Inhibitory Control Training and Disruptive Behaviour in Young People

Submitted by Joanna Green, to the University of Exeter

as a thesis for the degree of Doctor of Clinical Psychology, May 2017

I certify that all material in this thesis which is not my own work has been identified and that no material has previously been submitted and approved for the award of a degree by this or any other University.

Signature: ……..

Table of Contents

List of Tables

Literature review

Empirical paper

List of Figures

Literature review

Empirical Paper

SCHOOL OF PSYCHOLOGY

DOCTORATE IN CLINICAL PSYCHOLOGY

LITERATURE REVIEW

The Use of Inhibitory Control Measurement in Studies of Interventions Targeting Externalising Behaviour: A Systematic Review

Trainee Name:	**Joanna Green**
Primary Research Supervisor:	**Doctor Jennifer Limond** Consultant Clinical Neuropsychologist, College of Life and Environmental Sciences
Secondary Research Supervisor:	**Professor Huw Williams** Associate Professor of Clinical Neuropsychology, College of Life and Environmental Sciences
Target Journal:	Neuropsychological Rehabilitation (see Appendix B for instructions for authors)
Word Count:	3992 words (excluding abstract, table of contents, list of figures, tables, figures, captions for tables and figures, references, footnotes, appendices)

Submitted in partial fulfilment of requirements for the Doctorate Degree in Clinical Psychology, University of Exeter

Abstract

Background: Adolescence is a crucial time for the development of executive control, including the maturation of inhibitory control (IC) skills. Interventions for young people (YP) who display disruptive, externalising behaviour have the potential for improving IC, however the effectiveness is unknown (Ross & Hoaken, 2010).

Objectives: This literature review explores whether psychosocial interventions for YP displaying externalising behaviour are measuring change in IC and if so what effect is being observed.

Method: Systematic review of all literature to date using EBSCO, Ovid and Cochrane databases with a narrative discussion of the included studies. The critique was guided by the Effective Public Health Practice Project's (EPHPP) "Quality Assessment Tool" (Thomas, Ciliska, Dobbins, & Micucci, 2004).

Results: Thirteen relevant papers were included, consisting of randomised controlled trials, controlled clinical trials and cohort studies. A variety of measures and interventions were reported which demonstrate limited relations between behaviour and IC improvement. However, improvements are observed based on direct measures of IC.

Conclusions: There is a small amount of research that analyses measurement of IC within interventions and further research is required to determine the longevity of effects and the potential for IC improvements.

Keywords: inhibitory control, impulsivity, executive control functions, externalising behaviour.

Introduction

Involvement in disruptive and delinquent, externalised behaviour is common during adolescence (Carroll et al., 2006), however for some young people (YP) this behaviour is persistent and particularly impairing (Riggs, Greenberg, Kusché, & Pentz, 2006). Crucial neuropsychological development occurs during adolescence with maturation of inhibitory control (IC) skills following the development of reward-processing motivational skills (Romer, Betancourt, Brodsky, Giannetta, Yang, & Hurt, 2011). This staggered development results in YP's increased motivation for reward without the full skills to supress their inhibitions or delay gratification and is commonly associated with disruptive behaviour (Carroll et al., 2006). IC is one element of the multifaceted construct of impulsivity which is managed by executive control functions (ECF; Weafer, Baggott, & de Wit, 2013) and includes cognitive (impulsive choice) and behavioural (impulsive automatic action) elements of executive inhibition (Nigg, 2000). Persistent deficits in IC are related to impulsivity, social-skills deficits and behavioural dysregulation manifested as aggression, violence, risk-taking, substance use and gambling (Chen, Muggleton, Juan, Tzeng, & Hung, 2008; Fishbein et al., 2006). The ability to manage impulses and inhibit an inappropriate or unhelpful response by demonstrating restraint is therefore an important functional skill in managing daily life.

Whilst cognitive neurorehabilitation programs for YP with neuropsychological impairments, which specifically focus on improving ECF, have shown promising effects (Riggs et al., 2006), interventions for IC improvement are lacking. However, there are a number of interventions which

target disruptive, externalising behaviour in YP, the majority of which utilise cognitive-behavioural therapy (CBT) frameworks. CBT based interventions aim to reduce disruptive behaviour by modifying the YP's maladaptive thoughts about the world, the self and others and develop social and functional skills (Riggs et al., 2006). This focus on cognitive and behavioural skills and functioning, potentially indirectly target ECF skills (Ross & Hoaken, 2010), however it is unclear if these interventions are having an impact on IC skills. In addition, ECF deficits have the potential to interfere with a YP's capacity to benefit from psychosocial interventions aimed at behavioural modification (Blume, Marlatt, & Schmaling, 2000; Fishbein et al., 2006; Ross & Hoaken, 2010), and it is unclear if IC changes are being considered within the intervention effectiveness literature. If improving ECF, using specifically targeted interventions, has the potential to enable YP to gain greater benefit from existing behavioural interventions (Ross & Hoaken, 2010) it is important to determine what, if any, change is already being measured and reported.

Many behavioural interventions potentially indirectly target improving ECF, impulsivity and IC skills (Riggs et al., 2006), however it is unclear as to which of these abilities are truly being improved (Mullin & Simpson, 2007). Impulsivity is considered a multidimensional construct of ECF and includes behavioural and cognitive elements of inhibitory control, however, the domains or constructs which are incorporated remains unclear (Meda et al., 2009). In addition, a variety of measures of ECF, IC and impulsivity are widely available, including self and third-party reports and direct measures (Meda et al., 2009; Reynolds, Ortengren, Richards, & de Wit, 2006). However, there are conflicting views as to the areas of impulsivity or IC that these tools are measuring

including behaviours of impulsive disinhibition and impulsive decision making (Reynolds, Penfold, & Patak, 2008). This literature review therefore aims to examine if psychosocial interventions for YP displaying disruptive, externalising behaviour are measuring any changes in IC (including as an effect or confound of the intervention and/or due to maturation) and if so, to synthesise the reported effects.

Literature review questions: Are psychosocial interventions targeting YP's externalising behaviours measuring change in IC? If interventions are measuring IC change what effects are being observed and what interventions are these changes attributed to?

Method

A systematic review of the literature was conducted to provide a critical overview of the published evidence. This systematic review was conducted using the 2009 Preferred Reporting Items for Systematic Review and Meta-analysis (PRISMA) reporting protocol (Moher, Liberati, Tetzlaff, & Altman, 2009) as this allows for a standardised non-biased approach to the review.

Inclusion/Exclusion Criteria

Table 1 shows the criteria for inclusion and exclusion of studies. The criteria were broad to capture a wide-range of relevant research. A range of experimental studies were included within the review, however theoretical reviews, discussion pieces and cross-sectional designs were all excluded from the review. The review was limited to peer-reviewed articles to ensure a comparable level of quality was present. This review was limited to articles available in the English language. It is accepted that these reliances may or

may not have introduced bias to the review, provided a culture specific overview and potential publication bias, which has been considered throughout the review (Torgerson, 2003).

Table 1

Inclusion and Exclusion Criteria for Determination of Suitability for Review

Inclusion Criteria	**Exclusion Criteria**
Primary research (quantitative and qualitative)	Book reviews, conference presentations, meetings, letters/commentaries, expert opinions, review articles, meta-analyses, discussion pieces.
Full text available in English	Full text not available in English
Published in a peer reviewed journal	Non-peer reviewed publications
Date: all ranges.	
Participants aged 18 years and below (Rationale: neuropsychological development; Geier, Terwilliger, Teslocvich, Velanova, & Luna, 2009).	Participants aged 19 years and above
Intervention/Exposure: Participants will be accessing preventative or rehabilitative psychosocial interventions for externalising, disruptive, risky or offending behaviour. Studies will be included if they incorporate an intervention that targets participants' externalising behaviour, makes reference to and/or measures impulsivity or IC.	Participants not accessing intervention or exposure. Interventions that are solely medical or pharmacological in design. Interventions that are directed at internalising behaviours and risks to self.
Comparison/control group: Both within and between-subject comparisons of IC/Impulsivity will be included within this review. Between-subjects' comparisons must enable post treatment comparison.	Studies that take one point in time measurement of impulsivity/IC with no measurement of change or control group comparison possible.
Outcome: Studies will be included within the review that specifically measure participants' externalising behaviour and a measure of impulsivity or IC via the use of indirect measures, including self/third-party report and/or observation and/or direct measures, including neuropsychological tests.	Studies which do not make specific measurement of impulsivity/IC or externalising behaviour.

Table 2 shows the collections that were accessed by searching EBSCO and Ovid databases within this review. The Cochrane database of systematic reviews was also searched. The selected databases were examined using keyword searches which were further refined using Boolean characters such as “OR” and “AND” between groups of keywords. The words were truncated using an “*” to search for words with different suffixes and wildcard “#” for character alterations and proximity word searches (near/number of words) were used (Table 3).

Table 2

Research databases and collections accessed for the search

EBSCO Research database accesses:	**Ovid research database accesses:**
AMED (Allied and Complementary Medicine Database), British Education Index, Child Development & Adolescent Studies. CINAHL Plus, eBook Collection, eJournals, ERIC, MEDLINE, Psychology and Behavioural Sciences Collection	PsycARTICLES, PsycINFO, Social Policy & Practice

Table 3

Search Words used in groups separated with Boolean Characters

	AND	AND	AND	AND
Inhibit* or impuls* or (self#control) or (self#mediation) or (Barratt Impulsivity) or (Behavioural Activation Scale) or (Eysenck Impulsivity Scale) or (Sensitivity to Reward Scale) or (Novelty Seeking Scale) or (Sensation Seeking Scale) or (stop signal) or stroop or (go#no go) or (continuous performance) or (delay discounting) or (probability discounting) or (card* arranging reward responsivity) or (balloon analogue risk) or (IOWA gambling) or (Information Sensitivity) or (beads task)	Psycholog* or psychosocial or cognitive or behaviour or behaviour* or neuropsychology*	Treatment or rehabilit* or program* or training or intervention or prevention or preventing or controlling or manag* or reduc*	Externalising or externalizing or (risk* near/2 (behaviour* or behavior*)) or (problem* near/2 (behaviour* or behavior*)) or devian* or offen* or crimin* or crime or perpetrator or delinquen* or recidivism or bully* or anti-social or thief or theft* or arson* or (fire and sett*) or homicid* or conduct or murder* or manslaughter* or attack* or aggress* or assault* or harm* or tortur* or assail* or molest* or rapist* or (rape* and offen*) or physical* abus* or spouse abus* or partner abus* or sexual abus* or child abus*	Youth or young or juvenile or child* or adolescen*

Search and Screening Procedures

All searches were conducted in the keyword, title and abstract fields to ensure that retrieved literature addressed the key concepts of the research question. Studies published up to September 2016 were included in the search. The results were screened for their eligibility based on their title and abstract (first screening). All results which appeared to be eligible were then screened again by reviewing the full text to ensure eligibility (secondary screening; Torgerson, 2003).

Figure 1 indicates the initial database searches retrieved a total of 3539 records. 3063 records were selected for first screening once 476 duplicates and irrelevant articles were removed. 135 records reached second screening from which 13 records were selected for review.

Baer and Nietzel's (1991) meta-analysis was identified in the initial search but was excluded as it did not provide adequate information regarding the measures used. However, three additional references were obtained which included interventions for externalising behaviour and were screened for eligibility but were excluded at second screening.

The Cochrane database search retrieved 44 records which were taken to first screening. 35 records were excluded during first screening and the remaining 9 records were excluded following second screening.

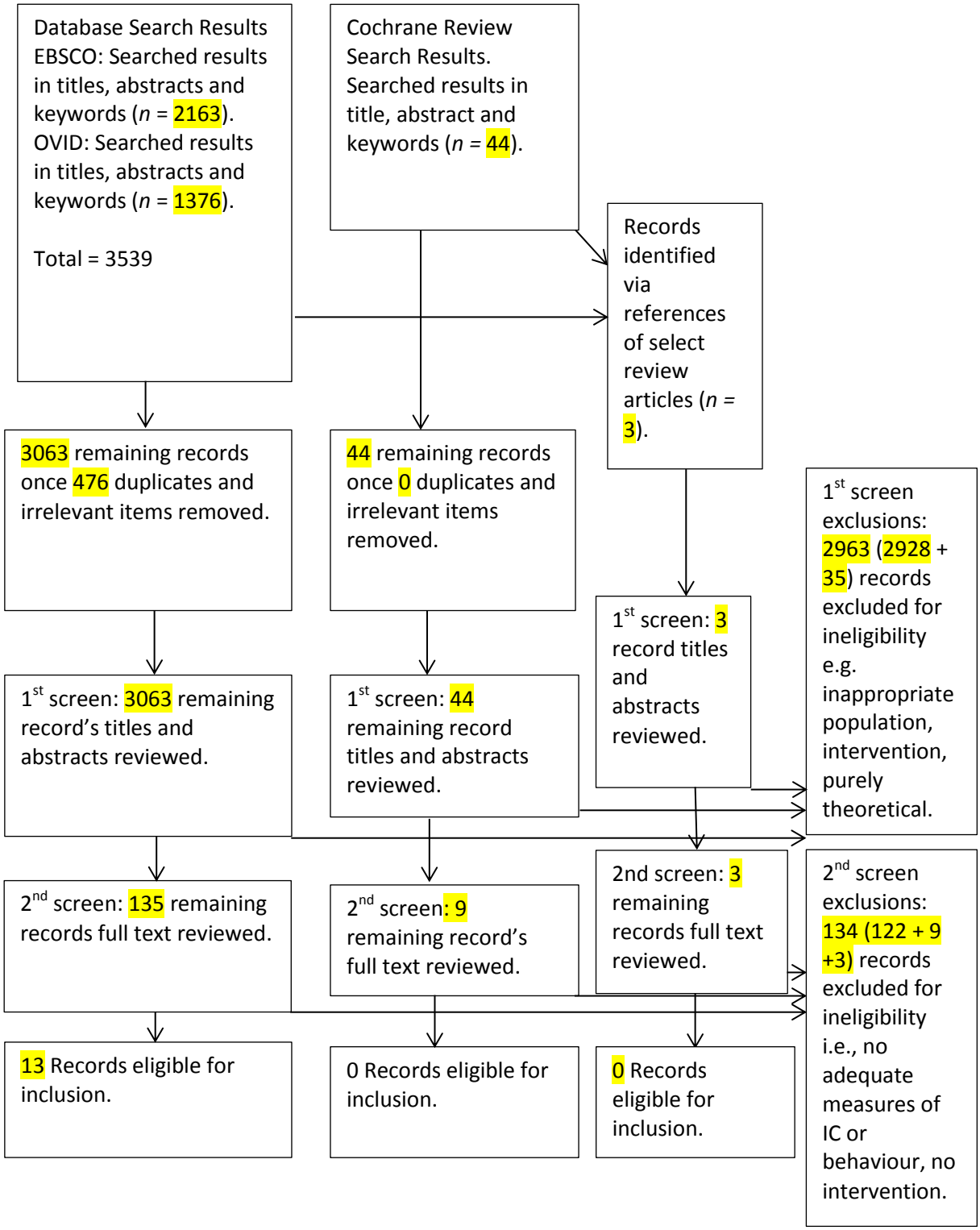


Figure 1. Identification process of articles.

Evaluation Criteria

In order to guide this critique the Effective Public Health Practice Project's (EPHPP) "Quality Assessment Tool" (Appendix A; Effective Public Health Practice Project, 1998; Thomas, Ciliska, Dobbins, & Micucci, 2004) was used to guide consideration of the randomisation of intervention, blindness of allocation, matching and similarity of groups at baseline, specificity of eligibility criteria, use of standardised, valid and reliable outcome measurement and the analysis including intention to treat. This tool was used to inform the discussion of the quality of the articles.

Screening Reliability

Ideally, to ensure that the inclusion/exclusion criteria had being applied consistently and that relevant papers were selected a secondary rater would have reviewed a portion of the screening to enable an assessment of interrater reliability (Torgerson, 2003). Unfortunately, due to time and resource constraints this was not possible and the bias this adds to this review is acknowledged.

To ensure that the quality assessment had being applied consistently, a sample (20%) of the included studies (1, 3, 4 and 6) were reviewed by a second-rater enabling comparison of each item score. Cohen's k was calculated at .638 ($p < 0.001$) across all item scores, indicating good interrater agreement (Torgerson, 2003). The items of disagreement had no overall effect on categorical rating. Areas of disagreement were reviewed until consensus was reached.

Results

The thirteen articles selected for inclusion within the review (Table 4) will be discussed in terms of their quality and ability to address the research question.

Table 4

Study Design and Sample Characteristics, Measures and Interventions Used, Key Findings and Limitations

Reference	**Design and Participants**	**Measures of interest used**	**Intervention**	**Control/ Comparison Groups**	**Key findings and effect sizes**	**Limitations and Quality assessment**
Study 1. Barkley et al., 2000	Location: USA, Design: Controlled Clinical Trial, Sample Characteristics: *n* = 158, 4.5-6 year old pre-schoolers with disruptive behaviour (above 93rd percentile on parent ratings of hyperactivity/impulsivity [CPRS] or above DSM-IIIR threshold for ADHD and ODD) Population: School, Mean age: 4.8 years, % Male 66.	Measures of IC/ Impulsivity: CPT. Measures of externalising behaviour: CBCL, HSQ, NABC, SSQ, SCRS and therapist observations.	1. Parent training - psychoeducation and behavioural training (PT). 2. Special classroom - cognitive behavioural training (STC). 3. Combined (PT + STC).	4 Groups: 1. No intervention (*n* = 42), 2. PT (*n* = 39), 3. STC (*n* = 37), 4. PT + STC (*n* = 40).	No significant differences obtained on measure of IC. Behavioural improvement found in school for classroom training only (CBCL teacher scale). Effect sizes unavailable.	Holistic, multi-domain assessment methods utilised Issues with randomisation and representativeness of sample to population. Non-randomised allocation of intervention types with STC intervention offered to those who met most diagnostic criteria on DSM-IIIR. Utilised intention to treat basis for analysis. Large and non-random attrition from parent training and combined groups. Motivational factors deemed key to ineffectiveness of training. Global EPHPP quality rating: Moderate.

Study 2. Camp, Blom, Hebert, & van Doorninck, 1977	Location: USA, Design: Controlled Clinical Trial, Sample Characteristics: *n* = 34, 6-8 years old with disruptive behaviour (2 standard deviations above mean on aggressive behaviour subscale on SBCL). Population: School, Mean age: Not stated, % Male 100.	Measures of IC/ Impulsivity: MFF. Measures of behaviour: SBCL.	Think Aloud program, including elements of self-instructional and problem-solving training.	3 groups: 1. Intervention group (*n* = 12), 2. No intervention, matched aggression, control group (*n* = 10) and 3. no intervention, normal, control group (*n* = 12).	Impulsivity significantly reduced post intervention in experimental group compared with matched-control group, when controlling for baseline score but not when compared with normal-control group. Aggression rating significantly reduced in experimental group compared with normal-control group when controlling for baseline score, but not when compared with matched-control group. Effect sizes unavailable.	Reliance on teachers' ratings for indication of change as they were not blind to experiment. Potentially unintended intervention due to difficulties with control groups not receiving matched therapeutic contact. Global EPHPP quality rating: Moderate.
Study 3. Chen, Li, Wang, Ou, Zhou, & Wang, 2014	Location: China, Design: Randomised Controlled Trial, Sample Characteristics: *n* = 66, 14-24 year old young male offenders sentenced for a violent offence. Population: Prison Mean age: 18.94 years, % Male : 100	Measures of IC/ Impulsivity: BIS - 11. Measures of behaviour: MOAS.	CBT based manualised program (Williams Life Skills Training, WLST).	2 Groups: Intervention group (*n* = 33) and treatment as normal (academic, health and legal education) control group (*n* = 33).	Significant reduction in impulsivity ratings post intervention and differences between groups, after controlling for baseline score. Significant decreases in aggression post intervention and differences between groups. Effect sizes unavailable.	Age, incorporates adults as well therefore development will confound these results. Measures are problematic, one self-report IC measure and one third-party observational behaviour measure. Treatment as normal would not have matched attention/hours of contact. Short term follow up only utilised. Global EPHPP quality rating: Strong- moderate.

Study 4. Feindler, Ecton, Kingsley & Dubey, 1986	Location: USA, Design: Controlled Clinical Trial, Sample Characteristics: 21, 13-18 year old, hospitalised young people with behavioural and emotional difficulties referred for anger control training. Population: Institution, Mean age: 15.9 years, % Male: 100.	Measures of IC/ Impulsivity: MFF. Measures of behaviour: SCRS carer report and observation.	CBT based anger control training.	2 Groups: Intervention group (n= 10) and no intervention, partially matched, waiting list control group (n=11).	Significant improvement in IC measure post intervention for intervention group only. Significant improvements in self-control behaviour post intervention for intervention group with significant deterioration found in control group. Effect sizes unavailable.	Control group not directly matched but also resident in same hospital and referred for same training. Differences between groups include intervention group being younger in age and having poorer interpersonal skills. Potential confounds include control group not having matched attention/hours of contact. Small sample size appropriately controlled for by statistical analysis. Study's ecological validity strengthened by use of variety of measures including continuous measure of behaviour and long follow up (3 years). Global EPHPP quality rating: Moderate.
Study 5. Feindler, Marriott, & Iwata, 1984	Location: USA, Design: Randomised Controlled Trial, Sample Characteristics: *n* = 36, 12.5-15.7 year old, school students, with disruptive behaviour (having been suspended	Measures of IC/ Impulsivity: MFF. Measures of behaviour: SCRS.	CBT based program.	2 Groups: Intervention group (*n* = 18) and matched control group (*n* = 18).	No significant changes found on IC measure between or within groups. Significant increase in teacher ratings of self-control found for intervention groups post intervention. Significant reductions in some (single fine based) behaviour for intervention groups during and post intervention, but	More problematic behaviours did not improve, potentially highlighting limited impact on of intervention. Significant differences between group's aggression levels at baseline will have confounded results. Difficulties' relying on teacher behaviour ratings as adherence to scoring was not checked. Issues with control group not having matched

	twice in last academic year for behaviour other than truancy or smoking), Population: School, Mean age:13.8 years, % Male: not stated.				not for more serious behaviours. Effect sizes unavailable.	attention/hours of contact. Global EPHPP quality rating: Weak - moderate.
Study 6. Gómez, Luciano, Páez-Blarrina, Ruiz, Valdivia-Salas & Gil-Luciano, 2014	Location: Spain, Design: Cohort study, Sample Characteristics: 5, 15-17 year old young people with disruptive behaviour, criminal justice involvement and failure to respond to previous interventions. Population: Community Mean age: 15.8 years, % Male: 60.	Measures of IC/ Impulsivity: MFF. Measures of behaviour: SCS self-report and observation.	Brief ACT protocol guided intervention	No control or comparison group.	Significant improvement in IC measures post intervention (d = 1.14). Significant reduction in disruptive behaviours (d = 1.29) with decreases in problematic behaviours reported across respondents.	No control or comparison group however uses single-case methodology appropriately to indicate treatment effects. Detailed information regarding cases and intervention enabling replication. Multiple sources of information regarding behaviour change. Global EPHPP quality rating: Moderate.

