* and *Symposia,* the format should include an Abstract, Introduction, Method, Results, and Discussion. This should be followed by References, Appendixes, Acknowledgments, Tables, Figures, and Figure Legends.

The use of abbreviations, except those that are widely used, is strongly discouraged. They should be used only if they contribute to better comprehension of the manuscript. Acronyms should be spelled out at first mention. Metric system (SI) units should be used.

Special Note Regarding Figures

Please upload your figure(s) in either a .doc or pdf. format. When uploading figures (color or black and white), they need only be a high enough resolution for the reviewers and editors to identify the information you are trying to convey. However, if your manuscript is accepted for publication, your figures must meet the following criteria:

High quality digital images (600 dpi or higher) should be provided in PDF, EPS, or TIFF formats. If a digital image is not available, please scan in the image. Figures should be numbered consecutively as they appear in the text. Any indication of features of special interest should also be included. Figures should be twice their intended final size and authors should do their best to construct figures with notation and data points of sufficient size to permit legible photo reduction to one column of a two-column format.

Color figures can be accepted. All color graphics must be formatted in CMYK and not in RGB, because 4-color separations cannot be done in RGB. However, the extra cost of printing these figures must be paid by the author: $500 for the first color page, $250 for each color page thereafter.

Tables and figures should be numbered in Arabic numerals. The approximate position of each table and figure should be provided in the manuscript: [INSERT TABLE 1 HERE]. Tables and figures should be on separate pages. Tables should have short titles and all figure legends should be on separate pages.

If you plan to use figures or tables that have been redrawn or modified from other publications, and you are not the copyright holder, please obtain permission for this re-use. Authors should err on the side of caution and seek advice from the editorial office if they are uncertain whether to seek permission.

Financial Support

Please provide details of the sources of financial support for all authors, including grant numbers. For example, "This work was supported by the National Institutes of Health (grant number XXXXXXX)". Multiple grant numbers should be separated by a comma and space, and where research was funded by more than one agency the different agencies should be separated by a semi-colon, with "and" before the final funder. Grants held by different authors should be identified as belonging to individual authors by the authors' initials. For example, "This work was supported by the Wellcome Trust (A.B., grant numbers XXXX, YYYY), (C.D., grant number ZZZZ); the Natural Environment Research Council (E.F., grant number FFFF); and the National Institutes of Health (A.B., grant number GGGG), (E.F., grant number HHHH)." Where no specific funding has been provided for research, please provide the following statement "This research received no specific grant from any funding agency, commercial or not-for-profit sectors."

References

References should be in American Psychological Association, 6th Edition, style (see the examples presented below).

Text references should be cited as follows: ". . . Given the critical role of the prefrontal cortex (PFC) in working memory (Cohen et al., 1997; Goldman-Rakic, 1987; Perlstein et al., 2003a, 2003b) . . ." with multiple references in alphabetical order. Another example is: "For example, Cohen et al. (1994,1997), Braver et al. (1997), and Jonides and Smith (1997) demonstrated . . ." References cited in the text with two authors should list both names. References cited in the text with three, four, or five authors, list all authors at first mention; with subsequent citations, include only the first author's last name followed by et al. References cited in the text with six or more authors should list the first author et al. throughout. In the reference section, list all authors up to seven. For eight or more, list the first six, then three ellipses, and end with the last author's name. Examples of the APA reference style are as follows:

Online/Electronic Journal Article with DOI:
Dikmen, S., Machamer, J. Fann, J. & Temkin, N. (2010). Rates of Symptom Reporting Following Traumatic Brain Injury. *Journal of the International Neuropsychological Society, 16,* 401-411. doi: 10.1017/S1355617710000196

Scientific Article:
Haaland, K.Y., Price, L., & LaRue, A. (2003). What does the WMS-III tell us about memory changes with normal aging? *Journal of the International Neuropsychological Society, 9,* 89-96.

Book:
Lezak, M.D., Howieson, D.B., & Loring, D.W. (2004). *Neuropsychological Assessment.* New York: Oxford University Press.

Book Chapter:
Knopman, D. & Selnes, O. (2003). Neuropsychology of Dementia. In K.M. Heilman & E.E. Valenstein (Ed.), *Clinical Neuropsychology.* New York: Oxford University Press.

Report at a Scientific Meeting:
Rothi, L.J.G. (2003, February). Use-dependent learning and neural plasticity: A revision of the pessimism surrounding neurorehabilitation. International Neuropsychological Society, Honolulu, Hawaii.

Manual, Diagnostic Scheme, etc.:
American Psychiatric Association (1994). *Diagnostic and Statistical Manual of Mental Disorders* (4th ed.). Washington, DC: American Psychiatric Association Press.

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Appendix 2.1: Research ethics committee letter

WoSRES
West of Scotland Research Ethics Service

NHS
Greater Glasgow and Clyde

West of Scotland REC 2
Ground Floor – The Tennent Institute
Western Infirmary
38 Church Street
Glasgow
G11 6NT

Professor Jonathan Evans
Academic Unit of Mental Health & Wellbeing
Gartnavel Royal Hospital
1055 Great Western Road
Glasgow
G12 0XH

Date 25 October 2011

Direct line 0141 211 2102
Fax 0141 211 1847
E-mail Sharon.macgregor@ggc.scot.nhs.uk

Dear Professor Evans

Study title: **Study on the Assessment of Decision Making following traumatic brain injury.**
REC reference: **11/WS/0051**

Thank you for your recent letter received 20th October 2011, responding to the Committee's request for further information on the above research.

The further information has been considered on behalf of the Committee by the Chair.

Confirmation of ethical opinion

On behalf of the Committee, I am pleased to confirm a favourable ethical opinion for the above research on the basis described in the application form, protocol and supporting documentation, subject to the conditions specified below.

Conditions of the favourable opinion

The favourable opinion is subject to the following conditions being met prior to the start of the study.

Management permission or approval must be obtained from each host organisation prior to the start of the study at the site concerned.

Management permission ("R&D approval") should be sought from all NHS organisations involved in the study in accordance with NHS research governance arrangements.

Guidance on applying for NHS permission for research is available in the Integrated Research Application System or at http://www.rdforum.nhs.uk.

Delivering better health
www.nhsggc.org.uk

Where a NHS organisation's role in the study is limited to identifying and referring potential participants to research sites ("participant identification centre"), guidance should be sought from the R&D office on the information it requires to give permission for this activity.

For non-NHS sites, site management permission should be obtained in accordance with the procedures of the relevant host organisation.

Sponsors are not required to notify the Committee of approvals from host organisations

It is the responsibility of the sponsor to ensure that all the conditions are complied with before the start of the study or its initiation at a particular site (as applicable).