Study 7. Kendall & Wilcox, 1980	Location: USA, Design: Controlled Clinical Trial, Sample Characteristics: *n* = 33, 8-12 year old school children, with problematic classroom behaviour, Population: School, Mean age: 10 years 5 months, % Male: 76.	Measures of IC/ Impulsivity: MFF, Porteus Mazes, ICCI, CTRS: Hyperactivity subscale. Measures of behaviour: SCRS and Therapists rating of improvement.	CBT based self-control training	3 Groups: 1. Concrete self-instruction intervention group (tasks worded to apply specifically to the task at hand), 2. Conceptual self-instruction intervention group (tasks worded abstractly to enable globalisation) and 3. No intervention, matched task control group. Numbers per group not stated.	All groups showed improvement in IC on MFF and Porteus mazes. Teacher ratings of hyperactivity showed improvements for the concrete group post-intervention and follow up and for the conceptual group from baseline to follow up. No self-rating improvements found. Improvements in teacher ratings of self-control (SCRS), Improvements observed in concrete group post-intervention but not at follow up, improvements in conceptual group post-intervention and at follow up from post-intervention. Significant differences were found between-subjects post-intervention and at follow up for the conceptual and control groups. Therapist ratings found significant improvements in both intervention groups. Effect sizes unavailable.	No blind measurers which weakens reliability of measures obtained, however range of measures used limits the impact of this. Global EPHPP quality rating: Moderate.

Study 8. McKay, Gonzales, Quintana, Kim, & Abdul-Adil, 1999	Location: USA, Design: Controlled Clinical Trial, Sample Characteristics: *n* = 88, school age (range not stated) children referred to child mental health service with disruptive behavioural difficulties, Population: Clinical, Mean age: 9 years, % Male: 81.	Measures of IC/ Impulsivity: CPRS: Impulsivity subscale and informal parent interview. Measures of behaviour: CPRS: Conduct problems subscale and informal parent interview.	Psychosocial , systemic intervention (Multiple Family Groups, MFG).	2 groups: MFG intervention group (*n* = 34) and treatment as normal (Individual child therapy or family therapy) control group (*n* = 54)	Intervention group showed significant improvements in impulsivity and conduct problems post intervention with 70% of parents reporting improved behaviour. Treatment as normal control group did not show change in impulsivity or conduct problems but 54% of parents reporting improved behaviour. Effect sizes unavailable.	Majority of males in experimental group and females in control group. Difficulties with integrity of therapy as led by families. Uses parent ratings only on both measures and uses same measure. Does not use intent to treat in data analysis. Global EPHPP quality rating: Weak.
Study 9. Moore & Cole, 1978	Location: USA, Design: Controlled Clinical Trial, Sample Characteristics: *n* = 14, 8-12 year old children selected from special educational placements due to disruptive behavioural difficulties and assessed as reaching diagnostic threshold for hyperkinesis,	Measures of IC/ Impulsivity: MFF. Measures of behaviour: CTRS.	Cognitive Self Instructional (CSI) training.	3 groups: 1. intervention group (*n* = 5), 2. Matched treatment as normal (time with therapist completing similar task without instruction) control group (*n* = 5) and 3. no intervention control group (*n* = 4).	Significant improvements in IC measure (MFF) for intervention group post intervention and significant differences in between group comparison with both control groups. No improvements in IC measures for control groups. No improvements in behaviour observed for any group. Effect sizes unavailable.	Does not indicate how randomisation was completed or any information regarding participant's characteristics. No non-clinical control group used. Difficulties with establishing integrity of training due to nature of individualised sessions. Global EPHPP quality rating: Weak.

	Population: Clinical, Mean age: 9 years 4 months, % Male: 79.					
Study 10. Nash, Stevens, Greenbaum, Weiner, Koren, & Rovet, 2015	Location: Canada, Design: Controlled Clinical Trial, Sample Characteristics: *n* = 25, 8-12 year olds with Foetal Alcohol Syndrome Disorders (FASDs), Population: Clinical, Mean age: 10.3 years, % Male: 52.	Measures of IC/ Impulsivity: NEPSY-II: Inhibition subtest. Measures of behaviour: CBCL: Aggression subscale, parent rating, BRIEF parent rating, and SSIS parent rating.	Alert program of self-regulation, manualised training.	2 groups: Intervention group (*n* = 12) and matched, waiting list, no intervention, control group (*n* = 13).	Significant improvements in one element of IC measure (NEPSY-II inhibition naming) for intervention group post-intervention and in comparison with control groups. Effect size =.283. No improvements in other two inhibition subtests for intervention group and no improvements in IC measures for control groups. Significant improvements in behaviour regulation ratings (BRIEF) post-intervention for intervention group (Effect size = .189) and in externalising behaviour (CBCL) ratings post-intervention and between groups for intervention group. Effect size = .095. No other improvements in other behaviour subscales or social skills (SSIS) in intervention or control group.	Individualised intervention, therefore difficult to assure integrity. Significant differences between groups at baseline, with intervention group having more cases of diagnosed ADHD and more cases of inutero drug and alcohol exposure. No non-clinical group and difficulties in generalisability to population due to requirements of IQ of 70+. Small effects of intervention found. Type of effect size statistic not stated. Global EPHPP quality rating: Moderate.

Study 11. Owens, Murphy, Richerson, Girio, & Himawan, 2008	Location: USA, Design: Controlled Clinical Trial, Sample Characteristics: *n* = 117, 5- 12 year old school children in area of low socioeconomic status, referred by teachers due to problems with inattention and disruptive behaviour, Population: School, Mean age: 8 years, % Male: 77%.	Measures of IC/ Impulsivity: DBD: impulsivity subtest, teacher and parent ratings. Measures of behaviour: DBD: conduct subscale, teacher and parent ratings.	Multiple interventions based on CBT and systemic therapy.	2 groups: Intervention group (*n* = 91) and matched waiting list, no intervention, control group (*n* = 26).	Improvements in parent and teacher impulsivity (Effect size = .4 and .32 respectively) and conduct ratings (Effect size = .34 and .23 respectively) for intervention group post-intervention however also improvements in parent impulsivity ratings for control group post-intervention (Effect size = .38). Significant between-group differences in teacher impulsivity and conduct ratings post-intervention. No significant differences observed between groups in parent impulsivity and conduct ratings post-intervention.	Some difficulties with generalisability of teacher referrals once aware of the aims of the group and no non-clinical control. 42% of control group received other intervention whilst enrolled. Some differences in groups at baseline, with intervention group being older and having more ADHD diagnoses. Some issues with the validity of measure and problematic using same measure of behaviour and IC. Small effects of intervention found. Type of effect size statistic not stated. Global EPHPP quality rating: Weak.
Study 12. Özcan, Oflaz, Türkbay, & Freeman Clevenger, 2013	Location: Turkey, Design: Cohort study, Sample Characteristics: *n* = 33, 6-12 years old with a diagnosis of ADHD according to DSM-IV-TR criteria and reported disruptive behaviour, Population: School, Mean age: 9.1 years, % Male: 91.	Measures of IC/ Impulsivity: DSM-IV-TR Disruptive Behaviour Disorders screening and assessment: impulsivity scale, parent and teacher rating.	"I can problem solve" problem-solving, manualised intervention.	No control or comparison group.	Significant improvements in impulsivity ratings from parents and teachers post intervention. Significant improvements in teacher ratings of behaviour post intervention. Effect sizes unavailable.	No control or comparison groups. No information regarding attrition. Detailed information regarding intervention enabling replication. Measures are problematic as only parent/teacher ratings used. No parent reports on behaviour. Global EPHPP quality rating: Weak.

		Measures of behaviour: CBCL; externalising index, teacher rating.				
Study 13. Yang & Lee, 2005	Location: USA, Design: Controlled Clinical Trial, Sample Characteristics: *n* = 14, 7-14 year olds, with histories of abuse victimisation and aggressive behaviour, Population: Clinical, Mean age: not stated, % Male: 29.	Measures of IC/ Impulsivity: AI: impulsivity subscale, self-report. Measures of behaviour: AI: verbal and physical aggression subscales, self-report.	CBT based guided debriefing session.	2 groups: Intervention group (*n* = 7) and matched aggression, matched activity, no intervention, control group (*n* = 7).	Significant differences in impulsivity ratings between groups (w^2 = .33), post intervention but no significant within-group improvements. No improvements in aggression rating within or between groups post intervention. Significant increase in aggressive behaviour within control group post intervention.	Significant weaknesses: 8/14 participants had previously attended program. Allowed self-referrals only. Relies on self-report only. Very short follow up. Strength in matching on levels of aggression at baseline and matching of aspects of intervention ensures hours of contact do not differ and confounds are managed. Small intervention effects found Global EPHPP quality rating: Weak.

Note. ACT = Acceptance and Commitment Therapy; ADHD = Attention Deficit and Hyperactivity Disorder; AI = Aggression Inventory; BIS – 11 = Barratt Impulsiveness Scale, 11th edition; BRIEF = Behavioural Rating Inventory of Executive Function; CBCL = Child Behaviour Checklist; CBT = Cognitive Behavioural Therapy; CPRS = Conners Parent Rating Scale; CPT = Continuous Performance Test; CTRS = Conners Teacher Rating Scale; DBD = Disruptive Behaviour Disorders Scale; DSM- IIIR = Diagnostic and Statistical Manual of Mental Disorders, 3rd edition, Revised; DSM-IV = Diagnostic and Statistical Manual of Mental Disorders, 4th edition; HSQ = Home Situations Questionnaire; ICCI = Impulse Control Categorisation Instrument; MFF = Matching Familiar Figures test; MOAS = Modified Overt Aggression Scale; NABC = Normative Adaptive Behaviour Checklist; NEPSY-II = Developmental NEuroPSYchological Assessment, 2nd edition; ODD = Oppositional Defiance Disorder; SBCL = School Behaviour Checklist; SCRS = Self-Control Rating Scale; SCS = Self-Control Schedule; SSIS = Social Skills Improvement System questionnaire; SSQ = School Situations Questionnaire.

Impact/Quality

Using the EPHPP tool 6/13 of the studies selected were rated as weak or moderate-weak (studies 5, 8, 9, 11, 12 and 13). Studies 1, 2, 4, 6, 7 and 10 received a moderate rating of quality and study 3 a moderate-strong rating. Specific quality assessment issues based on methodological and analytic rigour of the studies leading to these ratings will be detailed within each of the following sections. The findings of the studies and the synthesis of the review findings has then been weighted in favour of the higher quality studies (1, 2, 3, 4, 6, 7 and 10) identified.

Participants

The demographics for the participants varied with ages, with the majority (9/13) of studies (1, 2, 7, 8, 9, 10, 11, 12 and 13) including young children (6-12 years). The generalisability of study 3 is considered limited due to recruitment including participants up to 24 years and participants mean age was 18.94 years. This study was retained as the sample contained those aged 14-18 years.

The majority of studies (11/13) recruited a higher proportion of males (52-100%), as is common in studies of externalising behaviour and highlights a bias in this research area. Only one study (13) recruited a higher number of females, potentially as this targeted an abused population and one study (5) did not state the gender proportions recruited. Recruitment mainly targeted those with disruptive and delinquent behaviour (studies 1-9 and 11). Two studies (10 and 12) focused recruitment on those within diagnostic groups with related behavioural difficulties and study 13 targeted recruitment to those with histories of familial abuse, accordingly the within-subject and/or matched-control group comparisons of behaviour change

are considered more important within studies 10, 12 and 13 due to the potentially differing baselines of behaviour.

The highest quality studies utilised primary school aged (1 & 2), primary and secondary school aged (7 & 10) or secondary school aged adolescent (3, 4 & 6), predominantly male participants, recruited from disruptive or delinquent populations.

Design

The majority (11/13) of studies (1, 2, 3, 4, 5, 7, 8, 9, 10 & 11) utilised controlled clinical trial design with at least one comparison or control group, enabling within and between-subject comparisons to be made. Only two studies (3 and 5) met the standard of randomisation of participants required to be classed as a randomised controlled trial. Accordingly, the findings from these studies hold more potential generalisability. Two studies (6 and 12) utilised a cohort design, therefore only enabling within-subject comparisons to be considered.

Control/Comparison Groups

Control groups were used by all trials which enables a reliable degree of between-group comparisons to be made. Studies 1, 2, 4, 5, 10 and 11 used control groups, with no intervention or additional contact for matched participants (those meeting the same recruitment criteria as those in the intervention group). The potential of unintended interventions is limited and the comparisons reliability is strengthened by this approach, however it does not enable any non-intervention specific elements to be measured. The reliability of study 11 is weakened as 42% of control group participants received additional interventions within the time they were acting as a control. Studies 7 and 13 used a matched task group and studies 3, 8 and 9 used treatment as normal comparison groups, which enables comparisons of

non-intervention specific elements of contact to be made and reduces the ethical problem of withholding intervention. Study 2 used both matched and non-clinical participants to enhance the between group comparisons possible.

Two studies used additional comparison groups, including study 1 which used three intervention types (including 1 combined intervention group), and study 7 used two intervention types, therefore the number of interventions included in this review was sixteen.

The highest quality studies (1, 2, 3, 4, 6, 7 and 10) used a range of designs including cohort, randomised-controlled and controlled clinical trials, which incorporated control comparisons with some utilising additional comparisons with other interventions, tasks, matched or non-clinical participants to ensure the findings were reliable and valid.

Measures Used

Across the thirteen studies, ten different measures of IC were used, including direct measures, self-report and third-party ratings (Table 5). All measures were published with data regarding validity and reliability available. Therefore, whilst seven studies relied on one measure of IC this was only mildly problematic. Two studies (11 and 12) relied on parent and teacher ratings and studies 7 and 10 used both direct measurement and third-party reports which enhanced the reliability and strength of these studies.

Six studies used four different direct measures which included two measures of impulsive disinhibition (studies 1 and 10) and two measures of impulsive decision making (studies 2, 5, 7 and 9). Study 7 used two types of direct measure of

impulsive decision making and supplemented this with self and third-party rating of IC; however the remaining seven studies relied on one, sole direct IC measure. The potential training effect of direct IC measures was controlled within data analysis of all studies.

Table 5

Measures of Inhibitory Control/Impulsivity Used, with Descriptions of Each Measure and Supporting References Cited by Study Authors.

Measurement type	Measure used	Studies	Key reference provided	Summary of measure	IC/Impulsivity domain measured
Direct Measures	Continuous Performance Test (CPT; Preschool version)	Study 1	Gordon, 1983	Computerised task which presents the participant with a random series of stimulus digits, at the rate of one per second for 6 minutes. The participant is instructed to respond as quickly as possible every time a digit appears, except when the digit "1" appears, when their response should be inhibited. Provides data regarding omissions, commissions, perseverations, hit reaction time, and standard error.	Impulsive disinhibition
	Matching Familiar Figures Test (MFF)	Studies 2, 4, 5, 6, 7, 9	Kagan, 1966	Paper based task which presents the participant with several alternative figures, from which they must select one that matches a standard. The number of errors and the time required to complete the test are recorded. Provides data regarding impulsive and reflective responding.	Impulsive decision-making
	NEPSY-II Inhibition subtest	Study 10	Korkma, Kirk, & Kemp, 2007	Paper based task which presents the participant with a series of black and white shapes and arrows. The participant is instructed to name either the shape or direction or an alternate response, depending on the colour of the shape or arrow. Provides data regarding time required to complete the test, ability to shift between responses and ability to inhibit automatic responses in favour of novel responses.	Impulsive disinhibition
	Porteus Mazes	Study 7	Porteus, 1955	Paper based task which presents the participant with a series of progressively more difficult mazes. The participant is instructed to trace a pencil line indicating their route to the exit, avoiding dead-ends, blind alleys and whilst back tracking is not permitted. Provides data on scanning, learning from errors and time required to complete test.	Impulsive decision-making

Self-report	Aggression Inventory (AI) Impulsivity subscale	Study 13	Gladue, 1991	Paper based self-report form. Impulsivity subscale includes 6 items from total of 28 scale items scored on a 5 point scale. Items included: "I become easily impatient and irritable if I have to wait", " Others say that I lose patience easily", "I become easily impatient if I have to keep doing the same thing for a long time", "It often happens that I act too hastily", "I often act before I think", "I seem to do things I later regret" and "When I have to make up my mind, I usually do it quickly".	Self-reported trait impulsivity
	Barratt Impulsiveness Scale - 11	Study 3	Patton, Stanford, & Barratt, 1995	Paper based self-report form. Scale provides measure of behavioural construct of impulsiveness. Scale includes 30 items, scored on a 4-point scale with higher scores indicating higher impulsiveness. Items included: "I plan tasks carefully", "I do things without thinking", "I make-up my mind quickly", "I am happy-go-lucky", "I don't pay attention" and "I have racing thoughts".	Self-reported trait impulsivity
	Impulse Control Categorization Instrument (ICCI)	Study 7	Matsushima, 1964	Paper based self-report form. Scale provides 24 sentences describing situations to which the participant states the degree of choice between spontaneous impulsive-aggressive behaviour and behaviour requiring impulse control over immediate action.	Self-reported trait impulsivity
Third-party rating	Conners Rating Scales - Impulsiveness/ Hyperactivity subscale	Studies 7, 8, 9	Teacher rating scale (CTRS): Conners, 1969. Parent rating scale (CPRS): Goyette, Conners, & Ulrich, 1978	Paper based rating forms. Teacher rating scale consists of 59 items, scored on a 4-point scale. Items map onto 6 subscales (oppositional, cognitive problems/inattention, hyperactivity, anxious-shy, perfectionism, and social problems) from which the hyperactivity subscale score is used. The hyperactivity subscale measures the degree to which the participant is rated as restless, noisy, and excitable and tends to interrupt and disturb other children in the classroom. Parent rating scale consists of 48 items, scored on a 4-point scale. Items map onto 6 subscales (anxiety problems, conduct problems, hyperactivity, impulsivity, learning problems, and psychosomatic complaints) from which the impulsivity subscale score was used. The impulsivity subscale measures the degree to which the participant is rated as easily distracted, restless and fidgety.	Observed trait impulsivity

	DBD rating scale, impulsivity subtest	Study 11	Pelham, Gnagy, Greenslade, & Milich, 1992	Paper based rating forms. Teacher and parent rating scales consist of 45 items, scored on a 4-point scale. Items map onto 4 subscales (inattention, hyperactivity/impulsivity, oppositional defiance disorder and conduct disorder) from which the hyperactivity/impulsivity subscale score is used. Items included: "often interrupts or intrudes on others (e.g., butts into conversations or games)", "often talks excessively", "often fidgets with hands or feet or squirms in seat", "often blurts out answers before questions have been completed" and "often has difficulty playing or engaging in leisure activities quietly". The hyperactivity/impulsivity subscale measures the degree to which the participant meets the criteria for Attention Deficit Hyperactivity Disorder (ADHD) hyperactive-impulsive symptoms.	Observed trait impulsivity
	Disruptive Behaviour Disorders screening and assessment impulsivity scale	Study 12	American Psychiatric Association (APA), 2000	Paper based rating forms. Teacher and parent rating scales consist of 41 items based on Diagnostic and Statistical Manual of Mental Disorders, 4th edition Text Revision criteria. Items map onto 5 subscales (attention problems, hyperactivity, impulsivity, oppositional defiant disorder and conduct disorder) from which the impulsivity subscale is used.	Observed trait impulsivity

Fourteen measures of behaviour were used including self-report, third-party ratings and observation measures (Table 6). The majority were published measures, with data regarding validity and reliability available. Studies 1, 4, 6 and 8 supplemented these measures with non-standardised ratings and observations, with limited impact on quality as these were not sole measures. Seven studies relied on one measure of behaviour change (studies 2, 3, 5, 9, 11, 12 and 13) which slightly weakened these studies and studies 2 and 5 rely on non-blinded, third-party measures as the sole measure, which weakened their reliability.

The highest quality studies (1, 2, 3, 4, 6, 7 and 10) utilised mainly direct measures of impulsive disinhibition and decision making and third-party ratings of behaviour both supplemented with self-report and/or observational data related to trait impulsivity and behaviour.

Table 6

Measures of Externalising Behaviour Used, with Descriptions of Each Measure and Supporting References as Cited by Study Authors.