Approved documents

The final list of documents reviewed and approved by the Committee is as follows:

Document	*Version*	*Date*
Covering Letter		31 August 2011
GP/Consultant Information Sheets	1	16 August 2011
Investigator CV		
Letter of invitation to participant	1	31 August 2011
Other: CV Student - Julie Nellaney		10 August 2011
Participant Consent Form: Carer/Family Member	1	31 August 2011
Participant Consent Form	1	31 August 2011
Participant Information Sheet	2	04 October 2011
Participant Information Sheet: Non-NHS	2	04 October 2011
Participant Information Sheet: Carer/Family member	2	04 October 2011
Participant Information Sheet: Carer/Family member (Non-NHS)	2	04 November 2011
Protocol	1	31 August 2011
Questionnaire: Validated - UPPS-P		
Questionnaire: HADS		
Questionnaire: UPPS-P Carer/Family		
REC application		02 September 2011
Response to Request for Further Information		
Response to Request for Further Information		

Statement of compliance

The Committee is constituted in accordance with the Governance Arrangements for Research Ethics Committees (July 2001) and complies fully with the Standard Operating Procedures for Research Ethics Committees in the UK.

After ethical review

Reporting requirements

The attached document *"After ethical review – guidance for researchers"* gives detailed guidance on reporting requirements for studies with a favourable opinion, including:

- Notifying substantial amendments
- Adding new sites and investigators

- Notification of serious breaches of the protocol
- Progress and safety reports
- Notifying the end of the study

The NRES website also provides guidance on these topics, which is updated in the light of changes in reporting requirements or procedures.

Feedback

You are invited to give your view of the service that you have received from the National Research Ethics Service and the application procedure. If you wish to make your views known please use the feedback form available on the website.

Further information is available at National Research Ethics Service website > After Review

11/WS/0051	**Please quote this number on all correspondence**

With the Committee's best wishes for the success of this project

Yours sincerely

SMacgregor

for **Dr Sue Langridge**
Chair

Enclosures: "After ethical review – guidance for researchers"

Copy to: *Dr Julie Nellaney, Gartnavel Royal Hospital*
Dr Karen Bell, NHS Ayrshire & Arran

Appendix 2.2: R&D Approval letters

NHS
Greater Glasgow and Clyde

Coordinator/Administrator: Dr Erica Packard/Mrs Elaine O'Neill
Telephone Number: 0141 211 6208
E-Mail: erica.packard@ggc.scot.nhs.uk
Website: www.nhsggc.org.uk/r&d

R&D Management Office
Western Infirmary
Tennent Institute
1st Floor 38 Church Street
Glasgow, G11 6NT,

9 November 2011

Mrs Julie Nellaney
Trainee Clinical Psychologist
Mental Health & Wellbeing
Gartnavel Royal Hospital
1055 Great Western Road
Glasgow G12 0XH

NHS GG&C Board Approval

Dear Mrs Nellaney,

Study Title:	**Study on the Assessment of Decision Making following traumatic brain injury.**
Principal Investigator:	**Mrs Julie Nellaney**
GG&C HB site	**NHS GG&C Community**
Sponsor	**NHS Ayrshire & Arran**
R&D reference:	**GN11LD373**
REC reference:	**11/WS/0051**
Protocol no: (including version and date)	**V1; 31/08/11**

I am pleased to confirm that Greater Glasgow & Clyde Health Board is now able to grant **Approval** for the above study.

Conditions of Approval

1. **For Clinical Trials** as defined by the Medicines for Human Use Clinical Trial Regulations, 2004
   a. During the life span of the study GGHB requires the following information relating to this site
      i. Notification of any potential serious breaches.
      ii. Notification of any regulatory inspections.

It is your responsibility to ensure that all staff involved in the study at this site have the appropriate GCP training according to the GGHB GCP policy (www.nhsggc.org.uk/content/default.asp?page=s1411), evidence of such training to be filed in the site file.

NHS
Greater Glasgow and Clyde

2. **For all studies** the following information is required during their lifespan.
   a. Recruitment Numbers on a quarterly basis
   b. Any change of staff named on the original SSI form
   c. Any amendments – Substantial or Non Substantial
   d. Notification of Trial/study end including final recruitment figures
   e. Final Report & Copies of Publications/Abstracts

Please add this approval to your study file as this letter may be subject to audit and monitoring.

Your personal information will be held on a secure national web-based NHS database.

I wish you every success with this research study

Yours sincerely,

Erackard

Dr Erica Packard
Research Co-ordinator

Healthcare Quality, Governance and Standards Unit
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Crosshouse Hospital
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NHS Ayrshire & Arran

Mrs Julie Nellaney
Trainee Clinical Psychologist
University of Glasgow
Dept of Psychological Medicine
Admin Building
Gartnavel Royal Hospital
1055 Great Western Road
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G12 0XH

Date: 8 November 2011
Your Ref:
Our Ref: CAW/KLB/NM R&D 2011AA068

Enquiries to: Karen Bell
Extension: 25850
Direct Line: 01563 825850
Email: Karen.bell@aaahl.scot.nhs.uk

Dear Mrs Nellaney

Study on the Assessment of Decision Making following traumatic brain injury

I confirm that NHS Ayrshire and Arran have reviewed the undernoted documents and grant R&D Management approval for the above study.

Approved documents:

Document	Version	Date
SSI Form	Version 3.2	28/09/11 signed
R&D Form	Version 3.2	16/09/11 signed
Consent Form - Carer	Version 1.0	31/08/11
Consent Form – Participant	Version 1.0	31/0811
GP Letter	Version 1.0	16/08/11
Information Sheet - Carer (non NHS)	Version 2.0	04/10/11
Information Sheet - Carer	Version 2.0	04/10/11
Information Sheet - Participant (non NHS)	Version 2.0	04/10/11
Information Sheet - Participant	Version 2.0	04/10/11
Letter of Invitation	Version 1.0	31/08/11
HADS questionnaire	No version	No date
Questionnaire - UPPS-P	No version	No date

The terms of approval state that the investigator authorised to undertake this study within NHS Ayrshire & Arran is: -

- Mrs Julie Nellaney, NHS Ayrshire and Arran

With no additional investigators.

The sponsors for this study are NHS Ayrshire and Arran.

This approval letter is valid until 8 October 2012.

Regular reports of the study require to be submitted. Your first report should be submitted to Dr K Bell, Research & Development Manager in 12 months time and subsequently at yearly intervals until the work is completed.

Please note that as a requirement of this type of study your name, designation, work address, work telephone number, work e-mail address, work related qualifications and whole time equivalent will be held on the Scottish National Research Database so that NHS R&D staff in Scotland can access this information for purposes related to project management and report monitoring.

In addition approval is granted subject to the following conditions: -

- All research activity must comply with the standards detailed in the Research Governance Framework for Health and Community Care www.cso.scot.nhs.uk/publications/ResGov/Framework/RGFEdTwo.pdf and appropriate statutory legislation. It is your responsibility to ensure that you are familiar with these, however please do not hesitate to seek further advice if you are unsure.

- You are required to comply with Good Clinical Practice (ICH-GCP guidelines may be found at www.ich.org/LOB/media/MEDIA482.pdf), Ethics Guidelines, Health & Safety Act 1999 and Data Protection Act 1998.

- If any amendments are to be made to the study protocol and or the Research Team the Researcher must seek Ethical and Management Approval for the changes before they can be implemented.