Measurement type	**Measure used**	**Studies**	**Key reference provided**	**Summary of measure**
Self-report	Aggression Inventory (AI), verbal and physical aggression subscales	Study 13	Gladue, 1991	Paper based self-report form. Scale consists of 28 items, scored on a 5-point scale. Verbal subscale includes 7 items: "When a person tries to "cut ahead" of me in a line, I firmly tell him/her not to do so", "When a person tries to boss me around, I resist strongly", "When a person is unfair to me, I get angry and protest", "When a person criticizes me, I tend to answer back and protest.", "If a person insults me, I insult him/her right back", "When another person is mean to me, I get even with him/her" and "I think it is OK to make trouble for an annoying person". Physical subscale includes 4 items: "I get into fights with other people", "I really admire people who know how to fight with their fists or body (no weapon)", "When another person hassles or shoves me, I give him/her a shove or punch" and "When another person picks a fight with me, I fight back".
	Self-Control Schedule (SCS)	Study 6	Rosenbaum 1980	Paper based self-report form. Scale consists of 36 items, scored on a 6-point scale. Items map onto 4 subscales (Use of cognitions and self-statements to control emotional and physiological responses, application of problem solving strategies, the ability to delay immediate gratification and perceived self-efficacy).

Third-Party report	Behaviour Rating Inventory of Executive Functioning (BRIEF): Behavioural regulation index of parent rating	Study 10	Gioia, Isquith, Guy, & Kenworthy, 2000	Paper based rating forms. Parent rating scale consists of 86 items scored on a 3-point scale. Items map onto 8 subscales (emotional control, inhibit, initiate, monitor, organisation of materials, plan/organise, shift, working memory) which map onto two indices (Behavioural regulation and Metacognition) of which the behavioural regulation index is used. The Behavioural regulation index is a result of the composite inhibit, shift, and emotional control subdomains scores.
	Child Behaviour Checklist (CBCL)	Studies 1 (parent and teacher; aggression and externalising subscales), 10 (parent rating: aggression subscale) and 12 (teacher rating: externalising index)	Achenbach & Edelbrock, 1986	Paper based rating forms. Parent and teacher scales consist of 118 items scored on a 3-point scale. Items map on 8 subscales (social withdrawal, somatic complaints, anxiety/depression, social problems, thought problems, attention problems, delinquent behaviour, aggressive behaviour) which map onto two indices (internalising and externalising) of which the parent ratings of aggression and teacher ratings of externalising problems (result of composite delinquent and aggressive behaviour subscale scores) were used.
	Conners rating scale	Studies 8 (parent rating: conduct problem subscale) and 9 (teacher rating)	Teacher rating scale (CTRS): Conners, 1969. Parent rating scale (CPRS): Goyette, Conners, &	Paper based rating forms. Teacher rating scale consists of 59 items, scored on a 4-point scale. Items map onto 6 subscales (oppositional, cognitive problems/inattention, hyperactivity, anxious-shy, perfectionism, and social problems). Parent rating scale consists of 48 items, scored on a 4-point scale. Items map onto 6 subscales (anxiety problems, conduct problems, hyperactivity, impulsivity, learning problems, and psychosomatic complaints) from which the conduct problem subscale score was used.

			Ulrich, 1978	
	Disruptive Behaviour Disorders (DBD) rating scale, conduct subscale	Study 11	Pelham, Gnagy, Greenslade, & Milich, 1992	Paper based rating forms. Teacher and parent rating scales consist of 45 items, scored on a 4-point scale. Items map onto 4 subscales (inattention, hyperactivity/impulsivity, oppositional defiance disorder and conduct disorder) from which the conduct disorder subscale score was used. Items include: has run away from home overnight at least twice while living in parental or parental surrogate home (or once without returning for a lengthy period", "often lies to obtain goods or favours or to avoid obligations (i.e., "cons" others)", "has been physically cruel to people", "has stolen items of nontrivial value without confronting a victim (e.g., shoplifting, but without breaking and entering; forgery)", "often truant from school, beginning before age 13 years", "has deliberately destroyed others' property (other than by fire setting)", "often initiates physical fights with others who do not live in his or her household (e.g., peers at school or in the neighbourhood)", "has forced someone into sexual activity", "often bullies, threatens, or intimidates others", "has been physically cruel to animals", "often stays out at night despite parental prohibitions, beginning before age 13 years", "has stolen while confronting a victim (e.g., mugging, purse snatching, extortion, armed robbery)", "has deliberately engaged in fire setting with the intention of causing serious damage", "has broken into someone else's house, building, or car" and "has used a weapon that can cause serious physical harm to others (e.g., a bat, brick, broken bottle, knife, gun)".
	Home and School Situations Questionnaire (HSQ and SSQ)	Study 1	Barkley, 1990	Paper based rating form. Parent (HSQ) and teacher (SSQ) scales assess the pervasiveness of behaviour problems across 16 different home and public settings (HSQ) and 12 school situation (SSQ) and the severity of these behaviour problems. Rated on a 9-point scale.

	Informal parent interview	Study 8	McKay, Gonzales, Quintana, Kim, & Abdul-Adil, 1999	Details not provided.
	Modified Overt Aggression Scale (MOAS)	Study 3	Knoedler, 1989	Paper based rating form. Third-party (parent, teacher, carer) rating scale consists of 4 elements (verbal aggression, aggression against property, auto aggression, physical aggression) rated on a 5-point scale. Elements measure presence and severity of aggressive behaviours perpetrated by participant over the previous week.
	Normative Adaptive Behaviour Checklist (NABC)	Study 1	Adams, 1984	Paper based rating form. Parent scale consists of 120 items scored on a 3-point scale. Items map onto 8 adaptive functioning subscales (including fine motor, gross more, language, self-help skills, independence, and home responsibilities). Total adaptive behaviour score utilised.
	Self-Control Rating Scale (SCRS)	Studies 1 (parent rating), 4 (carer rating), 5 and 7 (teacher rating)	Kendall & Wilcox, 1979	Paper based rating form. Parent and teacher scales consist of 33 items scored on a 7-point scale. Items map onto 3 subscales (self-control, impulsivity, joint self-control and impulsivity). Items include: "Does the child stick to what he or she is doing until he or she is finished with it?", "Does the child grab for the belongings of others?" and "Does the child interrupt inappropriately in conversations with peers, or wait his/her turn to speak?".
	School Behaviour Checklist (SBCL)	Study 2	Miller, 1972	Paper based rating form. Teacher scale consists of 96 items which map onto 7 subscales (low-need achievement, aggression, anxiety, academic disability, hostile isolation, extraversion and total disability). Items include: "Does things to get others angry", "tries to get other children in trouble".
	Social Skills Improvement System (SSIS)	Study 10	Gresham & Elliot, 2008	Paper based rating form. Parent scale consists of 140 items scored on a 4-point scale. Items map onto 2 subscales (social skills and competing problem behaviours) of which the Social Skills subscale was used which evaluates communication, cooperation, assertion, responsibility, empathy, engagement, and self-control abilities.
Observation	Therapist observations of behaviour.	Studies 1, 4 and 6	Not applicable	

Interventions Used

Table 7 details the sixteen types of intervention used across the thirteen studies. Whilst some common elements and similarities have been drawn from the descriptions of the interventions (i.e. CBT based) it is apparent that the interventions themselves are not directly comparable. Elements of CBT were utilised in eight studies (studies 1, 3, 4, 5, 6, 7, 11 and 13). Systemic elements were included in the interventions detailed in studies 1, 8 and 11. Self-instructional training was used in studies 2, 7 and 9 and problem-solving training was used in studies 2 and 12, however studies 3, 4, 5, 7, 8, 10 and 13 also include elements of this in the intervention description.

Eleven interventions focused solely on the young person in the intervention and one focused solely on parent training (study 1.1). Three studies focused on the combined family for intervention. Intervention length varied from one session (study 13) to a year-long involvement with varying sessions (study 11).

The integrity of the interventions was checked and reported in six studies (1, 2, 7, 9, 10 and 11) and many of the studies relied on a manualised or modulated approach to intervention. However, the integrity of the interventions and ability to replicate the interventions in other groups is limited in the remaining studies and in particular studies 8 and 9, which provided individualised problem-based support.

Follow up lengths from baseline to final assessment varied from the same day (study 13) to one year (studies 6 and 11), with study 9 not stating the length of follow up. However, as the length of interventions varied, the follow up from the end of intervention also varies from termination of intervention (studies 5, 8, 9, 11, 12, and

13) to up to approximately one year (study 6) with studies 1, 2, 3, 6, 7 and 10 strengthened by their use of further follow up data.

The highest quality studies (1, 2, 3, 4, 6, 7 and 10) utilised mainly CBT based interventions with some self-instruction and problem-solving skills training, in both group and individual sessions. The number and length of sessions covered a range from four 90 minute sessions to over twelve sessions, with up to a year of follow up data.

Table 7

Interventions Used, with Participant Type, Frequency and Length of Sessions and Reported Follow Up Length.

Study	**Intervention/s**	**Intervention participant:**	**Individual/ group:**	**Session frequency and length:**	**Follow up**
1	1. Parent training: Psychoeducation and behavioural training on the causes of defiant behaviour; positive attending skills and praising, attending to child compliance and improving parental command effectiveness, rewarding children for non-disruptive behaviour, setting up a home token system, time out and response cost, managing children in public places with think aloud - think ahead strategies.	Parent	Group	10 sessions, once per week for 10 weeks. Then monthly booster sessions. Length of sessions not stated.	9 months post initial assessment
1	2. Special Classroom: Cognitive-behavioural therapy (CBT) including intensive token system, response cost, over-correction, and time-out from reinforcement, self-control training, social skills training (skill streaming program), anger control training, daily school report card with home-based reinforcement.	Young person	Group	One full day, plus informal teacher consultation.	9 months post initial assessment
1	3. Combined: Interventions 1 and 2.	Parent and young person	Groups	As interventions 1 and 2	9 months post initial assessment
2	Think Aloud program, including elements of self-instructional and problem-solving training. Includes: metacognitive strategy planning and evaluation, through the participant verbalising their thoughts whilst completing different tasks.	Young person	Individual	30 minute, daily sessions for 6 weeks	4-5 months post initial assessment

3	CBT based manualised program (Williams Life Skills Training, WLST). Including: Increasing awareness of and objectivity in distressing situations, evaluating, coping with and responding to situations, problem-solving skills, communication and empathising skills.	Young person	Group	2 hour sessions, once per week for 8 weeks	9 weeks post initial assessment
4	CBT based anger control manualised training. Including: training in relaxation, problem-solving, use of coping statements, self-instructions and assertive social interactions. Includes the evaluation and self-monitoring of own behaviour, anger and conflict experiences. Behavioural techniques included use of live modelling, rehearsal, role playing, negative and positive symbolic modelling using videotaped feedback. A reinforcement point system was used for in session compliance, cooperation and participation with end of session rewards.	Young person	Group	12 sessions over 8 weeks	3 weeks post intervention completion
5.	CBT based program. Including: suppression of both verbal and nonverbal aggressive responding, analysis of the provocation-anger cycle including antecedent, anger cues, aggressive responses, and consequent events via self-monitoring, instruction in time-out response and techniques to facilitate mastery of anger-provoking situations, relaxation techniques, teaching appropriate verbal and nonverbal assertive responses as alternatives in obtaining desired outcomes, role playing non-verbal behaviour in conflict resolution, problem-solving skills with the opportunity to practice. Cognitive skills included self-instruction, modification of the attributions, self-evaluation of performance and thinking ahead. Alongside homework assignments.	Young person	Group	50 minute, biweekly sessions, for 10 sessions (5 weeks)	5 weeks post intervention completion
6.	ACT based intervention. Including: Increasing a sense of personal responsibility, evaluating the effect of their behaviour regulation and the experience of creative hopelessness, identifying and clarifying personally important valued directions and promoting diffusion skills so that the adolescents could take charge of their private experiences and choose actions according to their values.	Young person	Individual	90 minute sessions, biweekly for4 sessions (2 weeks)	1 year post intervention completion

7	1. CBT based self-control training. Including: problem-solving requiring the cognitive and behavioural skills of planning, deliberation, and inhibition of responding, self-control strategies in interpersonal interactions and rule following in an interpersonal context. Utilised token economy for reinforcement. Based on concrete directions, worded to apply specifically only to the task at hand.	Young person	Individual	30-40 minute, biweekly sessions, for 6 sessions (3 weeks)	2 months post initial assessment
	2. As above, however based on conceptual directions, worded more globally and abstractly, in such a way that they could apply to a wide range of situations to enable generalisation of techniques.	Young person	Individual	30-40 minute, biweekly sessions, for 6 sessions (3 weeks)	2 months post initial assessment
8	Psychosocial, systemic intervention (Multiple Family Groups, MFG). Including two or more families joining in a group with therapist to provide family peer support, discuss common concerns with an explicit focus on problems with family interactions.	Family	Group	Weekly sessions for 16 weeks. Session length not stated	16 weeks post initial assessment
9	Cognitive Self Instructional (CSI) training. Including appropriate behaviour modelling, exercises and role play using verbalization of self-instruction and self-reinforcement for corrections of errors and task completion. Selective cuing and reinforcement was provided for the children's imitation of the trainer modelled behaviour.	Young person	Individual	30 minute sessions, weekly for 6 weeks	Not stated
10	Alert program of self-regulation, manualised training. Including self-regulation skills though activity based sessions to integrate sensory and cognitive processing via the analogy of a car engine. There are three successive stages of the sessions with a child not proceeding to the next stage until the previous one is mastered. Stage one focuses on the child learning to identify and label their engine levels and speeds. Stage two focuses on the child experimenting with changing their engine speeds by acquiring self-regulation strategies. Stage three focuses on using the strategies outside of therapy. Stage four focuses on selecting appropriate strategies independently for use outside of the therapy.	Young person	Individual	60 minute sessions, weekly for 12 sessions (12 weeks)	6 months post initial assessment

11	Multiple interventions based on CBT and systemic therapy. Elements included a Daily Report Card procedure (DRC), collaborative teacher consultation and behaviourally based parenting sessions. DRC included skills to identify, monitor, and change individualized target behaviours with reinforcement provided at home based on school performance. Teacher consultation included twice weekly, 20-minute collaborative sessions focusing on behavioural assessment, DRC planning, and troubleshooting. Behavioural parenting sessions were manualised sessions focusing on elements of parent education and managing defiant children.	Parent/young person/school	Individual	Number and frequency of sessions differing by participant based on individual needs. Involvement up to a year	1 year post initial assessment
12	"I can problem solve" problem-solving, manualised intervention. Includes 83 structured lessons using pictures, toys, puppets, games, stories, drama, role-plays, and dialogues based on real life conversations teaching and encouraging problem solving skills.	Young person	Individual	30 minute sessions, biweekly for 14 weeks	14 weeks post initial assessment
13	CBT based, guided debriefing session. Including reflection, problem-solving, coping skills and generalisation skills.	Young person	Group	One session during overnight respite care	None, all assessments completed within same day

Review Findings

Some degree of IC improvement was reported in eleven of the studies, including six of the seven of the highest quality studies (2, 3, 4, 6, 7 & 10). Within-subject improvements were reported in studies 4, 6, 7 and 12. Significant differences in between-group comparisons on IC measures post-intervention were reported by studies 2, 8, 11 and 13, however study 11 also observed improvements in IC measures for control groups, suggesting some potential difficulties in observing change within a trait-measure of IC or the confounding impact of an unintended intervention, limiting the strength of this study. Additionally, study 13 reported between-group differences but not within-subject improvements of IC, potentially highlighting differences in the groups at baseline, limiting the reliability of this study. Improvements in IC were reported in both within-subject and between-subject comparisons in studies, 3, 9, 10 and 11, which strengthened the reliability of their findings.

Some degree of behavioural improvement was reported in eleven of the studies with study 9 reporting no change and study 13 reporting no improvement in the intervention group and a worsening of behaviour within the control group. Within-subject improvements were reported in studies 1, 4, 5, 6, 8 and 12. However, a location specific effect was observed in study 1 (behaviour improvement only found in teacher ratings) and study 5 only observed improvement in less serious behaviours. This highlights the importance of generalisability of the interventions to the target population. In addition, study 8 reported improvements in behaviour in control groups suggesting a potentially confounding impact of an unintended intervention, limiting the strength of this study.

Significant differences in between-group comparisons on behaviour measures, post-intervention were reported in study 2, however only when comparing the intervention group to the normal-control group, when controlling for baseline scores. Improvements in behaviour were reported both within-subjects and between-subject comparisons in studies 3, 7, 10 and 11, which strengthened the reliability of their findings. Study 7 also reported a potentially delayed intervention effect for the conceptual self-instruction group, although no self-report improvements were found. The implication of this is that studies with short or no follow-up may not have observed a delayed response.

Six of the highest quality studies (2, 3, 4, 6, 7 and 10) found some improvements in IC and all of the highest quality studies (1, 2, 3, 4, 6, 7 & 10) found improvements in behaviour, using both within and between-subjects comparisons. Some of the IC changes were only found for the direct measures of IC and not corroborated with reliable self or third-party report (study 7) and behavioural changes were potentially location specific (study 1), delayed (study 7) or only in comparison with matched populations (study 2). Study 1 failed to find any change in IC measures, potentially related to methodological issues or poor motivation.

Discussion

This review provides an overview of the published literature regarding measurements of IC in psychosocial interventions for youth behaviour. The evidence is limited and further weakened by a number of methodological issues, inconsistent results and a lack of follow up or longitudinal studies meaning that the longer-term implications of these studies cannot be predicted, however, the following claims can be made.

The highest quality studies utilised primary school aged (1 & 2), primary and secondary school aged (7 & 10) or secondary school aged adolescent (3, 4 & 6) predominantly male participants, recruited from disruptive or delinquent populations. A range of designs were used, enabling control comparisons (whether between or within-subjects) with some utilising additional comparisons to ensure the findings were reliable and valid. CBT based interventions were mainly used, with some elements of problem-solving and self-instruction training incorporated. The intervention length ranged from four to over twelve sessions with up to a year of follow up data. IC measurement was based on reliable, direct measurement of impulsive-disinhibition and decision-making and behaviour change was based on third-party ratings, both supplemented with some self-report and/or observational data. Some improved IC and behaviour was found using both within and between-subjects comparisons; however some of the IC changes were only found for the direct measures of IC and some of the behavioural changes reported were inconsistent.

The IC improvements were reported in studies using direct measures but did not appear to be corroborated by third-party or self-report which highlights a discrepancy between changes observed across IC/impulsivity domains. This limits the ability to determine the efficacy of these interventions on trait-based IC measures. Overall, this supports the view of Reynolds et al., (2006) and Reynolds, Penfold, and Patak (2008), who found no significant association between direct measures and self/third-party trait measures of impulsivity and suggests that these measures are assessing different types of impulsivity, with direct measures assessing at least two unrelated subtypes of impulsive behaviour (impulsive disinhibition, requiring disinhibition of a prepotent

response and impulsive decision making, requiring the ability to evaluate and choose between different potential outcomes). The lack of observed improvement in indirect measures of IC highlights an area of research need, to determine if interventions can be adapted to promote improvements in self and/or third-party ratings of impulsivity or IC alongside improvements in direct measures of IC and externalising behaviour (Carroll et al., 2006).

Overall, it appears that there is a potential relationship between the efficacy of interventions in reducing externalising behaviour with changes in externalising behaviour and direct measures of IC. This supports the view that although behavioural interventions are not directly targeting IC, improvements in participant's behaviour and IC are being observed (Ross & Hoaken, 2010).

Strengths and Weaknesses of This Review

The selection of studies within this review has not been open to scrutiny of a second rater, therefore this review is considered as representing a potentially biased view on the available research. However, a comprehensive search strategy and inclusion criteria was established a priori to limit the impact of this on the studies reaching the review, in addition a standardised quality assessment tool was utilised to support the analysis and a second rater was used to corroborate the quality assessment of the selected studies to limit the impact of this on the reviews findings.

A further potential weakness of this review is the restrictive nature of the original search using terms in title, abstract or keywords only. The search utilised this approach to ensure that the returned studies provided an adequate degree of detail regarding the relevant terms required to complete the review.

The Cochrane library was searched to identify any additional articles referenced through review papers. No additional articles were identified, inferring that the original search strategy may have been adequate.

Suggestions for Future Research

Overall, this review indicates that it is possible to currently infer a potential relationship between behavioural and IC change following psychosocial intervention targeting externalising behaviour. Further research would focus on tracking the longevity of these findings, analysing the impact of improvements in IC on variables including improvements in self-awareness and self-monitoring of behaviour and IC and self-esteem and self-efficacy of the YP. These areas would be particularly useful as self-esteem and self-efficacy are themselves predictors of behavioural improvement in delinquent populations (Sapona, Bisset, & Conlong, 2011). In addition, it remains unclear, if interventions specifically targeting IC would result in behavioural modification and this would be a focus for further experimental research (Ross & Hoaken, 2010).

Future research would benefit from focusing on alternative populations of YP (including community youth offending, mental health services, school excluded groups) exhibiting externalising behaviour and the use of robust methodology to ensure intervention efficacy and effectiveness.

Conclusions

This review has highlighted the limited high quality research into the impact of psychosocial interventions for disruptive behaviour on IC change. The research available indicates a range of types of measures of IC are being used,

which appear to measure different aspects of IC. There appears to be a potential relationship between the efficacy of interventions to reduce externalising behaviour with changes in externalising behaviour and IC measures, with improvements observed appearing to be mainly related to direct measures of IC. The interventions which appear to exhibit an effect on IC and behaviour are CBT based interventions for between four and twelve sessions, indicating a potentially economic means of promoting change. Further research into this area is required, particularly that focusing on the longer-term effects of change and the impact of IC targeted interventions on IC and behaviour.

References

Achenbach, T. M., & Edelbrock, C. (1986). *Manual for the child behavior checklist and child behavior profile*. Burlington, VT: University of Vermont.

Adams, G. L. (1984). *Normative adaptive behavior checklist*. San Antonio, TX: The Psychological Corporation.