- The Researcher and NHS Ayrshire and Arran must permit and assist with any monitoring, auditing or inspection of the project by the relevant authorities.

- The NHS Ayrshire and Arran Complaints Department should be informed if any complaints arise regarding the project and the R&D Department must be copied into this correspondence.

- The outcome and lessons learnt from complaints must be communicated to funders, sponsors and other partners associated with the project.

- As custodian of the information collated during this research project you are responsible for ensuring the security of all personal information collated in line with NHS Scotland IT Security Policies, until the destruction of these data. Under no circumstances should personal data be stored on any unencrypted removable media e.g. laptop, USB or mobile device (for further information and guidance please contact the Information Governance Team based at Ailsa Hospital 01292 513693 or 513694).

If I can be of any further assistance please do not hesitate to contact me. On behalf of the department, I wish you every success with the project.

Yours sincerely

Professor Craig A White
Assistant Director (Healthcare Quality, Governance and Standards)

c.c. Dr Paul Mattison, Consultant in Rehabilitation Medicine, Ayrshire Central Hospital
Dr Rani Sinnak, Consultant Clinical Psychologist, Ayrshire Central Hospital
Professor Jonathan Evans, University of Glasgow (Academic Supervisor)
Sharon Mulhern, Psychologist, Ayrshire Central Hospital
Lesley Douglas, Finance, Ailsa Hospital
Information Governance, Ailsa Hospital
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Director:

Professor David E Newby

CPP/MJ/approval

10 November 2011

Mrs Julie Nellaney
Academic Unit for Mental Health and Wellbeing
Gartnavel Royal Hospital
1055 Great Western Road
Glasgow
G12 0XH

Dear Mrs Nellaney,

Lothian R&D Project No: **2011/P/PSY/22**

Title of Research: Study on the Assessment of Decision Making following traumatic brain injury.

REC No: 11/WS/0051

CTA No: N/A **Eudract:** N/A

PIS: Version 2 dated 4 October 2011 **Consent:** Version 1 dated 31 August 2011

Protocol No: Version 1 dated 31 August 2011

I am pleased to inform you that this study has been approved for NHS Lothian and you may proceed with your research, subject to the conditions below. This letter provides Site Specific approval for NHS Lothian.

We note that this project includes researchers who will require a Clinical Research Access letter from NHS Lothian. The individuals concerned should contact our offices with a view to applying for the necessary documentation. **Please note all final paperwork will have to be signed and returned to our R&D offices before a researcher can commence work on the project.**

Please note that the NHS Lothian R&D Office must be informed if there are any changes to the study such as amendments to the protocol, recruitment, funding, personnel or resource input required of NHS Lothian. This includes any changes made subsequent to management approval and prior to favourable opinion from the REC.

Substantial amendments to the protocol will require approval from the ethics committee which approved your study and the MHRA where applicable.

Please inform this office when recruitment has closed and when the study has been completed.

I wish you every success with your study.

Yours sincerely

CPhillips

Dr Christine P Phillips
Deputy R&D Director

cc Paul Dearie, QA Manager
Stewart Morgan, NRS

Appendix 2.3: Participant Injury Information

Participant no.	Severity of injury/detail if provided	Cause of injury	Time since injury
1	Severe. GCS 4, GOSE 4.	Fell down stairs	17 months
2	Unknown	Unsure	16 months
3	Severe. PTA 3 weeks.	Fall from ladder	9 months
4	Unknown	Hit by bus	7 years
5	Severe.	Fall from ladder	
6	Unknown	Hit with bottle. Intervening in assault	18 months
7	Unknown	Car accident	8 months
8	Severe. PTA 1 week.	Fell playing football	6 months
9	Severe. Enduced coma for 6 weeks.	Motorcycle accident. Knew about faulty breaks..	30 months
10	Severe.	Assaulted	7 years
11	Severe.	Car accident	21 years
12	Severe.	Unsure.	7 months
13	Unknown	Assaulted	8 years
14	Severe. Coma 3 months.	Motorcycle accident. No helmet, excess speed.	16 years
15	Moderate/severe. LOC = 24 hours.	Fell from ladder	18 months
16	Mild. GCS 15,GOSE 6.	Fell from window	8 years
17	Severe. LOC 10 days.	Assaulted	4 years
18	Severe. GCS 3.	Knocked off bike by car.	16 months
19	Severe. ICU/life support 3 months.	Car accident	13 years
20	Severe. LOC 4 weeks.	22 ft fall from roof	18 months
21	Severe. Subdural evacuation.	Assaulted	6 months
22	Severe. 5 week coma.	Car accident. Country road, car stuck under	18 months

		lorry.	
23	Severe. 9.5 month rehabilitation.	Assaulted	6.5 years
24	Severe. PTA 3 months.	Hit by car. Car mounted pavement.	4 years
25	Severe. GCS 3.	Assaulted	8 years
26	Unknown	Car accident	11 years
27	Severe. PTA 7 days.	Car accident	3 years
28	Severe. 3.5 month coma.	Car accident	6 years
29	Unknown	Unknown	1.3 years
30	Unknown	30 foot fall	4 years

Appendix 2.4: UPPS Impulsive Behaviour Scale

UPPS

Below are a number of statements that describe ways in which people act and think. For each statement, please indicate how much you agree or disagree with the statement. If you **Agree Strongly** circle **1**, if you **Agree Somewhat** circle **2**, if you **Disagree somewhat** circle **3**, and if you **Disagree Strongly** circle **4**. Be sure to indicate your agreement or disagreement for every statement below. Also, there are a few more questions on the next page

	Agree Strongly	Agree Some	Disagree Some	Disagree Strongly
1. I have a reserved and cautious attitude toward life.	1	2	3	4
2. I have trouble controlling my impulses.	1	2	3	4
3. I generally seek new and exciting experiences and sensations.	1	2	3	4
4. I generally like to see things through to the end.	1	2	3	4
5. My thinking is usually careful and purposeful.	1	2	3	4
6. I have trouble resisting my cravings (for food, cigarettes, etc.).	1	2	3	4
7. I'll try anything once.	1	2	3	4
8. I tend to give up easily.	1	2	3	4
9. I am not one of those people who blurt out things without thinking.	1	2	3	4
10. I often get involved in things I later wish I could get out of.	1	2	3	4
11. I like sports and games in which you have to choose your next move very quickly.	1	2	3	4
12. Unfinished tasks really bother me.	1	2	3	4
13. I like to stop and think things over before I do them.	1	2	3	4
14. When I feel bad, I will often do things I later regret in order to make myself feel better now.	1	2	3	4
15. I would enjoy water skiing.	1	2	3	4
16. Once I get going on something I hate to stop.	1	2	3	4
17. I don't like to start a project until I know exactly how to proceed.	1	2	3	4
18. Sometimes when I feel bad, I can't seem to stop what I am doing even though it is making me feel worse.	1	2	3	4
19. I quite enjoy taking risks.	1	2	3	4
20. I concentrate easily.	1	2	3	4
21. I would enjoy parachute jumping.	1	2	3	4
22. I finish what I start.	1	2	3	4
23. I tend to value and follow a rational, "sensible" approach to things.	1	2	3	4