American Psychiatric Association. (2000). *Diagnostic and statistical manual of mental disorders* (4th ed., text rev.). doi:10.1176/appi.books.9780890423349

Baer, R., & Neitzel, M. T. (1991). Cognitive and behavioral treatment of impulsivity in children: A meta-analytic review of the outcome literature. *Journal of Clinical Child Psychology, 20,* 400-412. doi:10.1207/s15374424jccp2004_9

Barkley, R. A. (1990). *Attention deficit hyperactivity disorder: A handbook for diagnosis and treatment.* New York: Guilford Press.

Barkley, R. A., Shelton, T. L., Crosswait, C., Moorehouse, M., Fletcher, K., Barrett, S., … Metevia, L. (2000). Multi-method psycho-educational intervention for preschool children with disruptive behavior: Preliminary results at post-treatment. *Journal of Child Psychology and Psychiatry, 41,* 319-332. doi:10.1111/1469-7610.00616

Blume, A. W., Marlatt, G. A., & Schmaling, K. B. (2000). Executive cognitive function and heavy drinking behavior among college students.

Psychology of Addictive Behaviors, 14, 299-302. doi:10.1037/0893-164X.14.3.299

Camp, B. W., Blom, G. E., Hebert, F., & van Doorninck, W. J. (1977). “Think Aloud”: A program for developing self-control in young aggressive boys. *Journal of Abnormal Child Psychology, 5,* 157-169.

Carroll, A., Hemingway, F., Bower, J., Ashman, A., Houghton, S., & Durkin, K. (2006). Delinquency: Differences among early-onset, late-onset, and non-offenders. *Journal of Youth and Adolescence, 35,* 519–529. doi:10.1007/s10964-006-9053-6

Chen, C., Li, C., Wang, H., Ou, J., Zhou, J., & Wang, X. (2014). Cognitive behavioral therapy to reduce overt aggression behavior in Chinese young male violent offenders. *Aggressive Behaviour, 40,* 329-336. doi:10.1002/ab.21521

Chen, C. Y., Muggleton, N. G., Juan, C. H., Tzeng, O.J. L., & Hung, D. L. (2008). Time pressure leads to inhibitory control deficits in impulsive violent offenders. *Behavioural Brain Research*, *187,* 483-488. doi:10.1016/j.bbr.2007.10.011

Conners, C. K. (1969). A teacher rating scale for use in drug studies with children. *American Journal of Psychiatry, 126,* 884-888.

Feindler, E. L., Ecton, R. B., Kingsley, D., & Dubey, D. (1986). Group anger control training for institutionalized psychiatric male adolescents. *Behaviour Therapy, 17,* 109-123.

Feindler, E. L., Marriott, S. A., & Iwata, M. (1984). Group anger control training for junior high school delinquents. *Cognitive therapy and research, 8,* 299-311.

Fishbein, D., Scott, M., Hyde, C., Newlin, D., Hubal, R., Serin, R., Chrousos, G., & Alesci, S. (2006). *Neuropsychological and emotional deficits predict correctional treatment response.* Washington, DC: United States Department of Justice, National Institute of Justice.

Geier, C. F., Terwilliger, R., Teslovich, K., Velanova, K., & Luna, B. (2009). Immaturities in reward processing and its influence on inhibitory control in adolescence. *Cerebral Cortex, 20,* 1-17. doi:10.1093/cercor/bhp225

Gioia, G.A., Isquith, P.K., Guy, S.C., & Kenworthy, L. (2000). Test review behaviour rating inventory of executive function. *Child Neuropsychology: A Journal on Normal and Abnormal Development in Childhood and Adolescence, 6*, 235-238. doi:10.1076/chin.6.3.235.3152

Gladue, B. A. (1991). Qualitative and quantitative sex differences in self-reported aggressive behavior characteristics. *Psychological Reports, 68*, 675-684.

Gómez, M. J., Luciano, C., Páez-Blarrina, M., Ruiz, F. J., Valdivia-Salas, S., & Gil-Luciano, B. (2014). Brief ACT protocol in at-risk adolescents with conduct disorder and impulsivity. *International Journal of Psychology and Psychological Therapy, 14,* 307-332.

Gordon, M. (1983). *The Gordon diagnostic system*. DeWitt, NY: Gordon Systems.

Goyette, C. H., Conners, C. K., & Ulrich, R. F. (1978). Normative data on revised Conners parent and teachers rating scales. *Journal of Abnormal Child Psychology*, *6*, 221-236.

Gresham, F. M., & Elliott, S. N. (2008). *Social skills improvement system: Rating scales.* Bloomington, MN: Pearson Assessments.

Kagan, J. (1966). Reflection-impulsivity: The generality and dynamics of conceptual tempo. *Journal of Abnormal Psychology, 71,* 17-24.

Kendall, P. C., & Wilcox, L. E. (1979). Self-control in children: Development of a rating scale. *Journal of Consulting and Clinical Psychology*, *47*, 1020-1029.

Kendall, P. C., & Wilcox, L. E. (1980). Cognitive-behavioral treatment for impulsivity: Concrete versus conceptual training in non-self-controlled problem children. *Journal of Consulting and Clinical Psychology, 48,* 80-91.

Knoedler, D. W. (1989). The modified overt aggression scale. *The American Journal of Psychiatry, 146,* 1081–1082.

Korkma, M., Kirk, U., & Kemp, S. L. (2007). *NEPSY II. Clinical and interpretative manual.* San Antonio, TX: Psychological Corporation.

Martin, A., Saunders, D. H., Shenkind, S. D., & Sproule, J. (2014).Lifestyle intervention for improving school achievement in overweight or obese children and adolescents. *Cochrane Database of Systematic Reviews, 3,* 1-93. doi:10.1002/14651858.CD009728.pub2

Matsushima, J. (1964). An instrument for classifying impulse control among boys. J*ournal of Consulting Psychology, 28,* 87-90.

McKay, M. M., Gonzales, J., Quintana, E., Kim, L., & Abdul-Adil, J. (1999). Multiple family Groups: An alternative for reducing disruptive behavioural difficulties of urban children. *Research on Social Work Practice, 9*, 593-607. doi:10.1177/104973159900900505

Meda, S. A., Stevens, M. C., Potenza, M. N., Pittman, B., Gueorguieva, R., Andrews, M. M., … Pearlson, G. D. (2009). Investigating the behavioral and self-report constructs of impulsivity domains using principal component analysis. *Behavioural Pharmacology, 20,* 390–399. doi:10.1097/FBP.0b013e32833113a3

Miller, L. C. (1972). School behaviour check list: An inventory of deviant behavior for elementary school children. *Journal of Consulting and Clinical Psychology, 38,* 134-144.

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. *Journal of Clinical Epidemiology, 62*, 1006-1012. doi:10.1016/j.jclinepi.2009.06.005

Moore, S. F., & Cole, S. O. (1978). Cognitive self-mediation training with hyperkinetic children. *Bulletin of the Psychonomic Society, 12*, 1*8-20.*

Mullin, S., & Simpson, J. (2007). Does executive functioning predict improvement in offenders' behaviour following enhanced thinking skills training? An exploratory study with implications for rehabilitation. *Legal*

and Criminological Psychology, 12, 117-131. doi:10.1348/135532505X91560

Nash, K., Stevens, S., Greenbaum, R., Weiner, J., Koren, G., & Rovet, J. (2015). Improving executive functioning in children with fetal alcohol spectrum disorders. *Child Neuropsychology, 21,* 191–209. doi:10.1080/09297049.2014.889110

Nigg, J. T. (2000). On inhibition/disinhibition in developmental psychopathology: Views from cognitive and personality psychology and a working inhibition taxonomy. *Psychological Bulletin, 126*, 220-46. doi:10.1037//0033-2909.126.2.220

Owens, J. S., Murphy, C. E., Richerson, L., Girio, E. L., & Himawan, L. K. (2008). Science to practice in underserved communities: The effectiveness of school mental health programming. *Journal of Clinical Child & Adolescent Psychology, 37,* 434–447. doi:10.1080/15374410801955912

Özcan, C. T., Oflaz, F., Türkbay, T., & Freeman Clevenger, S. M. (2013). The effectiveness of an interpersonal cognitive problem-solving strategy on behavior and emotional problems in children with attention deficit hyperactivity. *Archives of Neuropsychiatry, 50,* 244-251. doi:10.4274/npa.y6455

Patton, J. H., Stanford, M. S., & Barratt, E. S. (1995). Factor structure of the Barratt impulsiveness scale. *Journal of Clinical Psychology, 51,* 768–774. doi:10.1002/1097-4679(199511)51:6<768::AIDJCLP2270510607>3.0.CO;2-1

Pelham, W. E., Gnagy, E., Greenslade, K., & Milich, R. (1992). Teacher ratings of DSM-III-R symptoms for the disruptive behavior disorders. *Journal of the American Academy of child and Adolescent Psychiatry, 31,* 210-128.

Porteus, S. D. (1955). *The Maze Test: Recent Advances.* Oxford, England: Pacific Books.

Reynolds, B., Ortengren, A., Richards, J. B., & de Wit, H. (2006). Dimensions of impulsive behavior: Personality and behavioral measures. *Personality and Individual Differences, 40,* 305–315. doi:10.1016/j.paid.2005.03.024

Reynolds, B., Penfold, R. B., & Patak, M. (2008). Dimensions of impulsive behavior in adolescents: Laboratory behavioral assessments. *Experimental and Clinical Psychopharmacology, 16,* 124–131. doi:10.1037/1064-1297.16.2.124

Riggs, N. R., Greenberg, M. T., Kusché, C. A., & Pentz, M. A. (2006). The mediational role of neurocognition in the behavioural outcomes of a social-emotional prevention program in elementary school students: Effects of the PATHS curriculum. *Prevention Science, 7,* 91-102. doi:10.1007/s11121-005-0022-1

Romer, D., Betancourt, L. M., Brodsky, N. L., Giannetta, J. M., Yang, W., & Hurt, H. (2011). Does adolescent risk taking imply weak executive function? A prospective study of relations between working memory performance, impulsivity, and risk taking in early adolescence. *Developmental Science, 14,* 1119–1133. doi:10.1111/j.1467-7687.2011.01061.x

Rosenbaum, M. (1980). Individual differences in self-control behaviors and tolerance of painful stimulation. *Journal of Abnormal Psychology, 89*, 581-590. doi: 10.1037/0021-843X.89.4.581

Ross, E. H., & Hoaken, P. N. S. (2010). Correctional remediation meets neuropsychological rehabilitation how brain injury and schizophrenia research can improve offender programming. *Criminal Justice and Behavior, 37,* 656-677. doi:10.1177/0093854810363104

Sapona, M., Bisset, C., & Conlong, A. (2011). *What works to reduce reoffending: A summary of the evidence.* Retrieved from http://scotland.gov.uk/Resource/0038/00385880.pdf

Thomas, B. H., Ciliska, D., Dobbins, M., & Micucci, S. (2004). A process for systematically reviewing the literature: Providing the research evidence for public health nursing interventions. *Worldviews on Evidence Based Nursing, 1*, 176-184. doi:10.1111/j.1524-475X.2004.04006.x

Torgerson, C. (2003). *Systematic reviews*. London, UK: Continuum International Publishing Group.

Weafer, J., Baggott, M. J., & de Wit, H. (2013). Test-retest reliability of behavioral measures of impulsive choice, impulsive action, and inattention. *Experimental and Clinical Psychopharmacology, 21,* 475-481. doi:10.1037/a0033659

Yang, H., & Lee, Y. (2005). The use of single-session cinematherapy and aggressive behavioral tendencies among adopted children - A pilot study. *American Journal of Recreation Therapy, 4,* 35-44.

Zwi, M., Jones, H., Thorgaard, C., York, A., & Dennis, J. A. (2011). Parent training interventions for attention deficit hyperactivity disorder (ADHD) in children aged 5 to 18 years. *Cochrane Database of Systematic Reviews, 12,* 1-71. doi:10.1002/14651858.CD003018.pub3

Appendices

Appendix A. Effective Health Practice Project (EPHPP) Quality Assessment Tool for Quantitative Studies

Component Ratings

A)	Selection Bias		
		Q1. Are the individuals selected to participate in the study likely to be representative of the target population?	1. Very Likely 2. Somewhat Likely 3. Not Likely 4. Can't tell
		Q2. What percentage of selected individuals agreed to participate?	1. 80-100% 2. 60- 79% 3. <60% 4. Not applicable 5. Can't tell
	Section Rating:	Strong: 1 / Moderate: 2 / Weak: 3	
B)	Study Design		
		Indicate the study design:	1. Randomised controlled trial 2. Controlled clinical trial 3. Cohort analytic trial (2 group pre + post) 4. Case control 5. Cohort (1 group pre + post) 6. Interrupted time series 7. Other: 8. Can't tell
		Was the study described as randomized?	No (go to C) Yes
		If yes, was the method of randomization described?	No Yes
		If yes, was the method appropriate?	No Yes
	Section Rating:	Strong: 1 / Moderate: 2 / Weak: 3	

C)	Confounders		
		Q1. Were there important differences between groups prior to intervention?	1. Yes 2. No 3. Can't tell
		The following are examples of confounders:	1. Race 2. Sex 3. Marital status 4. Age 5. SES (income or class) 6. Education 7. Health status 8. Pre-intervention score on outcome measure
		Q2. Is yes, indicate the percentage of relevant confounders that were controlled (either in the design (e.g. stratification, matching) or analysis).	1. 80-100% 2. 60-79% 3. <60% 4. Can't tell
	Section Rating:	Strong / Moderate / Weak 1 / 2 / 3	
D)	Blinding		
		Q1. Was (were) the outcome assessor(s) aware of the intervention or exposure status of participants?	1. Yes 2. No 3. Can't tell
		Q2. Were the study participants aware of the research question?	1. Yes 2. No 3. Can't tell
	Section Rating:	Strong / Moderate / Weak 1 / 2 / 3	
E)	Data Collection Methods		
		Q1. Were data collection tools shown to be valid?	1. Yes 2. No 3. Can't tell
		Q2. Were data collection tools shown to be reliable?	1. Yes 2. No 3. Can't tell
	Section Rating:	Strong / Moderate / Weak 1 / 2 / 3	

<table>
<tr><td>F)</td><td>Withdrawals and Drop outs</td><td></td><td></td></tr>
<tr><td></td><td></td><td>Q1.Were withdrawals and drop outs reported in terms of numbers and/or reasons per group?</td><td>1. Yes
2. No
3. Can’t tell
4. Not applicable (one time surveys or interviews)</td></tr>
<tr><td></td><td></td><td>Q2. Indicate the percentage of participants completing the study. (If the percentage differs by groups, report the lowest)</td><td>1. 80-100%
2. 60-79%
3. <60%
4. Can’t tell
5. Not applicable</td></tr>
<tr><td></td><td>Section Rating:</td><td><table><tr><td>Strong</td><td>Moderate</td><td>Weak</td></tr><tr><td>1</td><td>2</td><td>3</td></tr></table></td><td></td></tr>
<tr><td>G)</td><td>Intervention Integrity</td><td></td><td></td></tr>
<tr><td></td><td></td><td>Q1. What percentage of participants received the allocated intervention or exposure of interest?</td><td>1. 80-100%
2. 60-79%
3. <60%
4. Can’t tell</td></tr>
<tr><td></td><td></td><td>Q2. Was the consistency of the intervention measured?</td><td>1. Yes
2. No
3. Can’t tell</td></tr>
<tr><td></td><td></td><td>Q3. Is it likely that subjects received an unintended intervention (contamination or co-intervention) that may influence the results?</td><td>1. Yes
2. No
3. Can’t tell</td></tr>
<tr><td>H)</td><td>Analysis</td><td></td><td></td></tr>
<tr><td></td><td></td><td>Q1. Indicate the unit of allocation.</td><td>Community
Organisation/Institution
Practice/office
Individual</td></tr>
<tr><td></td><td></td><td>Q2. Indicate the unit of analysis.</td><td>Community
Organisation/Institution
Practice/office
Individual</td></tr>
<tr><td></td><td></td><td>Q3. Are the statistical methods appropriate for the study design?</td><td>1. Yes
2. No
3. Can’t tell</td></tr>
<tr><td></td><td></td><td>Q4. Is the analysis performed by intervention allocation status (i.e. intention to treat) rather than actual intervention received?</td><td>1. Yes
2. No
3. Can’t tell</td></tr>
</table>

GLOBAL RATINGS FOR THIS PAPER	Strong	Moderate	Weak	
	1 (no weak ratings)	2 (one weak rating)	3 (2+ weak ratings)	

Appendix B. Submission Guidance for Authors from Neuropsychological Rehabilitation Manuscript preparation

Journal-specific guidelines

This journal accepts original (regular) articles, scholarly reviews, and book reviews.

The style and format of the typescripts should conform to the specifications given in the Publication Manual of the American Psychological Association (6th ed.).

There is no word limit for manuscripts submitted to this journal. Authors should include a word count with their manuscript.

General guidelines

Manuscripts are accepted in English. Oxford English Dictionary spelling and punctuation are preferred. Please use double quotation marks, except where “a quotation is ‘within’ a quotation”. Long quotations of words or more should be indented without quotation marks.

Manuscripts should be compiled in the following order: title page; abstract; keywords; main text; acknowledgements; references; appendices (as appropriate); table(s) with caption(s) (on individual pages); figure caption(s) (as a list).

Abstracts of 150-200 words are required for all manuscripts submitted.

Each manuscript should have up to 5 keywords.

Search engine optimization (SEO) is a means of making your article more visible to anyone who might be looking for it. Please consult our guidance here.

Section headings should be concise.

All authors of a manuscript should include their full names, affiliations, postal addresses, telephone numbers and email addresses on the cover page of the manuscript. One author should be identified as the corresponding author. Please give the affiliation where the research was conducted. If any of the named co-authors moves affiliation during the peer review process, the new affiliation can be given as a footnote. Please note that no changes to affiliation can be made after the manuscript is accepted. Please note that the email address of the corresponding author will normally be displayed in the article PDF (depending on the journal style) and the online article.

All persons who have a reasonable claim to authorship must be named in the manuscript as co-authors; the corresponding author must be authorized by all co-authors to act as an agent on their behalf in all matters pertaining to publication of the manuscript, and the order of names should be agreed by all authors.

Biographical notes on contributors are not required for this journal.

Please supply all details required by any funding and grant-awarding bodies as an Acknowledgement on the title page of the manuscript, in a separate paragraph, as follows:

For single agency grants: "This work was supported by the [Funding Agency] under Grant [number xxxx]."

For multiple agency grants: "This work was supported by the [Funding Agency 1] under Grant [number xxxx]; [Funding Agency 2] under Grant [number xxxx]; and [Funding Agency 3] under Grant [number xxxx]."

Authors must also incorporate a Disclosure Statement which will acknowledge any financial interest or benefit they have arising from the direct applications of their research.

For all manuscripts non-discriminatory language is mandatory. Sexist or racist terms must not be used.

Authors must adhere to SI units. Units are not italicised.

When using a word which is or is asserted to be a proprietary term or trade mark, authors must use the symbol ® or TM.

Style guidelines

Word templates are available for this journal. If you are not able to use the template via the links or if you have any other template queries, please contact authortemplate@tandf.co.uk

Authors must not embed equations or image files within their manuscript

Figures

Please provide the highest quality figure format possible. Please be sure that all imported scanned material is scanned at the appropriate resolution: 1200 dpi for line art, 600 dpi for grayscale and 300 dpi for colour.

Figures must be saved separate to text. Please do not embed figures in the manuscript file.

Files should be saved as one of the following formats: TIFF (tagged image file format), PostScript or EPS (encapsulated PostScript), and should contain all the necessary font information and the source file of the application (e.g. CorelDraw/Mac, CorelDraw/PC).

All figures must be numbered in the order in which they appear in the manuscript (e.g. Figure 1, Figure 2). In multi-part figures, each part should be labelled (e.g. Figure 1(a), Figure 1(b)).

Figure captions must be saved separately, as part of the file containing the complete text of the manuscript, and numbered correspondingly.

The filename for a graphic should be descriptive of the graphic, e.g. Figure1, Figure2a.

Publication charges

Submission fee

There is no submission fee for Neuropsychological Rehabilitation.

Page charges

There are no page charges for Neuropsychological Rehabilitation.

Colour charges

Colour figures will be reproduced in colour in the online edition of the journal free of charge. If it is necessary for the figures to be reproduced in colour in the print version, a charge will apply. Charges for colour figures in print are £250 per figure ($395 US Dollars; $385 Australian Dollars; 315 Euros). For more than 4 colour figures, figures 5 and above will be charged at £50 per figure ($80 US Dollars; $75 Australian Dollars; 63 Euros).

Depending on your location, these charges may be subject to Value Added Tax.

Reproduction of copyright material

If you wish to include any material in your manuscript in which you do not hold copyright, you must obtain written permission from the copyright owner, prior to submission. Such material may be in the form of text, data, table, illustration,

photograph, line drawing, audio clip, video clip, film still, and screenshot, and any supplemental material you propose to include. This applies to direct (verbatim or facsimile) reproduction as well as “derivative reproduction” (where you have created a new figure or table which derives substantially from a copyrighted source).

You must ensure appropriate acknowledgement is given to the permission granted to you for reuse by the copyright holder in each figure or table caption. You are solely responsible for any fees which the copyright holder may charge for reuse.

The reproduction of short extracts of text, excluding poetry and song lyrics, for the purposes of criticism may be possible without formal permission on the basis that the quotation is reproduced accurately and full attribution is given. For further information and FAQs on the reproduction of copyright material, please consult our Guide.

Supplemental online material

Authors are encouraged to submit animations, movie files, sound files or any additional information for online publication.

Manuscript submission

All submissions should be made online at the Neuropsychological Rehabilitation Scholar One Manuscripts website. New users should first create an account. Once logged on to the site, submissions should be made via the Author Centre. Online user guides and access to a helpdesk are available on this website.

Manuscripts may be submitted in any standard editable format, including Word and EndNote. These files will be automatically converted into a PDF file for the review process. LaTeX files should be converted to PDF prior to submission because ScholarOne Manuscripts is not able to convert LaTeX files into PDFs directly. All LaTeX source files should be uploaded alongside the PDF.

Copyright and authors' rights

To assure the integrity, dissemination, and protection against copyright infringement of published articles, you will be asked to assign us, via a Publishing Agreement, the copyright in your article. Your Article is defined as the final, definitive, and citable Version of Record, and includes: (a) the accepted manuscript in its final form, including the abstract, text, bibliography, and all accompanying tables, illustrations, data; and (b) any supplemental material hosted by Taylor & Francis. Our Publishing Agreement with you will constitute the entire agreement and the sole understanding between you and us; no amendment, addendum, or other communication will be taken into account when interpreting your and our rights and obligations under this agreement.

Free article access

As an author, you will receive free access to your article on Taylor & Francis Online. You will be given access to the My authored works section of Taylor & Francis Online, which shows you all your published articles. You can easily view, read, and download your published articles from there. In addition, if someone has cited your article, you will be able to see this information. We are

committed to promoting and increasing the visibility of your article and have provided guidance on how you can help. Also within My authored works, author eprints allow you as an author to quickly and easily give anyone free access to the electronic version of your article so that your friends and contacts can read and download your published article for free. This applies to all authors (not just the corresponding author).

Reprints and journal copies

Corresponding authors receive a complimentary copy of the issue containing their article. Complimentary reprints are available through Rightslink® and additional reprints can be ordered through Rightslink® when proofs are received. If you have any queries about reprints, please contact the Taylor & Francis Author Services team at reprints@tandf.co.uk. To order a copy of the issue containing your article, please contact our Customer Services team at Adhoc@tandf.co.uk

Open Access

Taylor & Francis Open Select provides authors or their research sponsors and funders with the option of paying a publishing fee and thereby making an article permanently available for free online access – open access – immediately on publication to anyone, anywhere, at any time. This option is made available once an article has been accepted in peer review.

SCHOOL OF PSYCHOLOGY

DOCTORATE IN CLINICAL PSYCHOLOGY

EMPIRICAL PAPER

Direct, near and far transfer effects of inhibitory control training in young people: A multiple-baseline, single-case experimental design.

Trainee Name:	**Joanna Green**
Primary Research Supervisor:	**Doctor Jennifer Limond** Consultant Clinical Neuropsychologist, College of Life and Environmental Sciences
Secondary Research Supervisor:	**Professor Huw Williams** Associate Professor of Clinical Neuropsychology, College of Life and Environmental Sciences
Target Journal:	Neuropsychological Rehabilitation Journal.
Word Count:	8000 words (excluding abstract, table of contents, list of figures, references, footnotes, appendices)

Submitted in partial fulfilment of requirements for the Doctorate Degree in Clinical Psychology, University of Exeter

Acknowledgements

I would like to thank and acknowledge all the young people that took the time to take part in my research. I would also like to thank the parents and teachers of the participants for their support. In addition, I would like to thank the staff at the schools I recruited through, or attempted to recruit through, for their time, specifically the Science department at Cotham School.

I must thank and acknowledge the help received from Tobias Stevens in the Cognitive Science team with programming the training.

Thank you to my main supervisor Dr Jenny Limond for all of her support, resourcefulness and guidance with the completion of this study. Thank you also to my second supervisor Professor Huw Williams and previous supervisor Dr Anna Adlam for her support with the original proposal development.

I would like to thank my family, D and S, for their patience, time and love throughout everything. This is dedicated to the memory of my wonderful mum.

Abstract

Objective: Adolescence is a period of crucial neuropsychological development. Executive control functions (ECF) develop during adolescence and are constructs involving the planning, initiation, and regulation of goal-directed behaviour. ECFs include impulse control critical for behavioural regulation. Training approaches for improving inhibitory control (IC) and impulsivity in young people (YP) are in their infancy, although some positive effects have been found in adults. This research aimed to test the hypothesis that IC intervention would improve IC and impulsivity (direct, near and far-transfer effects) and improve behavioural-control (mid and far-transfer effects) in YP.

Methods: Six healthy YP, aged 11-16 years, attending mainstream education, participated in this single-case, multiple-baseline experimental design. The participants completed assessments at three phase-change points and completed continuous measures of their own impulsivity and behaviour goals. Each participant completed a baseline and intervention phase of differing randomised lengths within the 20 day study. The data were analysed visually using non-parametric tests of difference, randomisations tests and indices of reliable change.

Results: IC and impulsivity were not observed to improve with intervention based on direct and far-transfer effects and limited improvement was observed based on near-transfer effects. Overall, behavioural control was not observed to improve with intervention based on near and far-training effects, but limited improvements were observed for some individual participants.

Conclusion: The intervention was not observed to be effective in reducing IC or improving behavioural control overall, with very limited effects found in individual cases, which are discussed in directions for future research.

Introduction

Adolescence is a period of crucial neuropsychological development. Intensified activity and development within socio-emotional and reward-drive systems in adolescence, results in the heightened propensity for stimulating novel, rewarding experiences. This, in addition to the increasing influence of social groups and peers, can result in increased risk taking behaviour (Centifanti, Modecki, MacLellan, & Gowling, 2014; Geier, Terwilliger, Teslovich, Velanova, & Luna, 2009; Steinberg, 2007). The regulation systems which balance the reward-drive are slower to mature, resulting in a period of increased desire for reward, supported by immature behavioural regulation systems (Romer et al., 2011; Steinberg et al., 2008). Executive control functions (ECF) are cognitive constructs involving the planning, initiation, and regulation (i.e., maintaining or altering) of goal-directed behaviour. ECFs include skills of cognitive flexibility and strategy formation, attention, working memory, response monitoring, and impulse control; all skills critical for behavioural regulation (Ross & Hoaken, 2010). ECF impairment is associated with impulsivity, sensitivity to consequences, poor decision making, inattention, social skills deficits and behavioural dysregulation.

Impulsivity is a multifaceted construct of which inhibitory control (IC) is one element. IC development is protracted throughout adolescence and into young adulthood (Steinberg et al., 2008; Velanova, Wheeler, & Luna, 2008). There is developing evidence that behavioural difficulties during adolescence are related to IC deficits (Carroll et al., 2006; Chen, Muggleton, Juan, Tzeng, & Hung, 2008; Fishbein et al., 2006), alongside immature detection and appraisal of rewards (Geier et al., 2009). The ability to manage impulses and inhibit an

inappropriate or unhelpful response, by demonstrating restraint, is an important functional skill in managing daily life and is a crucial developmental process occurring through adolescence (Beauchamp, Kahn, & Berkman, 2016).

Models of impulsivity and IC suggest distinctions between cognitive impulsivity (impulsive choice and interference control) and behavioural impulsivity/IC (impulsive action and motor inhibition) both managed by ECFs (Nigg, 2000; Weafer, Baggott, & de Wit, 2013). Control over impulses and behaviour regulation are proposed to result from both a top-down cognitive control mechanism and the control of behavioural impulsive drives. The behavioural activation system (BAS) and behavioural inhibition system (BIS) proposed by Gray's personality model (as cited in Carver & White, 1994) suggests that behavioural dysregulation can result from both a top-down control mechanism failure, including poor interference motor IC, and an overactive activation system (heightened impulsive activation; Caswell, Morgan, & Duka, 2013; Nigg, 2000). In general, these distinct processes can both contribute to the expression of impulsivity.

Training IC/Impulsivity

Within normal development, impulse control and IC skills improve with age throughout adolescence and into early adulthood (Ross & Hoaken, 2010; Steinberg et al., 2008). Training approaches for improving IC/impulsivity in young people (YP) have been highlighted as potentially beneficial in reducing risk-taking behaviour and improving skills of young people and adults (Berkman, Kahn, & Merchant, 2014; Carroll et al., 2006; Geier et al., 2009; Johnstone et al., 2012; Nigg, 2000) despite being in their infancy (Diamond & Lee, 2011; Riggs, Greenberg, & Rhoades, 2011).

In adults, IC training commonly uses the stop-signal paradigm and is associated with improved response inhibition, reduced risk-taking behaviour (e.g., using a gambling task), and increased caution in decision-making (due to increased proactive control strategies) in the short term (i.e., for up to two hours; Bergh et al., 2006; Verbruggen, Adams, & Chambers, 2012; Verbruggen et al., 2013). Stop-signal training incorporates the stop-signal paradigm where participants are required to respond to a go stimulus, but not respond when a stop stimulus follows the go stimulus following a delay (stop signal delay [SSD]; Verbruggen & Logan, 2008). Performance in this paradigm is modelled as a race between the go and stop processes, triggered by the presentation of the respective stimuli. Stopping the prepotent go-response requires fast motor control processes, and slower cognitive control processes which monitors and adjusts performance. When the go process finishes before the stop process the response is incorrectly executed and when the stop process finishes before the go process the response is correctly inhibited. The latency of the stop process (stop-signal reaction time; SSRT) can be estimated using the race model to provide a measure of the control processes involved in stopping (Verbruggen & Logan, 2008).

The stop-signal paradigm has been successfully used to train IC functions in adults, as successful performance in the task involves monitoring of go and stop performance and the adjustment of response strategies to ensure the conflicting demands of the task are well managed (Spierer, Chavan, & Manue, 2013). Monitoring processes appear to rely on different but interacting mechanisms with stopping the response requiring a fast control mechanism, which interacts with a distinct (metacognitive) mechanism that supervises and

adjusts responses dependant on performance (Verbruggen & Logan, 2008). Accordingly, research has shown that repetition of the paradigm is met with the slowing of responding and development of inhibition (Verbruggen & Logan, 2008). However, whilst IC improvement has been found through brief repetition of the paradigm within adults (Berkman, Kahn, & Merchant, 2014), the longevity and reliability of the training effects (Enge et al., 2014) and the generalisability to real-world contexts, remain inconclusive (Masui & Nomura, 2011; Spierer, Chavan, & Manue, 2013).

Whilst stop-signal training has been shown to be beneficial in improving IC in adults in the short term, there is a lack of research specifically evaluating IC training in YP (Riggs, Greenberg, & Rhoades, 2011). It remains unclear if IC training improves IC in YP (direct effect of training as demonstrated by improved SSRT scores; Unsworth et al., 2015) and whether training gains are specific or generalisable (Spierer, Chavan, & Manue, 2013). Generalisable gains potentially enable the effective and efficient application of strategies in different contexts (effects transfer; Bjorklund, 2012). Effects can be potentially transferred to both near (conceptually related tasks including other direct IC measures) and far skills (distant tasks related to other areas of functioning including behavioural manifestations). In the facilitation of successful generalisability of the effect, general rehabilitative methods of cognitive interventions have been highlighted as important (Limond, Adlam, & Cormack, 2014). Cognitive interventions appear to be most effective when they are embedded within the YP's everyday context (e.g., involving parent/carer in the delivery of the training and scaffolding the generalisation to real-world contexts; Ylvisaker & Feeney, 2002; Krasny-Pacini et al., 2014). Interventions

incorporating a metacognitive element to promote the YP's awareness of the strategies and skills learnt during training, and to facilitate explicit links between the skills learnt and those needed in real-world contexts, have also been effective in improving functional outcomes (e.g., Braga, Rossi, Moretto, da Silva, & Cole, 2012; Butler et al., 2008).

It is unclear whether IC training utilising the stop-signal paradigm can generally improve impulse control in YP by utilising the formation of proactive cognitive strategies to enable transfer effects (Taatgen, 2013). It is also unclear if training-induced IC strategy formation can be generalised to behaviours including impulse control in everyday life (near-transfer effect) and real world conceptually related skills, including engagement in risky or prosocial behaviour in everyday life (far-transfer effects; Beauchamp, Kahn, & Berkman, 2016; Enge et al., 2014; Thorell, Lindqvist, Nutley, Bohlin, & Klingberg, 2009). It is also unclear if it is efficient and effective to support the formation and use of proactive IC strategies with metacognitive skills.

Aims

This research aims to investigate whether IC can be improved in YP, and whether the intervention gains generalise to real-world behaviours.

Research Questions

In a sample of YP:

1. Does the stop-signal intervention improve IC/Impulsivity?
2. Does the stop-signal intervention affect behavioural-control?

Research Hypotheses

H1. YP provided with the stop-signal intervention will demonstrate improved IC as measured by the SSRT (direct-training effect), non-trained tasks (near-transfer effect), and ecologically-valid questionnaire (far-transfer effects).

H2. YP provided with the stop-signal intervention will show improved behavioural-control as measured by the goal-attainment scale, ecologically-valid questionnaire measures and non-trained task of behavioural-control (mid and far-transfer effects).

Method

Design

A randomised, simultaneous multiple-baseline single-case experimental design (SCED) was used to determine the effects of an IC intervention (stop-signal training and metacognitive strategies) on the measures of IC, impulsivity and behaviour. A SCED was selected to evaluate the effects of the intervention as it provides a strong, systematic basis for causal inference whilst reducing error, with each participant acting as their own control (Kratochwill et al., 2010). Replication across participants using randomised baseline and intervention-phase lengths was selected to systematically analyse the impact of the stop-signal intervention. In this model, baseline measurements of the YP's behaviour were taken, with each participant's baseline measurements acting as his or her own control. A minimum period of baseline-phase of five measurements (days) was used to ensure a degree of stability and validity of the measurements (Kratochwill et al., 2010). The phase-change of each participant was randomised resulting in the duration of the baseline-phase ranging from 5 to 10 days, determined using a computerised random number generator. This resulted six possible phase-change points. Behaviours were measured either

continuously or at 3 time points: onset of baseline, onset of intervention (phase-change) and at intervention termination.

Due to the nature of the study it was not possible to use blinding or masking of the participants or researcher and the possible implications of this as an area of weakness is acknowledged and further considered within the discussion (Tate et al., 2016).

Ethical Considerations for Empirical Research

The study was given a favourable opinion by the University of Exeter Ethics Committee (see Appendix A). Ethical issues surrounding the participation of children and YP in research were considered in line with The British Psychological Society (BPS) Code of Ethics (2009) and a risk protocol outlining the ethical considerations is provided in Appendix B.

Measures

Characterisation measures. To characterise participants' cognitive, executive and behavioural functioning, an assessment battery was conducted prior to the study. The battery included neuropsychological assessments, selected to provide measures of general intellectual ability and executive function. Further information about these measures is provided in Appendix D. The YP's cognitive functioning was assessed using the Wechsler Abbreviated Scale of Intelligence – Second Edition (WASI-II) to provide measures of verbal comprehension, perceptual reasoning and a full-scale intelligence quotient (FSIQ; Wechsler, 2011). Standardized composite scores were used with a mean of 100 and standard deviation (SD) of 15, with higher scores indicating greater functioning.

The Behavior Rating Inventory of Executive Function (BRIEF) was used to provide a measure of everyday general executive function, behaviour regulation, and metacognition. The BRIEF-T was completed by the YP's main teacher and the self-report (BRIEF-SR) was completed by the participant. Standardized T-scores were utilized with a mean of 50 and SD of 10, with higher scores reflecting greater executive dysfunction (Gioia, Isquith, Guy, & Kenworthy, 2000).

The Strengths and Difficulties Questionnaire (SDQ) was used to provide a measure of general strengths and behavioural difficulties. The SDQ-T4-17 was completed by the YP's main teacher and the self-report (SDQ-S11-17) was completed by the participant. Internalising and externalising scale scores range from 0-20 and impact scale scores range from 0-10, with higher scores reflecting greater difficulties. The prosocial scale ranges from 0-10 with lower

scores reflecting greater difficulties. Score categorisations of average, slightly raised, high and very high (and average, slightly low, low and very low for prosocial scale) were utilised to indicate areas of difficulty (Goodman, 2001).

Outcome measures.

Phase-change measures. The following five measures were taken at baseline onset, and at intervention onset and termination.

Near-transfer effects of IC (H1) were measured using the Delis-Kaplan Executive Functioning Systems (D-KEFS) Color-Word Interference Test (CWIT; Delis, Kaplan, & Kramer, 2001). Scaled scores were utilised with a mean of 10 and SD of 3. Higher scaled scores are indicative of better performance. Cumulative percentile ranks are provided for errors indicating the percentage of the normative sample that achieved an equal or higher number of errors than the participant.

The Stoplight task provides a non-trained, mid-transfer measure of IC and risk-taking behaviour (H2; Chein, Albert, O'Brien, Uckert, & Steinberg, 2011; Steinberg et al., 2008). This task involves a computer-simulated driving task. High brake latencies or failures to brake (including number of crashes and intersections crossed successfully) are indicative of increased risk taking behaviour compared with age standardised norms (Steinberg, et al., 2008).

The self-report Barratt Impulsiveness Scale for Adolescents – 11 (BIS-A-11) was used to provide a measure of the participant's level of everyday impulsivity and a far-transfer measure (H1). Higher scores indicate increased

impulsivity compared with age and gender standardised norms (Fossati, Barratt, Acquarini, & Di Ceglie, 2002; Patton, Stanford, & Barratt, 1995).

The self-report Behavioural Inhibition/Behavioural Activation Scale (BIS/BAS; Carver & White, 1994) was used as an experimental measure to supplement the BIS-A-11 scale and as a far-transfer measure of IC (H1) and behavioural-control (H2). High scores on the BIS scale indicates higher IC and higher scores on the BAS scales indicates increased behavioural activation (Carver & White, 1994) compared with age standardised norms (Urošević, Collins, Muetzel, Lim, & Luciana, 2012; Yu, Branje, Keusers, & Meeus, 2011).

The self-report School Engagement Questionnaire (SEQ) provided a far-transfer measure of behavioural-control (H2). Low scores indicate problems with school engagement compared with age standardised norms (Fredricks et al., 2011; Kenny, Blustein, Chaves, Grossman, & Gallagher, 2003).

***Continuous measures of change*.** Performance on the stop-signal training (measured by the SSRT) was used as a continuous measure to determine any direct improvements in IC (H1).

The self-report Goal-Attainment Scale (GAS; Roach & Elliot, 2005) was completed daily as a measure of perceived ability to refrain from impulsive, risky and difficult behaviour (H2; far-transfer effect). The GAS utilises the participants own determined outcome goals and quantified scoring with higher scores reflecting greater goal-attainment (Krasny-Pacini, Chevignard, & Evans, 2014; Tennant, 2007; Turner-Stokes, 2009). An example scale is provided in Appendix C.

The training. The daily stop-signal training used visual stimuli for both the go and stop processes provided on a laptop computer screen. Go signals were presented as arrows on the screen pointing either left or right and the participants were instructed to respond to the signal as quickly as possible by pressing the corresponding direction arrow. On 50% of the trials, the go signal was followed by the stop-signal (arrow colour change) at which the participants were told to inhibit their response. The daily training task included 4 training blocks, each including 48 trials, with a 15 second break in between each block. The participants completed between 10 and 15 training days.

The SSRT is an estimate of the time taken for response inhibition to be successfully completed after a stop signal has been presented and is an indicator of the efficiency of the inhibition process. Further technical details about the training are provided in Appendix E.

The Stoplight task and stop-signal training were both presented on a laptop running Microsoft Windows, presented on a 14inch screen with standard definition. The program Strawberry Perl was utilised for the Stoplight task and programs MATLAB and Psychtoolbox were utilised for the stop-signal training.

Participants

Inclusion criteria for participation were (a) age between 11-16 years, (b) engaging in mainstream education, (c) able to speak and read basic level English, (d) physically able to use a laptop computer. Exclusion criteria were (a) a formal diagnosis of any mental disorder, illness, brain injury or (b) a documented learning disability or assessed IQ below 70. The rationale for these criteria was to enable testing potential effectiveness of the intervention with

typically developing, healthy YP, to improve feasibility of the study. The use of a SCED in this study reduces the number of participants required to enable valid inferences (Dugard, File, & Todman, 2012).

Six secondary school students were recruited (two males and four females; aged between 11 and 15 years old; mean age = 14.04 years; SD = 1.39). An opportunity sample of students was recruited from the Bristol area. Two participants were recruited through their schools and four participants were recruited through a community parenting network advertisement. The participants were remunerated for their time.

Procedure

Two participants were recruited through a local Secondary School. The researcher met with and shared information about the research with key teachers. The teachers invited their pupils to further information sessions with the researcher in the school. Screening instruments (Appendix F) and consent to contact forms (Appendix G) were provided and the teachers were invited to screen and invite any eligible pupil to the study. Four participants were recruited through a community parenting network. The parent/carers contacted the researcher to obtain further information about the research, and screening questionnaires and consent to contact forms were provided to the parent/carers.

Eligible participants met with the researcher individually who provided further information about the study, clarified inclusion and exclusion criteria, and answered any questions. Information sheets were provided to the participants and their parent/carers (Appendices H and I) and written consent was obtained from the participants and their parent/carer (Appendices J and K). Participants

then met with the researcher again to complete the characterisation measures, initial outcome measures and establish the goals for use within the GAS measure.

The participants were allocated a participant number and a randomised phase-change point (Kratochwill & Levin, 2010). The participants entered the baseline-phase and were asked to complete the GAS daily. Following the baseline-phase the participants entered the intervention at one of six phase-change points. The allocation of each participant's baseline and intervention-phase is shown in Appendix L.

At the start of the intervention phase the researcher met with the participant to complete the phase-change measures, and explain the intervention and workbook. Each intervention session lasted approximately 15-minutes per day. The workbook was designed to support the generalisability of the strategies and skills developed in training, to the participants' everyday activities. The workbook (see Appendix M) was designed in accordance with the strategies provided by: Butler et al's., (2008) cognitive remediation program; and Riggs, Greenberg, Kusch´e and Pentz's (2006) promoting alternative thinking (PATH) strategies. Wording structure was based on self-instruction training (Baer & Nietzel, 1991).