Please go to the next page

	Agree Strongly	Agree Some	Disagree Some	Disagree Strongly
24. When I am upset I often act without thinking.	1	2	3	4
25. I welcome new and exciting experiences and sensations, even if they are a little frightening and unconventional.	1	2	3	4
26. I am able to pace myself so as to get things done on time.	1	2	3	4
27. I usually make up my mind through careful reasoning.	1	2	3	4
28. When I feel rejected, I will often say things that I later regret.	1	2	3	4
29. I would like to learn to fly an airplane.	1	2	3	4
30. I am a person who always gets the job done.	1	2	3	4
31. I am a cautious person.	1	2	3	4
32. It is hard for me to resist acting on my feelings.	1	2	3	4
33. I sometimes like doing things that are a bit frightening.	1	2	3	4
34. I almost always finish projects that I start.	1	2	3	4
35. Before I get into a new situation I like to find out what to expect from it.	1	2	3	4
36. I often make matters worse because I act without thinking when I am upset.	1	2	3	4
37. I would enjoy the sensation of skiing very fast down a high mountain slope.	1	2	3	4
38. Sometimes there are so many little things to be done that I just ignore them all.	1	2	3	4
39. I usually think carefully before doing anything.	1	2	3	4
40. Before making up my mind, I consider all the advantages and disadvantages.	1	2	3	4
41. In the heat of an argument, I will often say things that I later regret.	1	2	3	4
42. I would like to go scuba diving.	1	2	3	4
43. I always keep my feelings under control.	1	2	3	4
44. I would enjoy fast driving.	1	2	3	4
45. Sometimes I do impulsive things that I later regret.	1	2	3	4

Appendix 2.5: Participant Information Sheet

Academic Unit of Mental Health and Wellbeing
Academic Centre
Gartnavel Royal Hospital
1055 Great Western Road
G12 0XH

Study on the Assessment of Decision Making following traumatic brain injury

Participant Information Sheet

We would like to invite you to take part in a research study. Before you decide you need to understand why the research is being done and what it would involve for you. Please take time to read the following information carefully. Talk to others about the study if you wish. Ask us if there is anything that is not clear or if you would like more information.

Who is conducting the research?

The research is being carried out by Julie Nellaney and Professor Jon Evans from the Department of Psychological Medicine.

What is the purpose of the study?

This project looks at the effect of brain injury on decision making. After brain injury, people sometimes say that it is harder to make decisions. Some people find that they are a bit more impulsive than they used to be, perhaps acting before thinking things through. For most people this is not a major problem, but for some this can cause difficulties in everyday life. In order to help people who may be having difficulties of this sort we need ways we can assess these difficulties so that we can understand them better. We are currently investigating whether a new computerised task can help us assess this type of decision making. We are looking for people with traumatic brain injury to help with this research. For this project we need people who don't have difficulties with this sort of decision making as well as people who may have these sorts of difficulties.

Why have I been invited?

You have been invited to take part in this study as you have experienced a traumatic brain injury and are between 18 and 65 years of age.

Do I have to take part?

No, it is up to you to decide. We will describe the study to you and go through this information sheet, which we will then give to you. You will be asked to sign a consent form to show you have agreed to take part. You are free to withdraw at any time, without giving reason. This would not affect the standard of care you receive or your future treatment.

After you have been provided with the information sheet and you have had the opportunity to read it and think about whether you want to participate, if you have not responded already then a member of the clinical team may ask you at your next appointment (on one occasion only) whether you have received the information and remind you that if you want any further information about the study you can return the reply slip and the researcher will contact you to answer any questions. This is because people who have a brain injury may have difficulties with memory that may make them more likely to forget to respond to a letter even though they had intended to do so.

What does taking part involve?

Taking part involves participating in approximately 2 hours of assessment. This will include a variety of tasks such as completing questionnaires (one asking about mood and one asking questions about how you make decisions), paper and pen style tasks (for example completing puzzles, memory and language tasks). There are also 2 computer tasks which will ask you to make simple decisions and work out what you think might be the best approach to a scenario. The computer tasks are quite similar to computer games, but you do not need any previous knowledge of using computers or playing computer games.

You can have a break half way through testing and at any other time if required.

The information gained from this assessment will be passed on to the team responsible for your rehabilitation and can be used to inform the content of your rehabilitation. With your permission we will also inform your GP that you are taking part in the study.

We will also ask a family member or carer questions regarding your injury and will ask them to complete a short questionnaire. Whilst this information is useful to gain, you will still be able to participate in the study even if they do not wish to answer these questions.

What happens to the information?

Your identity and personal information will be completely confidential and known only to the researcher. The information obtained will remain confidential and stored within a locked filing cabinet. The data are held in accordance with the Data Protection Act, which means that we keep it safely and cannot reveal it to other people, without your permission.

If we publish any findings from the study, this will be in the form where your results are combined with those of many other people and averagescores are presented. We take very special care not to publish any details that could lead to an individual being identified.

What are the possible benefits of taking part?

Our aim is to improve understanding about the best way to assess impulsive decision making following traumatic brain injury and by taking part in this research you are helping in this process.

It is also hoped that by taking part in this research, you will be providing valuable information regarding your own rehabilitation, as relevant information can be passed on to the clinical team involved in your care.As mentioned above, impulsive behaviour can have a big impact on every daylife, therefore being aware of it gives us an opportunity to consider it in rehabilitation.

Who has reviewed the study?

This study has been reviewed by Research and Development Departments in NHS Ayrshire and Arran, NHS Greater Glasgow and Clyde and NHS Lothian. It has also been reviewed by the Local Research Ethics Committee.

If you have any further questions?

We will give you a copy of the information sheet and signed consent form to keep. If you would like more information about the study and wish to speak to someone not closely linked to the study, please contact Denyse Kersel, Clinical Director, Community Treatment Centre for Brain Injury on 0141 300 6313 or denyse.kersel@ggc.scot.nhs.uk.

If you have a complaint about any aspect of the study?

If you are unhappy about any aspect of the study and wish to make a complaint, please contact the researcher in the first instance but the normal NHS complaint mechanisms is also available to you.