The workbooks utilised metacognitive strategies to support the participant in preparing themselves and to engage with the training. Once this section of the workbook was completed the participant completed the computerised stop-signal training. Then the participant returned to their metacognitive workbook to encourage them to reflect on the session, the skills

and strategies learnt during the training, and how these might be applied in everyday contexts (particularly contexts where behavioural difficulties were likely to manifest).

The participants completed the intervention daily (5 days per week) until the maximum 20 days within the study had been reached. The participants then met with the researcher again to complete the phase-change measures and were debriefed about their experience of the intervention and research (debrief information provided in Appendix N).

Data Analysis

The analyses were performed using SPSS (version 23), Microsoft Excel (Version 2010) and RStudio (Version 3.3.1). As is consistent with SCED research the data from continuous (daily) behavioural measures were analysed visually for fluctuations, variability and trends (Onghena & Edgington, 2005). The Slope and Level Change (SLC) procedure was used to estimate and eliminate baseline trend to indicate reliable slope and level changes within the intervention phase (Solanas, Manalov, & Onghena, 2010). To determine treatment effectiveness of the stop-signal intervention on IC (H1) the SSRT data from the daily training were analysed visually for each participant. In addition, a Wilcoxon Signed Ranks test was used to compare the mean SSRT of the first and last 3 days of training for each participant.

To determine the effectiveness of the intervention on the daily measures of behaviour (H2: GAS), randomisation tests for phase designs were used (Edgington & Onghena, 2005; Levin & Wampold, 1999; Ter Kuile et al., 2009).

Effect size (ES) calculations were completed using the non-overlap of all pairs (NAP), which controls for trend in the data (Parker & Vannest, 2009).

Standardised scores were calculated for each phase-change measure. Reliable change indices (RCIs) were used to analyse the measurements taken at each phase-change for IC (H1: BIS-11-A, BIS/BAS, CWIT) and behavioural-control (H2: BIS/BAS, SEQ, Stoplight task) to determine if any changes observed on these measures is statistically reliable. RCIs were calculated by determining the standard error of difference between the participant's scores using the tests standard error of measurement. Scores differing by 1.96 times the standard error of difference are considered to indicate statistically reliable change (Evans, Margison, & Barkham, 1998; Jacobson & Truax, 1991).

Results

Sample Characteristics

Table 1 provides summary participant characteristics with additional characteristics provided in Appendix O. The characterisation assessments indicate that two participants (2 and 3) fell within the average range for all functioning. Participant six fell within the high average range for cognitive functioning and within the average ranges for other functioning. Participant four fell within the average range for all areas of cognitive and executive functioning however received a low score within the prosocial scale of the SDQ (both self and teacher report). This highlighted an absence of common prosocial behaviours.

Participant one scored within the low average range for cognitive functioning and within the clinically significant range for executive functioning difficulties (global executive composite; GEC). This assessment suggested difficulties with the participant's ability to regulate their own behaviour (behavioural regulation index) and problem solve (metacognitive index; MI). In addition, this participant scored within the elevated range for difficulties identified by the SDQ, highlighting issues with conduct and peer relationships, which were having an impact on their daily life (impact score). It is important to note that this participant was diagnosed with dyslexia and was receiving additional behavioural support at school and at home.

Participant five scored within the average ranges for cognitive and executive functioning but within the very high range for difficulties within the self-report SDQ, highlighting some issues with conduct, emotions and peer relationships, which were having an impact on their daily life (impact score). These difficulties were not reflected in the teacher's report. Despite these reported difficulties no involvement with social or health services was reported and no additional pastoral support was required at school.

Table 1

Summary of Participants Characteristics and Functioning

Participant Characteristics:		Participant No:					
		1	2	3	4	5	6
Assessment Results:							
Assessment:	Domain assessed:						
Wechsler Abbreviated Scale of Intelligence (WASI-II)	Full Scale Intelligence Quotient (FSIQ)[a]	81	110	108	108	110	121
	Verbal Comprehension Index[a]	84	110	103	92	113	120
	Perceptual Reasoning Index[a]	83	108	112	123	104	116
Behaviour Rating Inventory of Executive Function (BRIEF)	Executive Function Global Composite (SR/T)[b]	73/ 68	63/ 43	45/ 60	52/ 63	59/ 45	52/ 54
	- Behavioural Regulation Index (SR/T)[b]	73/ 66	60/ 45	41/ 61	55/ 63	64/ 49	51/ 60
	- Metacognition Index (SR/T)[b]	70/ 67	64/ 42	50/ 58	49/ 60	52/ 43	52/ 50
Strengths and Difficulties Questionnaire (SDQ)	Total Difficulties (SR/T) (Maximum = 40)	18**/ 15*	11/ 6	7/2	11/ 10	21** */0	11/3
	- Externalising Problems (SR/T)[c] (Maximum = 20)	9/10	6/0	4/2	3/7	7/0	6/0
	- Internalising Problems (SR/T)[c] (Maximum = 20)	9/5	5/6	3/0	8/3	14/0	5/3
	- Impact Score (SR/T)[c] (Maximum = 10)	7***/ 3***	0/0	0/0	0/0	4***/ 0	0/0
	- Prosocial Behaviour (SR/T)[c] (Maximum = 10)	2***/ 3***	9/10	9/8	5**/ 4**	7/7	8/10

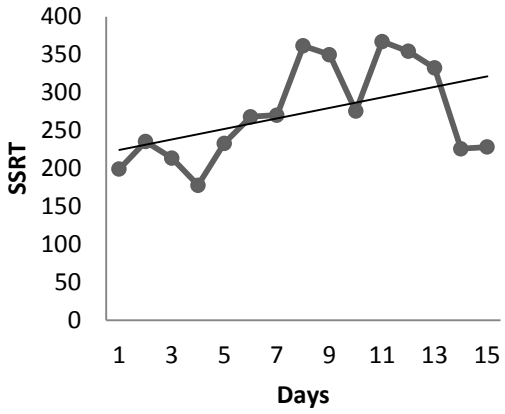
Note. SR = Self-report, T=Teacher report, [a]Standard Score, [b]T score, [c]Raw Score*Slightly Raised/Low Score, **High/Low Score, ***Very High/Low Score.

Hypothesis 1: Inhibitory Control Performance

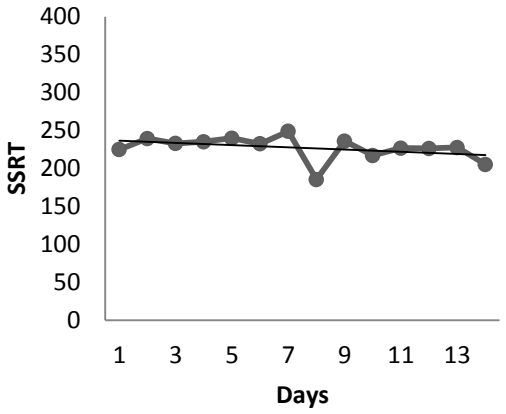
It was hypothesised that the stop-signal intervention would improve participants' IC/Impulsivity, as measured by the trained task (SSRT), non-trained task (CWIT) and questionnaires (BIS-II-A and BIS/BAS).The intervention-phase SSRT distribution and trend regression lines for each participant are shown in figure 1. Raw data is provided in Appendix P. Decreases in SSRT are indicative of improved IC and these graphs illustrate the

SSRT scores remained stable for three participants, decreased for one participant (5) and increased for two participants (1 and 4). The Wilcoxon signed-rank test did not demonstrate a statistically significant change in SSRT scores (phase-change to post- intervention) due to training (trained task; Z=-.73, p = .46).

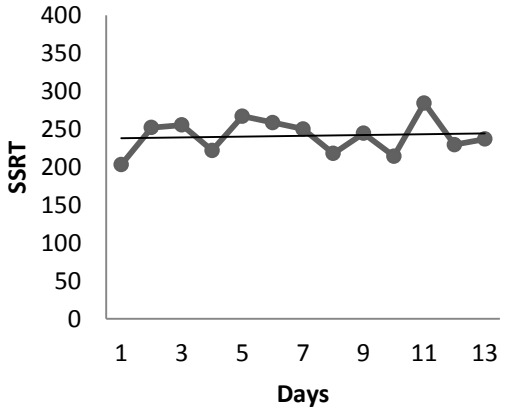
Participant 1:



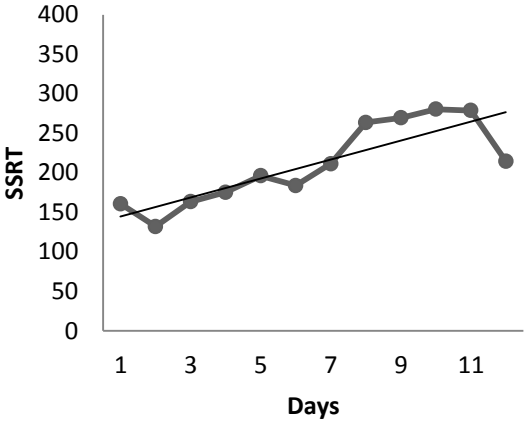
Participant 2:



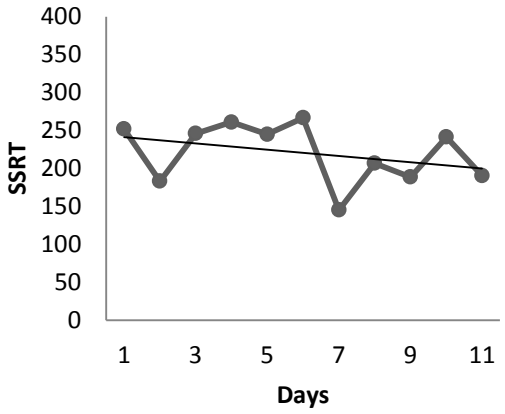
Participant 3:



Participant 4:



Participant 5:



Participant 6:

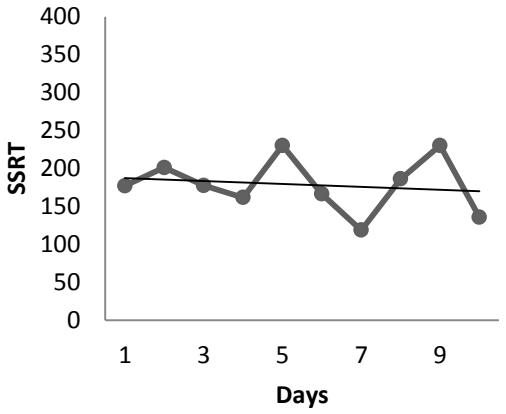


Figure 1. Stop-signal reaction time (SSRT) scores per intervention-phase day, per participant, with trend lines.

Table 2 shows the phase-change IC/impulsivity measure scores for each participant in comparison with population norms (scaled/z-scores), with significant RCI's for each phase-change highlighted (raw data provided in Appendix Q). The RCI for each measure suggests reliable change was not found for any participant on the far-transfer questionnaire measures of inhibitory control (BIS-11-A, BIS/BAS).

Within the non-trained task (near-transfer) measure of IC (CWIT) a reliable decrease was observed in completion time inhibition for three participants: pre-baseline to post-intervention for participant one and phase-change to post-intervention for participants two and six (although change was observed from pre-baseline to phase-change indicating possible practice effects). In addition, reliable decreases in errors pre-baseline to post-intervention, were observed for four participants (1, 2, 3 and 4), however two participants' (3 and 4) scores also observed a reliable decrease pre-baseline to phase-change, indicating possible practice effects. No reliable changes were observed on inhibition-switching completion times and reliable improvement was only observed on errors from pre-baseline to phase-change (participants 2 and 4).

Table 2

Summary of Participants IC/Impulsivity Phase-Change Scores

				Participant No:					
Measure:	Domain assessed:	Subdomains assessed:		1	2	3	4	5	6
BIS-11-A	Impulsiveness	Total[a]	Pre	0.70	-0.42	0.12	0.89	-0.63	-0.10
			Phase-Change	0.70	0.23	0.33	1.26	-0.20	-0.10
			Post	0.23	0.12	0.23	1.08	-0.40	-0.30
BIS/ BAS	Behavioural Inhibition System (BIS)	Total[a]	Pre	0.11	-2.07	-1.07	-3.4	-3.4	-2.74
			Phase-Change	0.11	-0.74	-0.40	-3.07	-4.07	-1.40
			Post	0.68	-2.40	-1.07	-4.07	-4.07	-2.07
CWIT	Inhibition	Completion Time[b]	Pre	1	6	10	13	7	9*
			Phase-Change	1	9	11	13	9	13
			Post	5*	11*	12	13	10	13*
		Error[b]	Pre	12	10*	11*	9*	13	13
			Phase-Change	11*	8*	13	11	13	13
			Post	14*	12*	13*	12*	13	13
	Inhibition / Switching	Completion Time[b]	Pre	1	5	11	11	6	11
			Phase-Change	4	7	12	14	10	13
			Post	6	10	13	14	8	13
		Error[b]	Pre	10	12*	12	6*	11	13
			Phase-Change	13	7*	13	10	10	13
			Post	13	12	13	11*	10	13

Note: BIS-11-A = Barratt Impulsiveness Scale 11 for adolescents, BIS/BAS = Behavioural Inhibition/ Activation Scale, CWIT = Colour-Word Interference Test, [a]z scores, [b]Scaled scores, *significant reliable change indices (RCI) score.

Hypothesis 2. Behavioural Control Performance

It was hypothesised that participants provided with the stop-signal intervention would show improved behavioural control, as measured by questionnaires (GAS, BIS/BAS & SEQ) and non-trained tasks (Stoplight task).

Figure 2 illustrates the daily GAS scores across both phases, with median levels plotted for each phase and baseline SD bands plotted. GAS raw scores are provided in Appendix R. Overall the graphs indicate variability across both phases of the study with one participant (3) observing a level (median) increase and five participants (1, 2, 4, 5 and 6) observing no level change or a level decrease between baseline and intervention-phase. The SD bands suggest that the GAS scores between phases do not differ reliably from what would be expected from baseline variability, with only two participants (1 & 2) observing any scores outside the SD range during intervention.

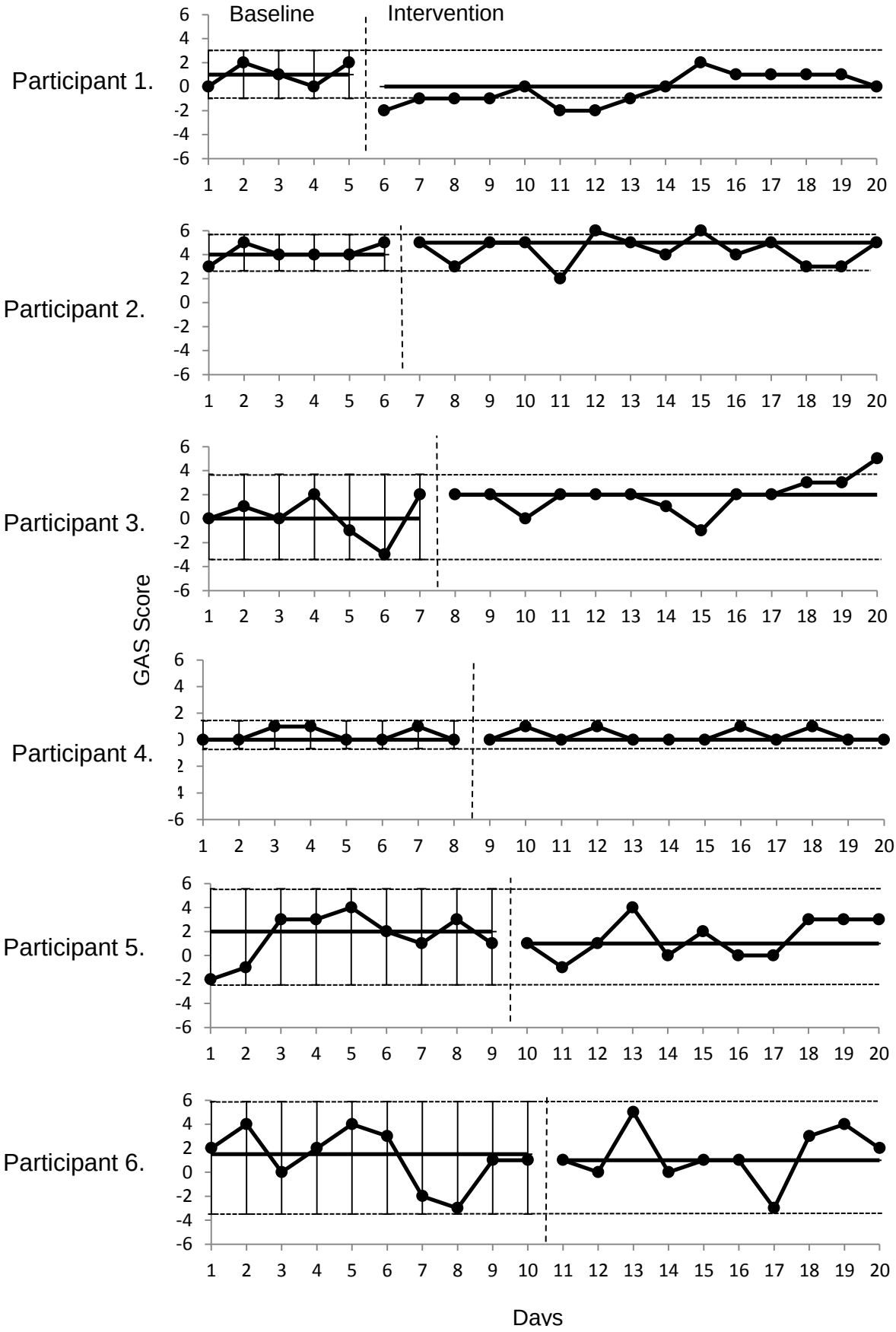
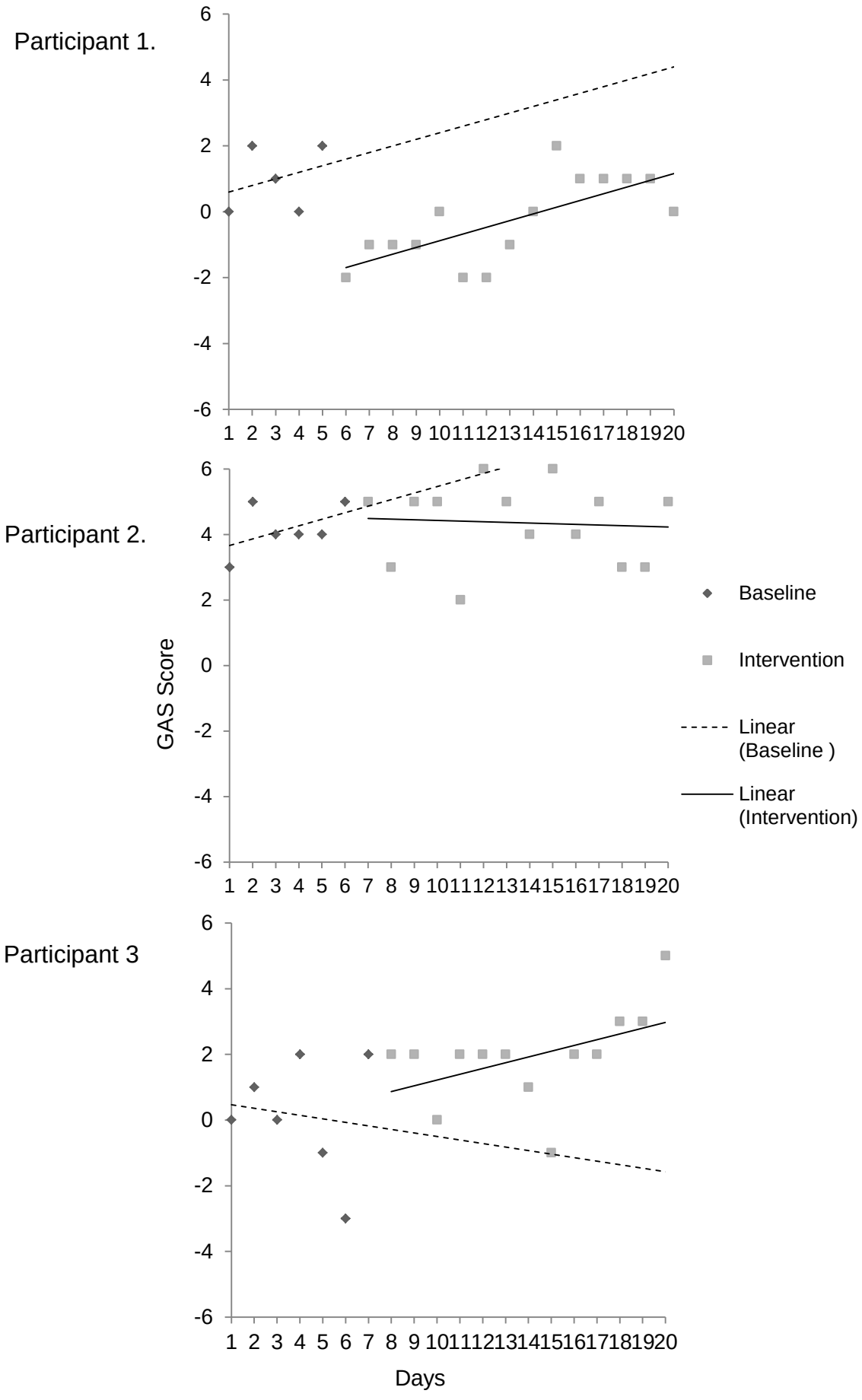


Figure 2. GAS scores per day, with median lines per study phase and baseline standard deviation bars across phases.

Figure 3 illustrates the trend regression (least squares) lines for each phase and projected baseline trend for each participant across both phases. Trend lines suggest that three participants (1, 3 and 6) showed improvements in their GAS scores as intervention progressed, with three participants (2, 4 and 5) showing deterioration or stability in GAS scores. In addition, two participants' (1 and 5) trend lines indicate stability in direction, and two participants' (3 & 6) trend lines suggest change from deterioration to improving scores during the intervention-phase.