Contacts:

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Appendix 2.6: Participant Consent Form

Academic Unit of Mental Health and Wellbeing
Academic Centre
Gartnavel Royal Hospital
1055 Great Western Road
G12 0XH

Participant Consent Form

Study on the Assessment of Decision Making following traumatic brain injury

	Please initial the BOX
I confirm that I have read and understand the information sheet dated XX/XX/XXXX (version X) for the above study and have had the opportunity to ask questions.	☐
I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason, without my medical care or legal rights being affected.	☐
I understand that sections of my medical notes may be looked at by the research team where it is relevant to my taking part in the research. I give my permission for the research team to access my records.	☐
I give permission for a family member to be asked questions regarding my injury and to complete a short questionnaire.	☐
I give permission for my GP to be informed that I am taking part in the current study.	
I consent to the results of this study being summarised in a document and being provided to the team in charge of my care.	☐
I agree to participate in the study.	☐

Name of Participant Date Signature

Name of Researcher Date Signature

Appendix 2.7: Major Research Proposal

Study on the Assessment of Decision Making following traumatic brain injury

Abstract: Impulsive behaviour is a well recognised feature in patients following traumatic brain injury (TBI). Despite the prevalence of these behaviours and their social and economic costs, there has been a lack of research on the construct of impulsivity and it is particularly sparse in the TBI literature. Studies examining impulsivity in relation to TBI confirm that impulsivity is higher in patients with TBI than in control participants. Impulsivity was related to a preference for a smaller reward that could be obtained immediately rather than a larger reward that could be obtained after a delay. Research has highlighted the need to measure impulsivity in a variety of ways, and not to rely on rating scales alone, leading to the development of behavioural tasks with more ecological validity. A recently developed virtual reality procedure termed the Secret Agent Task attempts to fill the gapin ecologically valid procedures which can be used to investigate impulsivity/risk taking. The aim of this study is to examine whether the test is sensitive to impulsivity in a group of participants following traumatic brain injury. This has important implications for patient rehabilitation and treatment.

Introduction

Impulsive behaviour is a well recognised feature in patients following traumatic brain injury (TBI) (Hornack, Rolls & Wade, 1996; Kolitz, Vanderploeg& Curtiss, 2003; McAllister 2008) that has important implications for rehabilitation and patient safety. Impulsive persons with TBI are more likely than non impulsive patients to demonstrate irritable or aggressive behaviour and poor decision making abilities (McAllister, 2008; Wood, 2001). In addition to negatively impacting rehabilitation processes and increases in cost of healthcare, such behaviours also impact more broadly on social outcomes following the TBI, such as interpersonal relationships and employment (Wood, 2001). Despite the prevalence of these behaviours and their social and economic costs, there has been a lack of research on the construct of impulsivity and it is particularly sparse in the TBI literature (Rochat et al, 2010). A study by Whiteside and Lynam (2001) examined the multidimensional aspect of impulsivity by using a well-established, comprehensive model of personality: the Five Factor Model (FFM) of personality as assessed by the Revised NEO Personality Inventory (NEO-PI-R; Costa and McCrae, 1992) which measure higher order factors of personality. Whiteside and Lynam (2001) argue that that although some impulsivity traits result in similar overt behaviours (i.e. acting without forethought), their aetiologies may be different. They conducted a factor analysis on several widely used measures of impulsivity and the facets of the NEO-PI-R related to impulsivity and found a four factor solution. The four components of impulsivity they identified were labelled urgency (the tendency to experience strong reactions, frequently under conditions of negative affects); (lack of) premeditation (the tendency to think and reflect on the consequences of an act before engaging in that act); (lack of) perseverance (the ability to remain focused on a task that may be boring or difficult); and sensation seeking (the tendency to enjoy and pursue activities that are exciting, and openness to trying new experiences). They then selected the items with the highest loadings on each factor to create the UPPS Impulsive Behaviour Scale. Each of the four factors of impulsivity strongly correlated with a specific factor of the NEO-PI-R.

Research has been carried out in relation to decision making and inhibitory control, and the brain structures involved in these functions. This has been investigated using reward-choice paradigms such as the Iowa Gambling Test (IGT, Bechara et al., 1994, 2000b), in which subjects use feedback to determine their selection of cards that might win or lose them money. Studies indicate that patients with ventromedial prefrontal lesions are unable to use somatic cues to guide decision making on the basis of recent experience or in conditions of uncertainty (Bechara et al, 1999, 2003). Poor performance on the IGT has been associated with lesions involving the ventromedial prefrontal cortex (Bechara et al, 1994, 1996, 1999) or amygdala (Bechara, 1999, 2003). Recent lesion studies suggest the involvement of more extensive structures including the dorsolateral prefrontal cortex for the IGT (Fukui, 2005).

Although research relating to impulsivity and traumatic brain injury is sparse, a recent pilot study by McHugh and Woods (2008) found that self-reported impulsivity, as assessed by the Barratt Impulsiveness Scale-11 (BIS-11; Patton, Stanford and Barrett, 1995), a scale containing three impulsivity factors (non-planning, motor and attentional impulsivity), was higher in patients with TBI than in control participants. Furthermore, using a temporal discounting task, they found that (1) the value of rewards decreased more steeply in patients with TBI than in control participants when the delay to obtain the reward increased and (2) impulsivity was related to a preference for a smaller reward that could be obtained immediately rather than a larger reward that could be obtained after a delay (McHugh and Wood, 2008).

Votruba (2008) highlighted the need to measure impulsivity in a variety of ways, and not to rely on rating scales alone. Rating scales are based on retrospective recall of behaviours by either the patient, clinician or carer, and therefore they are susceptible to a variety of biases and distortions associated with faulty recall. There have been pushes made to develop tasks which tap into real-life aspects of behaviour and thus have more ecological validity. Whilst there have been a number of definitions of ecological validity, in a neuropsychological context it was defined by Sbordone (1996) as “the functional and predictive relationship between the patients performance on a set of neuropsychological tests and the patients behaviour in a variety of real-world settings”. The IGT is believed

to model real-life decision making and be consistent with construct of cognitive impulsivity. However recently some limitations of the IGT have been proposed which have led to the construct validity and ecological validity of the task being called into question (Buelow&Suhr, 2009). Results in adults have been inconsistent and this may be in part due to evidence which suggests that the risky decision making component of the IGT is more apparent in the later trials of the task compared to the earlier trials. Decisions made during the first block of trials are "decision making under ambiguity" because there has not been time for a participant to experience any of the win/loss contingencies. Selections made during the last block of trials are "decision making under risk", because after many plays participants should have experienced the differing win/loss contingencies enough to know which decks are risky and which are not; thus decisions to play a risky deck at that point would reflect a different decision making process than playing a risky deck earlier in the trial. The difference in type of decision making assessed across trials of the IGT should be considered when collapsing selections across blocks to create a summary score based on total advantageous and disadvantageous selections, and may be related to inconsistencies in research findings when summary scores were used as the IGT dependent variable. Additionally Dunn et al (2006) reported that there is variability in the control data with 20% of healthy control participants performing disadvantageously on the IGT.

A recently developed virtual reality procedure termed the Secret Agent Task (also called The Spook Task) (Young, Gudjonsson& Morris, in preparation) attempts to provide an ecologically valid measure of impulsivity/risk taking. The Secret Agent Task is a behavioural decision-making tool which simultaneously measures a broad range of risk-taking and moral behaviours. The participant is told that s/he is a 'secret agent' and has been parachuted down into enemy territory. The mission is to deliver a message to another secret agent at the end of the game. The participant is asked to try to respond as s/he would in normal life when having to make important decisions and, in order to encourage this, the game requires the participant to multi-task under pressure (having to maintain an 'Energy' score during the task). The four constructs measured in the task are: risk taking (e.g. risk of injury, loss to others); antisocial behaviour; altruism; and

impulsivity. The task has been piloted in board game format with a group of 30 forensic male inpatients detained in a medium secure unit (Young et al, in preparation). It is also currently being validated in a computerised format as a risk assessment tool in 50 mentally disordered patients, 50 personality disordered patients and 50 normal controls. In summary, despite the existence of a number of valid, reliable measures of impulsivity, efforts are being made to develop tasks which tap into real-life aspects of behaviour and thus have more ecological validity. Research has highlighted the importance of measuring impulsivity using a variety of modalities (Vortruba, 2008) and not to rely on questionnaire measures alone. Questionnaires measuring impulsivity often rely on the individual having a reliable informant who can provide information on both their current level of functioning and their pre-morbid functioning, however these responses can be prone to rater biases and not all patients will have a reliable informant. Using behavioural tools provides additional evidence and information to support the formulation process – it offers the clinician the opportunity to observe any difficulties first hand. Behavioural measures provide a means of illustrating to the patient the nature of their difficulties via feedback of their own performance on the task, instead of relying on indirect feedback from relatives. They also provide an objective and engaging means of measuring change over time within a rehabilitation setting.

In the Secret Agent task a virtual reality environment is used to create a format that allows for an interactive environment that should enhance motivation and increase engagement with the assessment process.

Aims

The aim of this study is to examine whether the test is sensitive to impulsivity in a group of participant with traumatic brain injury.

Hypotheses

Primary

1. The scores on UPPS Impulsive Behaviour Scale will correlate with performance on the Secret Agent task.

2. Scores on the Iowa Gambling Task will correlate with scores on the Secret Agent task.

3. Subscales of UPPS will map onto Secret Agent subscales.

    - Urgency **and** (lack of) premeditation on the UPPS Impulsive Behaviour Scale will correlate with Impulsivity subscale on the Secret Agent Task.

    - Sensation seeking will correlate with risk taking on the Secret Agent Task.

Secondary

To examine discriminant validity it would be expected that although performance on a speed of processing task (the digit symbol coding task from the Repeatable Battery for Assessment of Neuropsychological Status) would be reduced compared to norms due to slowed speed of processing following TBI, performance would not be correlated with measures of impulsivity.

Plan of Investigation

Participants

30 participants with traumatic brain injury between 18 and 65 years of age will be recruited from variety of brain injury services.

Inclusion and Exclusion criteria

The study will involve a sample of adults with TBI, ranging from mild to severe. Thus the minimum requirement in terms of severity will be to have suffered an injury to the head resulting in loss of consciousness, loss of memory for events after the injury (post-traumatic amnesia, PTA) or a period of confusion following the injury. Participants will be at least six months post-injury. Participants should be between 18 and 65 years of age. Only participants for whom a significant other could provide information about the participant's current and pre-morbid behaviours will be included in the study.
Patients should have no history of learning difficulties and no disturbance of perceptual, language or motor disorders that could affect their performance on the computer task or the impulsivity questionnaire. Exclusion criteria compromises: psychiatric disorder

(including drug or alcohol abuse), previous neurological conditions, history of physical aggression.

Recruitment procedures

Participants will be recruited from Headway Scotland, the Community Treatment Centre for Brain Injury in Glasgow, Momentum's Vocational Rehabilitation Service, West Dumbarton Acquired Brain Injury Team, Brain Injury Rehabilitation Team (BIRT), Murdostoun Castle Rehabilitation Centre and Douglas Grant Rehabilitiation Centre (Ayrshire).

Verbal and written information about the study will be provided to staff and to potential participants and accompanying carers/family members that will explain the purpose of the study and invite them to participate.

Measures

Demographic information such as age and gender will be gained from participants in order to characterise the sample.

Clinical Measure of severity of injury

In order to characterise the sample further, measures of severity of injury will be recorded including length of period of unconsciousness and length ofPTA, if available. If appropriate we will obtain a retrospective PTA measure based on the participants recollection of post-injury events. In addition the Speed and Capacity of Language Processing Test will be administered as this can provide an indication of change in cognitive processing performance compared to pre-injury estimates.

The *Speed and Capacity of Language Processing Test* (SCOLP).(Baddeley, Emslie, &Nimmo-Smith, 1992).(5 minutes)

This test measures the slowing in cognitive processes that can be experienced by individuals with brain damage. The SCOLP consists of two separate measures: The *Speed of Comprehension Test* allows the rate of information processing to be measured, and the *Spot-the-Word Test* provides a framework for interpreting the results of the first test. SCOLP enables differentiation between a subject who has always been slow and a subject

whose performance has been impaired as a result of brain damage or some other stressor. It is sensitive to the effects of closed head injury, normal aging, Alzheimer's disease, schizophrenia, and to a wide range of drugs and stressors, including alcohol.

Standardised Neuropsychological Tests

Standardised neuropsychological test measures will be administered to all participants in order to describe the sample. The WTAR (Wechsler Test of Adult Reading) will be administered in order to provide information on their pre-morbid level of functioning(10 minutes). The Repeatable Battery for Assessment of Neuropsychological Status (RBANS, Randolph 1998) will be administered as a neurocognitive battery in order to provide information on general neurocognitive deficits. It is a brief battery with four alternate forms, measuring immediate and delayed memory, attention, language, and visuospatial skills. It requires approximately 25 minutes to administer, and is a "pencil-and-paper" test. If the RBANS has been administered recently then we will not repeat this and will use available results.

To examine for anxiety and depression, participants will also be asked to complete the Hospital Anxiety and Depression Scale (Zigmond&Snaith, 1983). (5 minutes)

Measures of impulsivity

1. UPPS Impulsive Behaviour Scale (Whiteside and Lynam, 2001). (5-10 minutes)

   This measures the multidimensional aspect of impulsivity. This scale has high internal consistency (Whiteside and Lynam, 2001) and studies support the construct validity of the four impulsivity-related traits (Whiteside and Lynam, 2001; Whiteside et al, 2005).

   This questionnaire will be administered to patient along with an adapted version for relative. Research has shown that it is important not to rely on patients' point of view of changes or impairment alone because patients' anosognosia could constitute a threat to validity (Rochat et al, 2010). It is therefore helpful to consider a rating completed by caregiver.

2. Secret Agent task. (25 minutes).

(Also called the *Spook Task*; Developed by Young, Gudjonsson& Morris, in preparation)

The Secret Agent task is a behavioural decision-making tool, which simultaneously measures risk-taking and moral behaviour. The task measures four constructs:

- **Risk-taking**. There are 18 risk taking scenarios, where the participant is given the option of taking the low, medium or high risk route. If the participant chooses medium or high risk routes then they are punished and lose points from total score. A risk-taking score is calculated by awarding a score of two points for choosing a high risk route, one point for a medium risk route and 0 points for a low risk route. The higher the score, the higher the risk taking of the participant.

- **Impulsivity**. Measured in two ways. (1) Whether they stop to take food and, (2) how quickly the participant makes a choice of the low, medium or high risk route. The impulsivity (1) measure is scored based on the number of times they stop for food, with an additional sub-measure of the amount of time they spend with their energy below a threshold. The impulsivity (2) measure is scored based on the number of times the participant selects an action option before the options have been fully explained to them.