Figure 4 illustrates the detrended GAS scores slopes and level change for each participant, once baseline trend has been accounted for (slope and level change procedure). These indicate that once baseline trend has been eliminated, participant six was observed to maintain a positive trend and increase in level during the intervention-phase, however five participants' (1, 2, 3, 4 and 5) GAS scores were observed to deteriorate or remain stable in slope and level.


Participant 1.
Participant 2.
Participant 3
GAS Score
Days
Baseline
Intervention
Linear (Baseline)
Linear (Intervention)

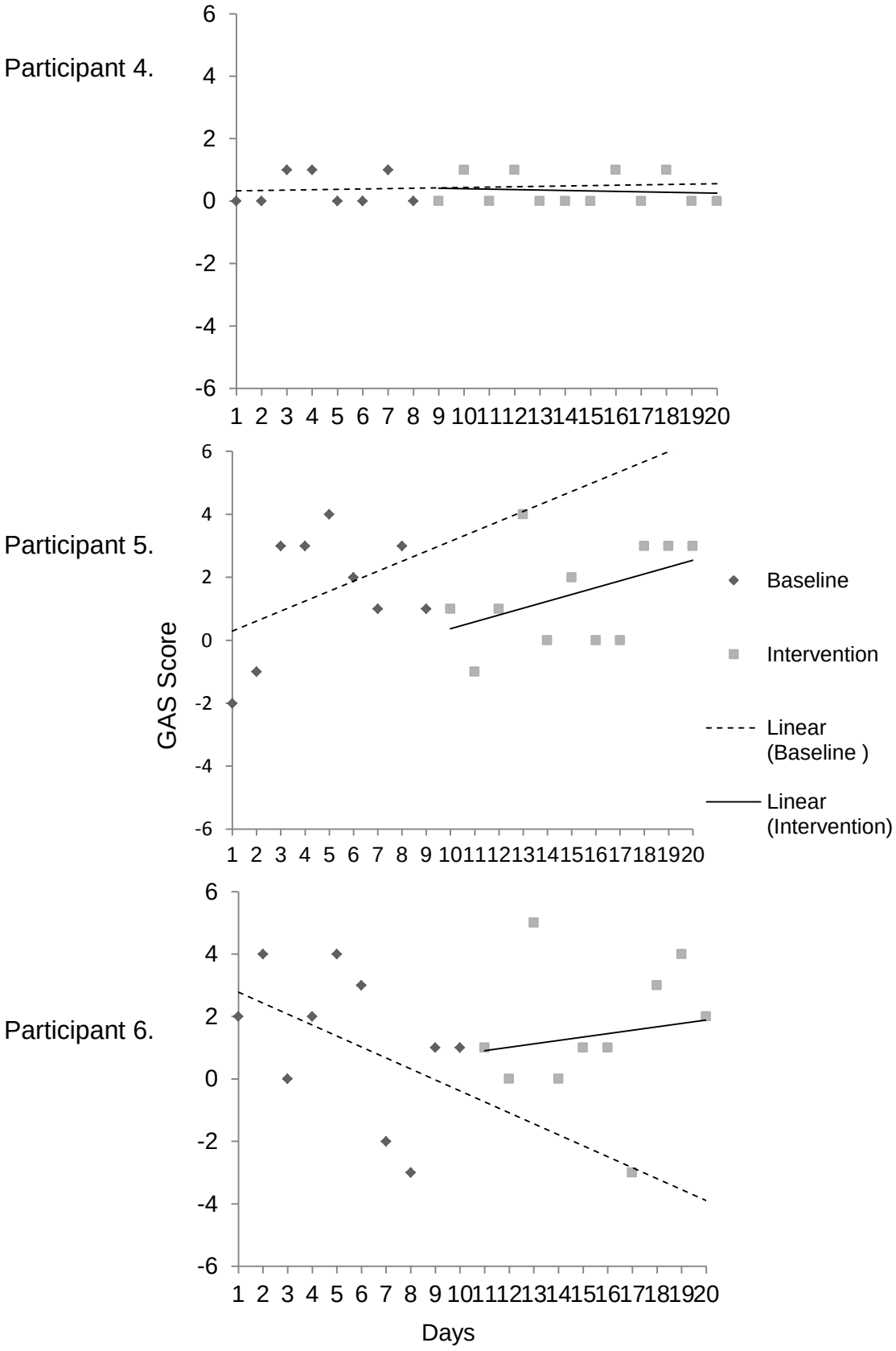
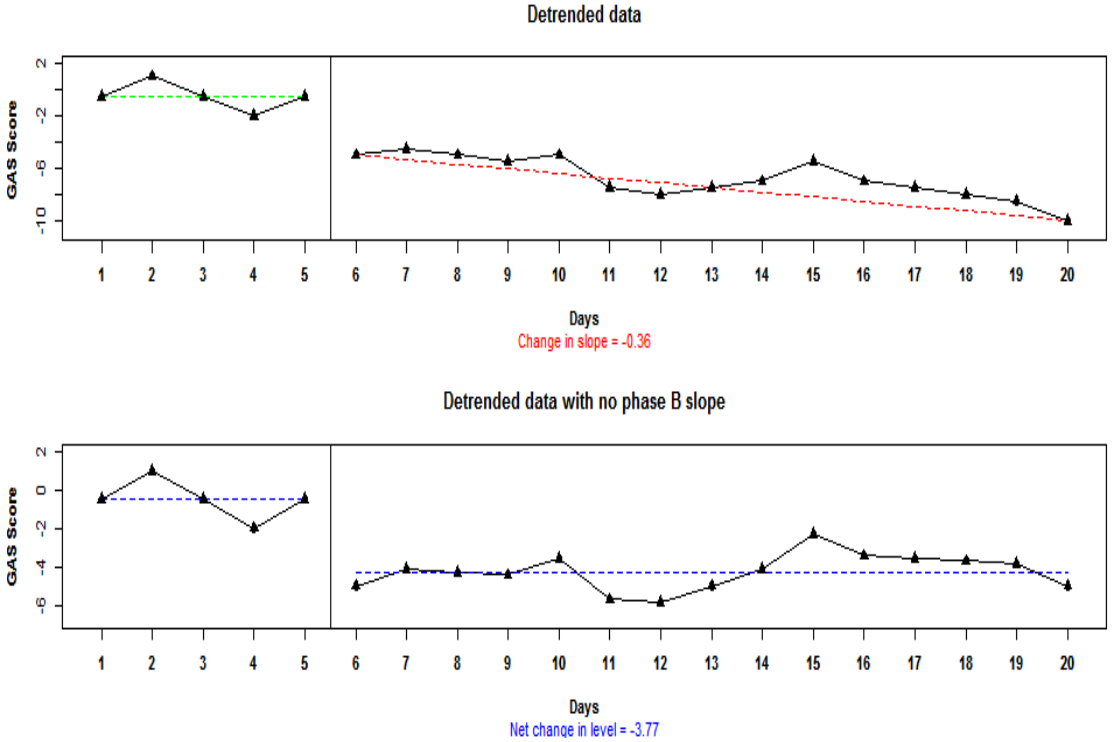
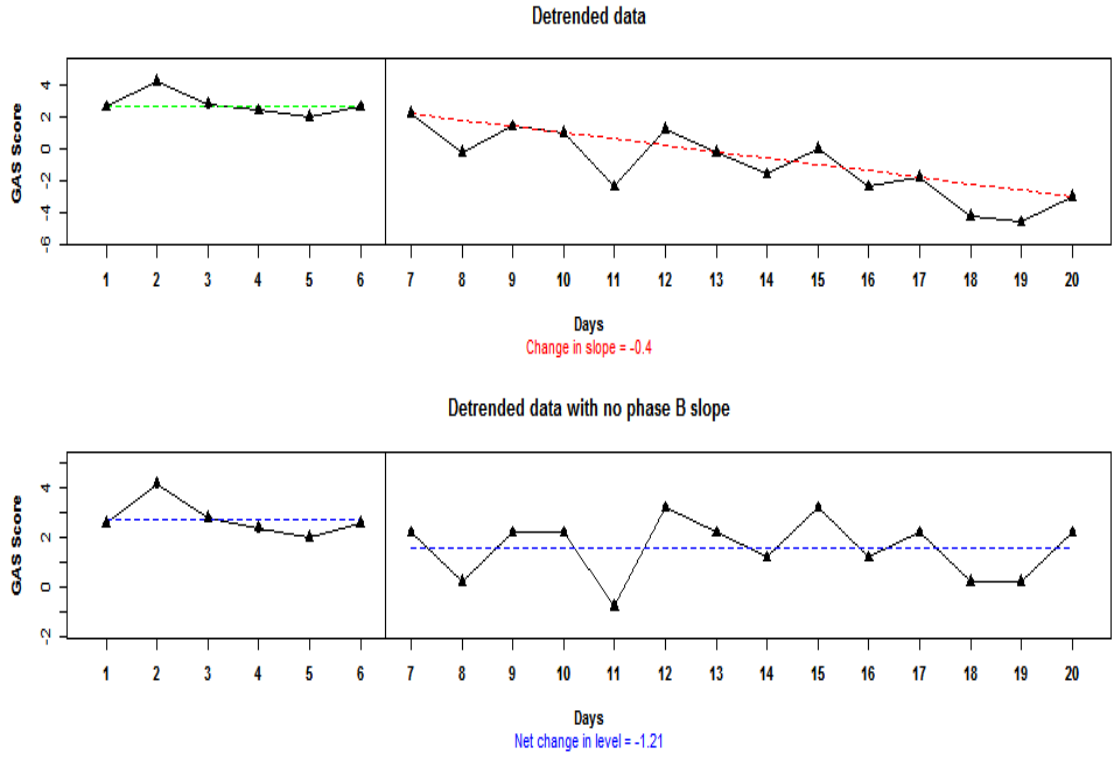


Figure 3. GAS scores per day, per participant, with linear trend per phase and projected baseline trend across phases.

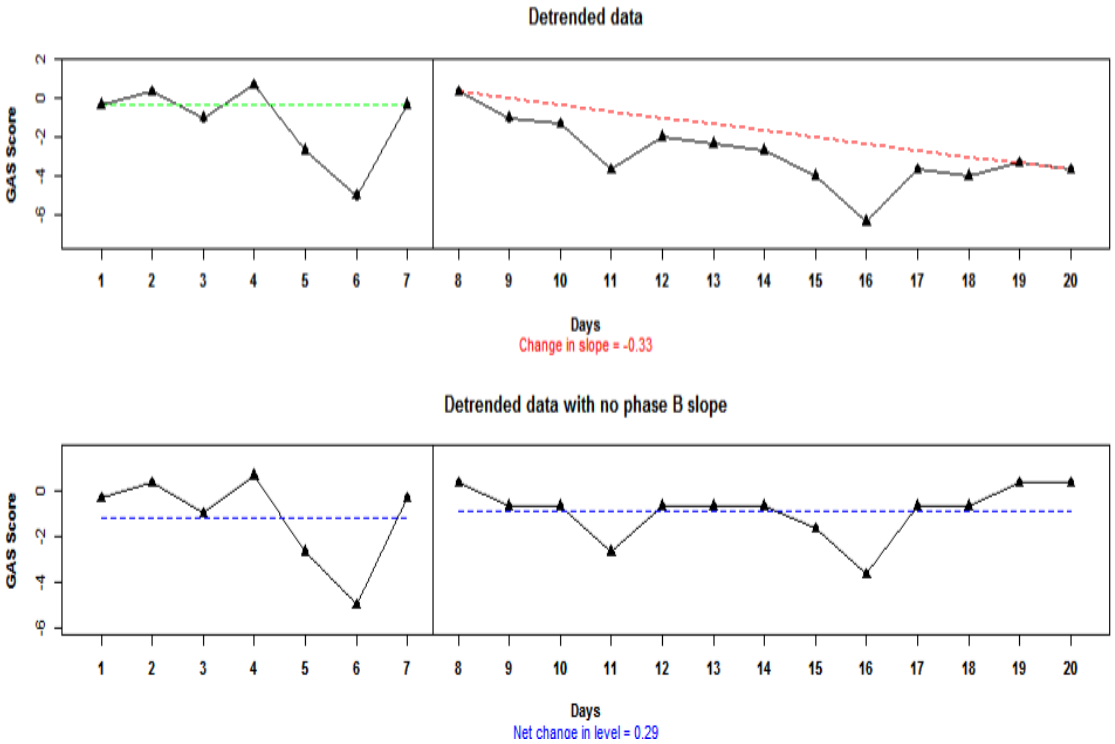
Participant 1.



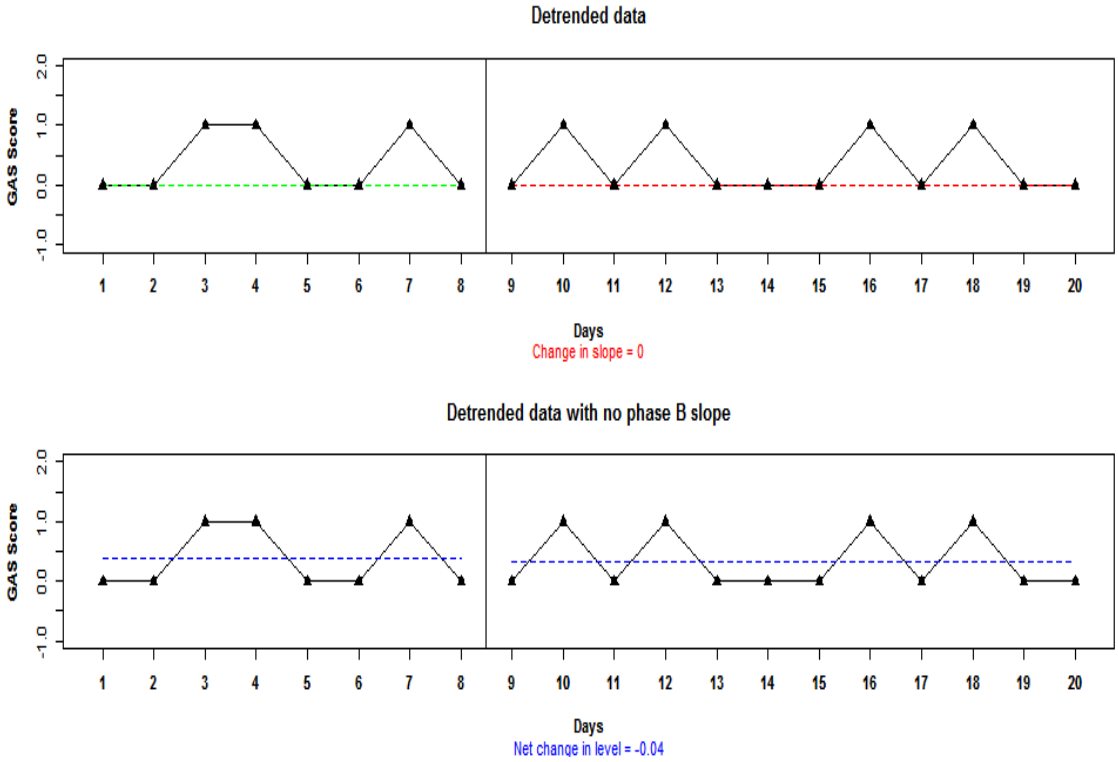
Participant 2.



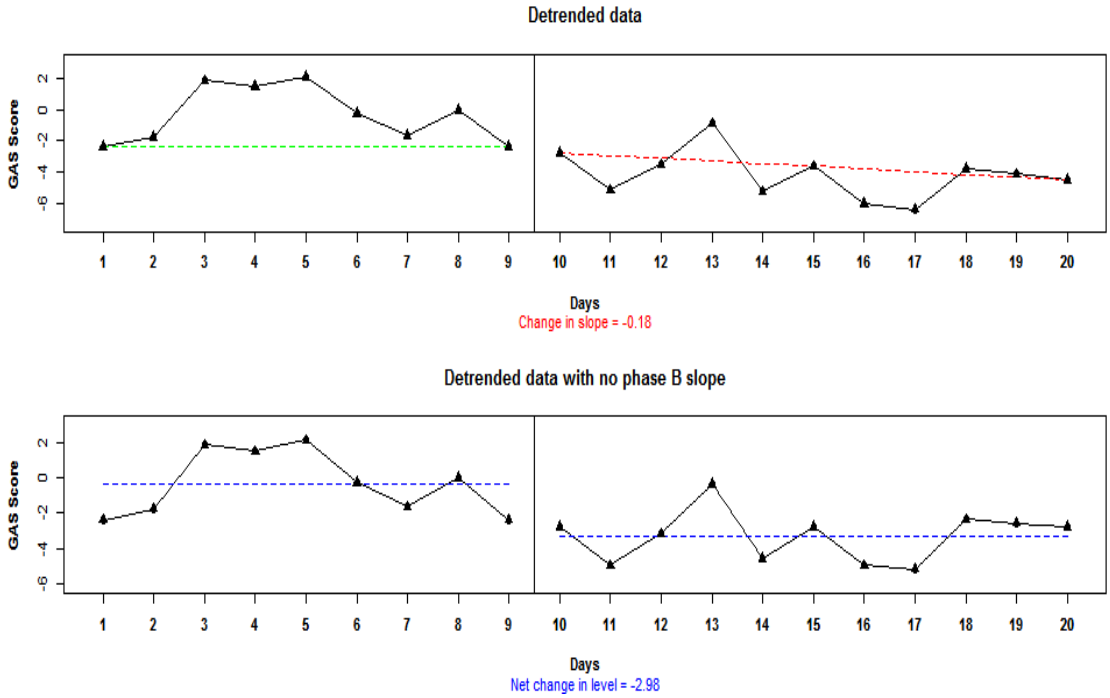
Participant 3.



Participant 4.



Participant 5.



Participant 6.

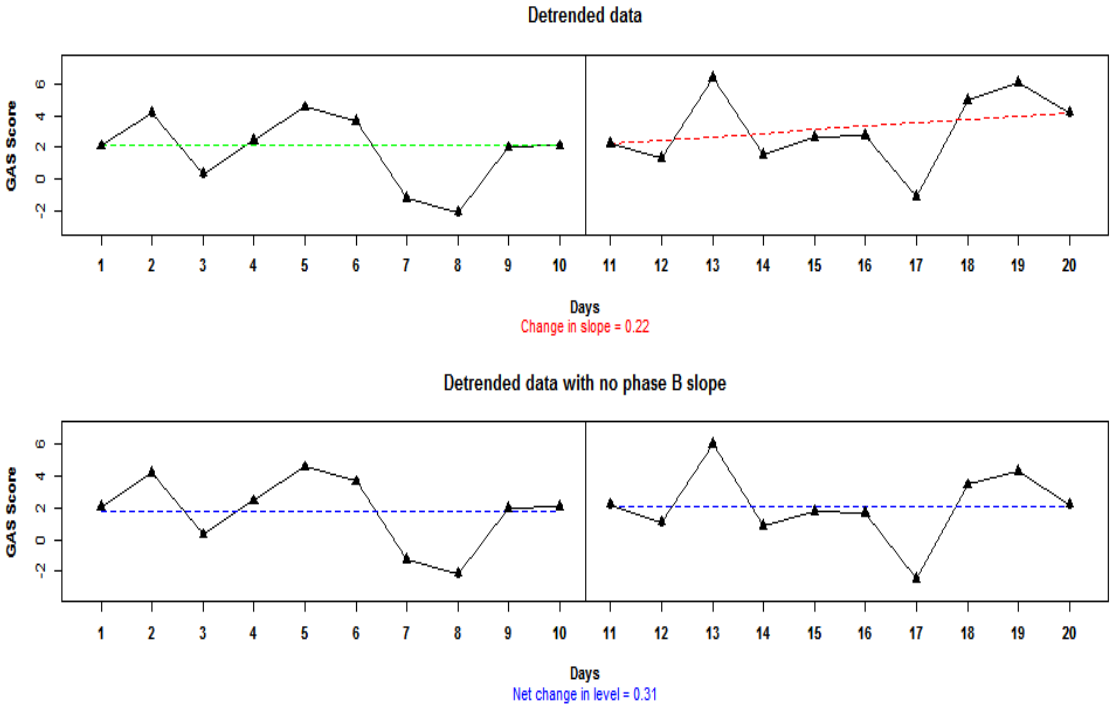


Figure 4. Detrended GAS scores per day and phase, indicating changes in level and slope once baseline trend has been eliminated.

To analyse the efficacy of the intervention on the GAS scores, individual and group-level (Monte Carlo version) randomisation tests were calculated. This tested the null hypothesis that there is no difference between measures for any of the measurement times. As illustrated in Table 3, no statistically significant effects of the intervention on participants or group-level GAS score were found. The non-overlap of all pairs classified the intervention as weak-moderate.

Table 3

Summary of Significance Test Findings for Changes in GAS Scores

Participant:	Significance level *(p)*:	Non-Overlap of all Pairs (effect size):
1	0.09	0.23
2	0.36	0.58
3	0.18	0.79
4	0.54	0.47
5	0.91	0.46
6	0.27	0.50
All	0.45	0.51

Table 4 shows the phase-change behavioural-control scores for each participant, with significant RCI's for each phase-change highlighted (raw data provided in Appendix S). The RCI for each measure suggests limited reliable change was found on measures of behavioural-activation (far-transfer), risk taking (Stoplight task: mid-transfer) and school engagement (far-transfer). Within the BAS subscales of the BIS/BAS scale, increased scores were observed including a reliable pre-baseline to post-intervention increase on drive for Participant Four, taking this participant above the population norm (indicating increased behavioural activation). In addition, a reliable change was observed pre-baseline and phase-change to post-intervention on the fun-seeking scale for participant one, taking their score closer to the population norm. A change from

pre-baseline to phase-change was observed for two participants (3 and 6) on the reward responsiveness subscale, indicating possible practice effects.