- **Altruism.** There are 5 altruistic moral dilemma scenarios, for example deciding whether to save a rabbit caught in a trap and lose time or leave the rabbit to die.

- **Anti-social Behaviour**. There are 5 antisocial moral dilemma scenarios, for example deciding whether to take protective clothing from a ranger's hut when it is raining, which could then leave the ranger without the protective clothing needed for a mountain rescue.

Scores on the altruism construct and the anti-social behaviour construct are combined to form a Moral Route (MR) measure. This is a measure of how empathic and pro-social the participant is whilst completing the mission. It is calculated by reversing the anti-social scenarios score, and adding it to the altruistic scenarios score in order to give a total MR score. The higher the MR score, the more moral (pro-social) behaviours the participant showed.

3. Iowa Gambling Task (Bechara et al., 1994) (20minutes)

The IGT was developed to simulate real-life financial decisions (Bechara et al., 1994) and is consistent with constructs of cognitive impulsivity. It is based on a long exploratory learning process to evaluate long-term risk anticipation in decision making. It is also strongly influenced by emotional factors related to rewards and penalties. The task goal is to maximise the profit from a loan of play money. Subjects are required to make a series of 100 card selections from one of four card decks (A, B, C & D) and each selection is followed by a showdown of a reward and a penalty. The reward/penalty schedules are predetermined: Deck A and B yield high immediate rewards but carry a risk of much higher long-term penalties, which will results in total loss in the long run (disadvantageous decks); Decks C and D yield low immediate rewards but smaller long-term penalties, which will result in long-term gain (advantageous decks). After the task, subjects are asked about which decks they thought were advantageous. A computerised version of the task has since been developed (Fukui et al., 2005)

Discriminant validity

The digit symbol coding task from RBANS will be used to explore discriminant validity. A successful evaluation of discriminant validity shows that a test of a concept is not highly correlated with other tests designed to measure theoretically different concepts. It would be expected that although performance on the digit symbol coding task would be slower than normal due to the individual experiencing a slower speed of processing following TBI, performance would not be correlated to impulsivity.

Design

A cross-sectional design will be used to investigate whether results on questionnaire measures significantly correlate with performance on the behavioural tasks measuring impulsivity in individuals with traumatic brain injury. Other exploratory analyses will be carried out in order to investigate correlations between the different measures.
Presentation of the tasks will be counterbalanced across participants.

Research procedures

We aim to meet with each participant on one occasion, the session lasting approximately 2 hours (with appropriate breaks provided).
The tests will be administered in the following order:

1. WTAR
2. HADS
3. SCOLP
4. Secret Agent Task*
5. RBANS
6. Iowa Gambling Task*
7. UPPS Impulsive Behaviour Scale

The order of the Secret Agent task and the Iowa Gambling task will be counterbalanced; half of the participants will be administered the Secret Agent task first, and the other half will complete the IGT first. This is due to the fact that participants will be exposed to negative feedback during the tasks and may subsequently take a more cautious approach on the next task.
If participants have completed any of the tasks/tests in the last 6 months then those results will be used instead and the test will not be repeated.

Justification of sample size

McHugh and Woods (2008) used a temporal discounting paradigm to measure decision making and impulsivity following TBI. They found that the TBI group demonstrated more impulsive decision making than controls. A standardised measure of impulsivity (the Barrett Impulsivity Scale - BIS II) was employed to compare performance on the discounting task against an alternative measure of impulsivity. They found a significant negative correlation between the delayed discounting task and their score on the BIS II ($r=-0.34$, $p<0.001$), indicating that steeper discounting of the larger reward by participants was related to higher levels of impulsivity as measured by BIS II. They used a sample size of 34 participants and a matched control group (matched for age and years of education with the patient group).

There are few studies to draw on which compare performance of a brain injured sample on specific measures of impulsivity and performance on a virtual reality (VR) task. However there are studies of relevance in studies which relate to global executive function. Knight et al (2002) found medium-large effect sizes ($r=0.46$ and -0.46) between performance measures of the Multiple Errands Test (MET-HV) and DEX scores. Rand et al (2009) found significant correlations between Virtual Multiple Errands Test (VMET) and Instrumental Activities of Daily Living Questionnaire in a post-stroke sample. They found a large effect size ($r=-0.82$) with a sample of 9 post-stoke patients and 40 healthy participants. Lamberts et al (2010) found medium effect size ($r=0.31$) between informant DEX scores and performance on Executive Secretarial Task (EST) in patient group which consisted of 35 brain injured participants.

The MET-HV and EST are considered “naturalistic” assessment measures as opposed to virtual reality measures. Given the increased methodological rigour entailed in VR methodology, there is reason for assuming that the correlation between a specific VR measure such as the Secret Agent Task and impulsivity ratings as measured by other established impulsivity measures in a head injured sample will provide a medium-large effect size in the present study. Therefore for the proposed study an effect size of $r=0.45$ is estimated. Using the G-Power statistical package (Faul, Erdfelder, Buchner, and Lang, 2009) and based on previous findings, it was calculated that if a medium- large effect size

(r = 0.45) is present, undertaking a one-tailed correlation, with power at 0.80 and alpha error at 0.05, a total of 29 participants are required.

Our power calculation is based upon correlation of relatives/carers rating of patients impulsivity on the UPPS Impulsive Behaviour Scale and performance on the Secret Agent Task. In the studies mentioned above the effect sizes are based on the participants rating or performance on all questionnaires or tasks and not the relative/carer rating.

Settings and equipment

A laptop will be required for completion of the Secret Agent Task. Other measures will be administered using paper and pen format.

Data analysis

Correlational analyses will be carried out between subscales of interest in the UPPS Impulsive Behaviour Scale, the IGT and the Secret Agent Task.

Correlations between measures

Correlational analyses will be carried out between the scores on the UPPS Impulsive Behaviour Scale and the scores on the Secret Agent task (Primary hypothesis 1), using Pearson's correlation coefficient or Spearman's Rank Order correlations if parametric assumptions are violated. Similar analyses will be carried out between scores on the IGT and scores on the Secret Agent task (Primary hypothesis 2).

Correlations between individual tasks or subscales

Correlational analyses will be carried out between individual subscales of UPPS Impulsive Behaviour Scale in order to test whether the hypothesised subscales map onto subscales of Secret Agent task (Primary hypothesis 3). Similar analyses will be carried out on scores from the digit symbol coding task and measures of impulsivity (Secondary hypothesis 1).

Health and Safety Issues

Researcher safety issues

Consideration has been taken for how to deal with participants who may become frustrated or aggressive during testing. It is unlikely that aspects of testing within this

study would provoke an aggressive response, however any potential participants with a history of physical aggression will be excluded from participation in the study.
Rooms will be provided within the various centres. Within the room where assessment is carried out the usual precautions will be taken, such as the clinician sitting nearest the door. Other staff will also be available for support if required

Participant safety issues

Careful acknowledgement has been taken for the potential strain which 2 hours of testing may inflict on TBI patients. This has been considered in terms of breaks during testing, and as with all neuropsychological testing, reassuring the participant that they can discontinue at any time.

Ethical Issues

Participants will be asked if they wish to participate in the study and their consent will be presumed on their decision to do so. Their capacity to make such a decision will be further confirmed by the appropriate clinician/manager within their service. For each patient a document/file will be made of their results (if the patient consents) and this will be passed on to the clinical team involved in their care. This document will be used to inform their rehabilitation.
The testing session of approximately 2 hours may be challenging for some adults with TBI so a break will be offered in the middle of the session. If participant looks uncomfortable or distressed by the procedure, they will offered additional breaks or asked if they would like to discontinue testing. The length of the session and purpose of the study will be explained to all participants and written consent will be obtained prior to commencing testing.

Financial issues

Separate costing sheet completed.

Timetable

- 2 page outline to supervisor for 3rd December 2010
- Draft proposal for 31st January 2011.
- Proposal for 16th May 2011.
- Systematic Review outline for 26th August 2011.
- September 2011 (or before) application to Ayrshire and Arran ethics committee
- October 2011 to March 2012. Data collection
- April 2012 to July 2012. Data analysis and write up,

References

AD, Emslie H &Nimmo-Smith I (1992) *The Speed and Capacity of Language Processing(SCOLP) Tes*t. Bury St Edmunds: Thames Valley Test Company.

Bechara, A., Damasio, A. R., Damasio, H., Anderson, S. W. (1994). Insensitivity to future consequences following damage to prefrontal cortex. *Cognition, 50,* 7-15.

Bechara, A., Damasio, H., Damasio, A. R., & Lee, G. P. (1999).Different contributions of the human amygdala and ventromedial prefrontal cortex to decision making.*Journal of Neuroscience, 19,* 5473-5481.

Bechara, A., et al. (2000b). Characterization of the decision-making deficit of patients with ventromedial prefrontal cortex lesions. *Brain, 123,* 2189-2202.

Bechara, A., Damasio, H., Damasio, A. R.(2003). Role of the amygdala in decision making. Annals of the New York Academy of Sciences, 985, 356-369.

Buelow, M. T &Suhr, J.A (2009). Construct Validity of the Iowa Gambling Task. *Neuropsychology Review, 19*(1), 102-114.

Costa, P. T., & McCrae, R. R. (1992). Revised NEO Personality Inventory (NEO-PI-R) and NEO Five-Factor Inventory (NEO-FFI): Professional Manual. Odessa, FL: Psychological Assessment Resources.

Dunn, B. D., Dalgleish, T., & Lawrence, A. D. (2006). The somatic marker hypothesis: A critical evaluation. *Neuroscience and Biobehavioral Reviews, 30,* 239-271.
Faul, F., Erdfelder, E., Buchner, A., & Lang, A. G. (2009). Statistical power analyses using G*Power 3.1: Tests for correlation and regression analyses. *Behavior Research Methods,41,* 1149-1160.

Fukui, H., Murai, T., Fukuyama, H., et al. (2005). Functional activity related to risk anticipation during performance the Iowa gambling task. *NeuroImage, 24*, 253-259.

Hornack, J., Rolls, E. T., & Wade, D. (1996). Face and voice expression identification in patients with emotional and behavioural changes following ventral frontal lobe damage. *Neuropsychologia, 34,* 247-261.

Knight, C., Alderman, N., & Burgess, P. W.(2002). Development of a simplified version of the multiple errands test for use in hospital settings.*Neuropsychological Rehabilitation, 12(3),* 231-255.

Kolitz, B. P., Vanderploeg, R. D., &Curtiss, G. 2003. Development of the Key Behaviours Change Inventory: A traumatic brain injury behavioural outcome assessment instrument. *Archives of Physical Medicine and Rehabilitation, 84,* 277-284.

Lamberts, K. F., Evans, J. J., &Spikman, J. M. (2010). A real-life, ecologically valid test of executive functioning: The Executive Secretarial Task. *Journal of Clinical and Experimental Neuropsychology, 32(1),* 56-65.

McAllister, T. W. (2008). Neurobehaviouralsequelae of traumatic brain injury: Evaluation and management. *World Psychiatry, 7,* 3-10.

McHugh, L., & Woods, R. L. (2008). Using a temporal discounting paradigm to measure decision-making and impulsivity following traumatic brain injury: A pilot study. *Brain Injury, 22,* 715-721.

Patton, J. H., Stanford, M. S., & Barrett, E. S. (1995). Factor structure of the Barratt Impulsiveness Scale. Journal of Clinical Psychology, 51, 768-774.

Rand, D., Basha-Abu Rukan, S, Weiss,P. L., & Katz, N. (2009). Validation of the virtual MET as an assessment tool for executive functions. *Neuropsychological Rehabilitation, 19*, 583-602.

Randolph, C. (1998). Repeatable Battery for the Assessment of Neuropsychological Status (RBANS). San Antonio: Harcourt, TX: The Psychological Corporation.
Randolph, C., Tierney, M. C., Mohr, E., & Chase, T. N. (1998). The Repeatable Battery for the Assessment of Neuropsychological Status (RBANS): preliminary clinical validity. *J ClinExpNeuropsychol, 20*(3), 310-319.

Rochat, L., Beni, C., Billieux, J., Azouvi, P., Annoni, J., & Van der Linden. (2010). Assessment of impulsivity after moderate to severe traumatic brain injury. *Neuropsychological Rehabilitation, 20(5),* 778-797.

Sbordone, R. J. (1996). Ecological validity: Some critical issues for the neuropsychologist. In R. J. Sbordone,& C. J. Long (Eds.), *Ecological validity of neuropsychological testing* (pp. 15–41). Delray Beach, FL: GR Press/St. Lucie Press.

Votruba, K. L., Rapport, L. J., Vangel, S. R., Jr., Hanks, R. A., Lequerica, A., Whitman, R. D., et al. (2008). Impulsivity and traumatic brain injury: The relations among behavioural observation, performance measures, and rating scales. *Journal of Head Trauma Rehabilitation, 23*, 65-73.

Whiteside, S. P &Lynam, D. R. (2001). The Five Factor Model and impulsivity: using a structural model of personality to understand impulsivity. *Personality and Individual Differences, 30*, 669-689.

Wood, R. L. (2001). Understanding neurobehavioral disability. In R. L. Wood & T. M. McMillan (Eds), *Neurobehavioural disability and social handicap following traumatic brain injury* (pp. 1-28). Hove, UK: Psychology Press.

Yechiam, E., et al. (2008). Neurocognitive deficits related to poor decision making in people behind bars. *Psychonomic Bulletin and Review, 15*(1), 44-51.

Young, S.,Gudjonsson& Morris (in preparation).A simulated test of moral dilemmas and risk-taking ('SPOOK') and its relationship with personality.

Zigmond, A. S., &Snaith, R. P. (1983). The hospital anxiety and depression scale. *ActaPsychiatrScand, 67*(6), 361-70.