A reliable pre-baseline and phase-change to post-intervention increase on the SEQ measure was observed for participant one. No other reliable changes were observed on this measure.

Within the non-trained Stoplight task, reliable pre-baseline to post-intervention increases in safe-stops were observed for two participants (1 and 2), however change from pre-baseline to phase-change was observed for Participant Six, indicating possible practice effects. A reliable pre-baseline and phase-change to post-intervention decrease in number of crashes was observed for Participant Two and a reliable pre-baseline to post-intervention decrease in intersections crossed was observed for Participant Five. A reliable pre-baseline to phase-change and post-intervention decrease in intersections crossed successfully was observed for Participant Four, however, a reliable pre-baseline and phase-change to post-intervention increase in brake-latency (time taken to apply brake) was also observed for Participant Four, indicating increased risk taking.

Table 4

Summary of Participants' Behavioural-Control Phase-Change Scores

				Participant No:					
Measure:	Domain assessed:	Subdomains assessed:		1	2	3	4	5	6
BIS/ BAS	Behavioural Activation System (BAS)	Reward Responsiveness[a]	Pre	-4.00	-6.80	-5.03	-6.21	-6.80	-4.44
			Phase-Change	-4.00	-6.21	-3.25*	-6.21	-7.40	-6.21*
			Post	-3.58	-5.62	-3.25*	-6.21	-7.40	-6.21*
		Drive[a]	Pre	-0.49	-1.03	1.06	-0.20	-0.20	-0.20
			Phase-Change	-0.49	-0.20	0.64	0.64	0.22	-0.20
			Post	0.28	-1.03	0.22	1.48*	0.22	0.22
		Fun Seeking[a]	Pre	-4.35	-2.97	-0.98	-1.48	-1.48	-2.47
			Phase-Change	-4.35	-2.97	-2.47	-1.98	0.01	-2.47
			Post	-2.01*	-2.97	-1.48	-1.98	0.01	-3.46
SEQ	School-engagement	Total[a]	Pre	-0.58	0.50	1.04	0.32	0.67	0.14
			Phase-Change	-0.58	0.32	1.04	-0.04	-0.04	-0.04
			Post	0.14*	0.32	0.86	0.14	0.32	-0.04
Stoplight Task	Risk-taking	Safe-stops[a]	Pre	0.72	-0.14	1.7	1.88	1.26	-1.34
			Phase-Change	1.72	0.33	1.7	2.25	1.72	0.63*
			Post	1.44*	0.95*	2.06	1.70	1.89	0.09*
		Crashes[a]	Pre	-0.43	0.41	-1.42	-1.16	-1.16	0.42
			Phase-Change	-1.32*	-0.38	-1.16	-1.68	-1.68	-0.11
			Post		-0.90*	-1.68	-0.89	-1.68	-0.11
		Intersections crossed successfully[a]	Pre	0.25	0.96*	-0.04	-0.75	0.11	3.48
			Phase-Change	-0.54	0.96	-0.39	-0.75	-0.17	0.31*
			Post	-0.54*	0.39	-0.39	-0.75	-0.45*	1.37*
		Latency to brake[a]	Pre	2.28	0.16	0.38	0.57	0.51	2.36
			Phase-Change	2.16	1.66	1.41	1.32	0.43	1.71
			Post	2.18	1.62	1.63	2.38*	0.70	1.61

Note: BIS/BAS = Behavioural Inhibition/ Activation Scale, SEQ= School Engagement Questionnaire, [a]z scores, *highlights indices reaching RCI threshold.

Discussion

The aim of this study was to investigate the effect of an IC intervention on YP's level of IC, impulsivity and everyday behaviour. The first hypothesis predicted that direct and near-transfer effects of the intervention would be found and participants would demonstrate reduced levels of impulsivity and IC. This hypothesis was partially supported by the results as two participants (1 and 2) were observed to perform reliably faster and made fewer inhibition errors following the intervention within the non-trained, near-transfer task (CWIT). However, direct effects of the training and far-transfer effects on the questionnaire measures of IC were not found.

The second prediction, that far-transfer effects of the intervention would be found and that participants would demonstrate reduced risk-taking behaviour and improved prosocial behaviour, was not supported by the data. The intervention was not observed to have an effect on the participants' daily measures of behavioural-control and the effect sizes of change detected suggested the intervention was weak. Whilst the overall hypothesis was not supported some discrete changes were observed, including increased behavioural activation for two participants (1 and 4), suggesting increasingly driven (or goal focused) behaviours or willingness to approach a rewarding event (fun-seeking behaviours). An increase in the school-engagement measure was also observed for Participant One and some decreases in risk-taking behaviours on the non-trained, mid-transfer (simulated driving) task were demonstrated for three participants

(1, 2 and 5). However, an increase in risk-taking behaviour was also observed for Participant Four.

It is clear that overall the participants were not observed to benefit from the intervention, however some limited findings were observed and in particular Participant one appeared to obtain some limited benefits. The reliable changes detected for this participant included faster inhibition and fewer errors, more goal-directed behaviours, an increase in school engagement and some increased risk-averse behaviour (safe-stops). It is interesting to note that this participant was the youngest participant, received the longest intervention-phase length and demonstrated the most cognitive, executive and social difficulties at the start of the study which could all potentially highlight areas for future research. It is possible that individual functioning, awareness (of IC skills and deficits) and motivation might be a factor in determining the efficacy of the intervention (Leotti & Wager, 2010). It would be important to further explore the effects in those with more problematic presentations, including those with below average cognitive functioning, increased levels of hyperactivity or externalised behaviour. Whilst based on the results of this study it is not possible to conclude which groups are likely to benefit most from this type of intervention, previous literature would suggest that similar intervention in YP with lower levels of IC and ECF skills may see greater effects due to the potential development of compensatory processes and motivational effects (Beauchamp, Kahn, & Berkman, 2016; Schubert, Strobach, & Karbach, 2014; Spierer, Chavan, & Manue, 2013).

Theoretical and Clinical Implications

Overall the results of this research does not support the view that IC intervention improves IC/Impulsivity in YP (Thorell et al., 2009), which is contrary to the healthy adult based research which has found improved IC following intervention (Spierer, Chavan, & Manue, 2013). The reasons for this are unclear but could indicate the design of the study was inappropriate for this type of training as will be further discussed as limitations of the study. In addition, very limited support has been found to suggest that it is possible to transfer effects of IC intervention to non-trained tasks and behaviour (Beauchamp, Kahn, & Berkman, 2016: Diamond & Lee, 2011), despite the use of metacognitive strategy support (Braga et al., 2012; Green, Strobach, & Schubert, 2013; Taatgen, 2013). This is contrary to the adult based research of Verbruggen, Adams, and Chambers (2012) who found behavioural improvement in non-trained tasks post-intervention, within the short- term. However, the non-trained tasks utilised by Verbruggen, Adams, and Chambers (2012) included content matched stimuli (financial amounts in a gambling task) which was not possible to replicate in this study.

These findings also do not provide support for the view that proactive IC strategies can be effectively generalised through the support of metacognitive skills, despite promising findings elsewhere (Braga et al., 2012). However, the lack of IC improvement itself in this study is likely to have restricted any potential effect. An additional potential explanation for this is the difficulty in transferring strategy-based intervention effects. The stop-signal training is designed to improve cognitive-control strategies which aim to strengthen general IC processes (Beauchamp, Kahn, &

Berkman, 2016). However, the specificity of the training (which requires inconsistent stopping and monitoring of go and stop processes) and the complexity of the mechanisms involved (including elements of IC, attention, monitoring, switching, goal-setting, and working-memory) may limit generalisation to other tasks (such as the inhibition of an alternative prepotent motor or cognitive response, controlling attention or interference-control; Thorell et al., 2009). It is unclear if stop-signal training can improve IC strategies or processes, the latter of which would enable the transfer of effects onto other similar processes, enabling plasticity, automaticity and observable transfer of effects (Schubert, Strobach, & Karbach, 2014).

Limitations of Study

It is important to note that the conclusions from this study are made with caution due to a number of methodological and analytical limitations of the study (Tate et al., 2016). The use of a SCED allows exploration of individualised outcomes based on individual baseline functioning, which reduces the error and confounding variables present and has enabled exploration of the research hypotheses. A multiple-baseline SCED was used to explore the effect of intervention across six participants with randomised, staggered phase-changes to provide sufficient power to detect change in behaviour and functioning. In addition, this study has strong ecological validity, as it was completed over a 20 day-period in school/home-environments, however this environment may not be suitable for this type of training (Diamond & Lee, 2011).. A weakness of this study design is its brevity, with a minimum baseline-phase length (5 days) and intervention-phase length (10 days) which were limited to increase

feasibility of the study. This brevity may not be appropriate for this design or of the length required for this type of intervention (Diamond & Lee, 2011). The variability and trend of the baseline measures for 4/6 participants indicated that the stability of behaviour within the baseline-phase was not achieved, which limits the ability to detect change within the data and the conclusions that can be drawn from these measures.

A potential strength and weakness of this study was the introduction of metacognitive strategies to support the IC training. So far IC training has seen very limited, content specific and short-term transfer to other skills (Diamond & Lee, 2011; Verbruggen, Adams, & Chambers, 2012), potentially due to the specificity of the training. The metacognitive workbooks were designed to support generalisability of the proactive strategies (which were not successfully trained as part of IC training within this study) to the YP's everyday experiences (Schubert, Strobach, & Karbach, 2014). The workbook was designed based on approaches to cognitive rehabilitation and included elements of emotional literacy and problem-solving skills (Diamond & Lee, 2011), however, it also potentially acted as an attention-switching exercise due to the dual nature of the task (Strobach, Becker, Schubert, & Kühn, 2015). Accordingly, it is difficult to determine which element or combinations of elements of the intervention were ineffective as both elements were delivered simultaneously.

In addition, the workbooks encouraged strategy development around improving IC in daily life and may have had an impact on the strategies that the participants used for the stop-signal training. The effects of bias towards go or stop processes (fastening or slowing of responses)

and the impact of bias on IC and behaviour are unknown in this age group (Leotti & Wager, 2010; Simpson et al., 2012; Verbruggen, Chambers, & Logan, 2013). However, the use of pro-active slowing strategies, leading to the passive-dissipation of the pre-potent response is likely to have affected the direct-effect of training (the SSRT's obtained).

While a potential strength in this study is the variety of measures and measurement type (self-report, direct measurement of behaviour, third-party report) used to gather information including the characterisation and research data across a range of domains (Green, Strobach, & Schubert, 2013; Middleton, 2002), this study would have been strengthened by the use of measures from other sources (i.e., parent/carers/teachers/observations) in assessing the outcomes of the intervention. A limitation of this study was the lack of blinding or masking of the participants and researcher, due to the nature of the design and limited resources. Therefore, potential implications for bias in the data due to participants' and researcher's expectation effects are acknowledged (Green, Strobach, & Schubert, 2013). Whilst the impact of non-blinding is problematic, this was managed by using measures which are less prone to bias, including direct-measurement and self-report measures at phase-change points. Future research may address this potential limitation by using independent assessors to collect observational phase-change data.

In addition, the measures used themselves are individually problematic. While the majority of measures used provided standardised, age-appropriate data to enable comparison with the population an exploratory measure (BIS/BAS) was also utilised. As the BIS/BAS was a

supporting measure, the potential impact of its use in this study was limited but some interesting findings regarding behavioural activation were found. The nature of the CWIT and Stoplight tasks was also problematic and confounding as potential practice effects could be construed as real improvement in these skills (Green, Strobach, & Schubert, 2013; Thorell et al., 2009), which is only partially controlled for when using reliable change indices.

The continuous measure of change was based on the GAS which provides an approach to identifying and quantifying each individual's own meaningful goal-attainment, which could include the degree to which they subjectively had improved their impulse control (near-transfer effect) and risk taking behaviour (far-transfer effect). This measure provides an individualised approach to outcome measurement, which has been shown to provide valid and reliable measurement of everyday effect on an individualised, context and problem-specific basis (Tennant, 2007). However, the GAS is not a standardisable measure enabling comparisons with others participants or populations. It is clear that construct validity is a significant issue with this measure (Erztgaard, Ward, Wissel & Borg, 2011), in addition to difficulties with the objectivity and observability of outcome scaling (Turner-Stokes, 2009). The GAS was used to improve the measurement of generalisability of the IC intervention to the participants' everyday life and, in accordance, the participants' motivation for the intervention. Despite this it is not possible to determine the level of motivation that each participant held for their own personal goals and therefore their motivation and engagement with intervention (Erztgaard et

al, 2011). In addition, the setting of goals could be considered confounding as goal-setting is an executive strategy in itself (Krasny-Pacini et al., 2014).

A weakness of this study is the lack of contextual control and the potential impact on the fidelity of the intervention. The SSRT data from the training task indicated that the participants did not observe direct improvement on IC, as would have been expected from the adult literature (Berkman, Kahn, & Merchant, 2014; Riggs, Greenberg, & Rhoades, 2011; Verbruggen, Adams, & Chambers, 2013; Verbruggen & Logan, 2008). However, it is important to note that the stop-signal training utilised within this study was not carried out in a laboratory context, which would have enabled the repetition of task instructions to the participants, although the instruction reminders were provided within the workbooks.

A strength of the study is the use of a SCED which enabled exploration of the impact of the intervention on different individuals. However, the small sample size and limited measurement times did not provide the power to further explore the impact of participants' characteristics (i.e., executive functioning, externalising or hyperactivity difficulties) on their intervention performance. In addition, this opportunity sample was not necessarily representative of the population and the impact of heightened motivation cannot be ignored. In addition, participants' levels of motivation and engagement are likely to have differed between individuals and may have had an impact on the results of this study (Schubert, Strobach, & Karbach, 2014).

A strength in this study was the use of complimentary data analysis methods, including visual inspection (Manolov, Losada, Chacón-Moscoso, & Sanduvete-Chaves, 2016) supported by randomisation tests (Edgington & Onghena, 2005; Levin & Wampold, 1999; Ter Kuile et al., 2009). This ensured a thorough exploration of the individual data for each case, between-phase and between-subjects data, strengthening the reliability of the findings. The potential bias on the data and likelihood of type 1 error is increased due to serial correlation (Dugard, File, & Todman, 2012), although the impact of this is minimised due to the complimentary use of visual analysis and percentage of non-overlapping data techniques (Kratochwill et al., 2010). Independent ratings and multiple daily measures would have improved reliability but were not considered feasible within the scope of this study. Future research may utilise a sequential treatments design to further explore the impact of autocorrelation on the results (Dugard, File, & Todman, 2012).

Future Directions

While a number of limitations and areas of bias have been highlighted as reducing the reliability of the already limited conclusions of this study, some potential implications of this study for future research can be tentatively considered.

Whether it is possible to support the development of process-based skills and scaffolding for those with limited skills utilising the stop-signal training is inconclusive (Spierer, Chavan, & Manue, 2013). It would be useful to explore the potential replication of this study within low-academic functioning and clinical populations who may obtain further benefits from

the training due to compensatory processes (Beauchamp, Kahn, & Berkman, 2016; Strobach, Becker, Schubert, & Kühn, 2015).

Due to the baseline variability observed and the limited effects found for the participant with the longest intervention phase, it may be useful to explore the impact of longer baseline and intervention phases. It would also be of interest to provide a longer follow-up period as it was not possible to determine the longevity of the limited effects observed in this study. In addition, it would be useful to utilise a sequential treatment design to explore the effect of different elements of the intervention and potentially explore the impact of content specific stimuli (i.e., IC and metacognitive) within the training to determine the effect on IC strategy use (Leotti & Wager, 2010).

Conclusion

The investigation of IC intervention for YP is in its infancy. This study has explored the direct, near and far transfer effects of IC training and metacognitive strategies to support generalisability. The intervention was not observed to be effective in reducing IC or improving behavioural control overall, with very limited effects found. Future researchers may wish to explore the sequential utilisation of IC training and metacognitive strategy development within similar populations and the implications of similar interventions within clinical populations.

References

Baer, R., & Neitzel, M. T. (1991). Cognitive and behavioral treatment of impulsivity in children: A meta-analytic review of the outcome literature. *Journal of Clinical Child Psychology, 20,* 400-412. doi:10.1207/s15374424jccp2004_9

Beauchamp, K. G., Kahn, L. E., & Berkman, E. T. (2016). Does inhibitory control training transfer?: Behavioural and neural effects on an untrained emotion regulation task*. Social Cognitive and Affective Neuroscience, 0*, 1–9. doi: 10.1093/scan/nsw061

Bergh, F. S., Bloemarts, E., Chan, J. S., Groenink, L., Olivier, B., & Oosting, R. S. (2006). Spontaneously hypertensive rats do not predict symptoms of attention-deficit hyperactivity disorder. *Pharmacology, Biochemistry and Behaviour, 83,* 380–390. doi: 10.1016/j.pbb.2006.02.018

Berkman, E. T., Kahn, L. E., & Merchant, J. S. (2014). Training-induced changes in inhibitory control network activity. *The Journal of Neuroscience*, *34,* 149 –157. doi: 0.1523/JNEUROSCI.3564-13.2014

Bjorklund, D. F. (2012). *Children's thinking: cognitive development and individual differences* (5th ed.). Belmont, CA: Wadsworth.

Braga, L. W., Rossi, L., Moretto, A. L., da Silva, J. M., & Cole, M. (2012). Empowering preadolescents with ABI through metacognition: Preliminary results of a randomized clinical trial. *NeuroRehabiliation 30,* 205-15. doi: 10.3233/NRE-2012-0746

British Psychological Society (BPS). (2009). *Code of ethics and conduct*. Leicester: BPS.

Butler, R. W., Copeland, D. R., Fairclough, D. L., Mulhern, R. K., Katz, E. R., Kazak, A. E., … Sahler, O. J. Z. (2008). A multicenter, randomized clinical trial of a cognitive remediation program for childhood survivors of a pediatric malignancy. *Journal of Consulting and Clinical Psychology*, *76,* 367-378. doi: 10.1037/0022-006X.76.3.367

Carroll, A., Hemingway, F., Bower, J., Ashman, A., Houghton, S., & Durkin, K. (2006). Delinquency: Differences among early-onset, late-onset, and non-offenders. *Journal of Youth and Adolescence, 35,* 519–529. doi:10.1007/s10964-006-9053-6

Carver, C. S., & White, T. L. (1994). Behavioral inhibition, behavioral activation, and affective responses to impending reward and punishment: The BIS/BAS scales. *Journal of Personality and Social Psychology, 67,* 319-333.

Caswell, A. J., Morgan, M. J., & Duka, T. (2013). Acute alcohol effects on subtypes of impulsivity and the role of alcohol-outcome expectancies. *Psychopharmacology*, *229,* 21-30. doi: 10.1007/s00213-013-3079-8

Centifanti, L. C. M., Modecki, K. L., MacLellan, S., & Gowling, H. (2014). Driving under the influence of risky peers: An experimental study of adolescent risk taking. *Journal of Research on Adolescence.* Advance online publication. doi: 10.1111/jora.12187

Chein, J., Albert, D., O'Brien, L., Uckert, K., & Steinberg, L. (2011). Peers increase adolescent risk taking by enhancing activity in the brain's reward circuitry. D*evelopmental Science*, *14,* 1-16. doi:10.1111/j.1467-7687.2010.01035.x

Chen, C. Y., Muggleton, N. G., Juan, C. H., Tzeng, O. J. L., & Hung, D. L. (2008). Time pressure leads to inhibitory control deficits in impulsive violent offenders. *Behavioural Brain Research*, *187,* 483-488. doi:10.1016/j.bbr.2007.10.011

Congdon, E., Mumford, J. A., Cohen, J. R., Galvan, A., Canli, T., & Poldrack, R. A. (2012). Measurement and reliability of response inhibition. *Frontiers in Psychology, 3*(37), 1-10. doi: 10.3389/fpsyg.2012.00037

Delis, D. C., Kaplan, E., & Kramer, J. H. (2001). *Delis-Kaplan Executive Function System (D-KEFS) examiner's manual.* San Antonio, TX: The Psychological Corporation.

Diamond, L., & Lee, K. (2011). Interventions shown to aid executive function development in children 4-12 years old. *Science, 333,* 959-964. doi: 10.1126/science.1204529

Dugard, P., File, P., & Todman, J. B. (2012). *Single-case and small-n designs. A practical guide to randomization tests (2nd ed.).* New York, NY: Routledge.

Dunning, D. L., & Holmes, J. (2014). Does working memory training promote the use of strategies on untrained working memory tasks? *Memory and Cognition, 42*, 854–862. doi: 10.3758/s13421-014-0410-5

Edgington, E. S., & Onghena, P. (2007). *Randomization tests* (4th ed.). Boca Raton, FL: Chapman & Hall.

Enge, S., Behnke, A., Fleischhauer, M., Küttler, L., Kliegel, M., & Strobel, A. (2014). No evidence for true training and transfer effects after inhibitory control training in young healthy adults*. Journal of Experimental Psychology, 40,* 987-1001. doi: 10.1037/a0036165

Ertzgaard, P., Ward, A. B., Wissel, J., & Borg, J. (2011). Practical considerations for goal attainment scaling during rehabilitation following acquired brain injury. *Journal of Rehabilitation Medicine, 43*, 8-14. doi: 10.2340/16501977-0664

Evans, C., Margison, F., & Barkham, M. (1998). The contribution of reliable and clinically significant change methods to evidence-based mental health. *Evidence Based Mental Health, 1,* 70-72. doi: 10.1136/ebmh.1.3.70

Fishbein, D., Scott, M., Hyde, C., Newlin, D., Hubal, R., Serin, R., Chrousos, G., & Alesci, S. (2006). *Neuropsychological and emotional deficits predict correctional treatment response.* Washington, DC: United States Department of Justice, National Institute of Justice.

Fossati, A., Barratt, E. S., Acquarini, E., & Di Ceglie, A. (2002). Psychometric properties of an adolescent version of the Barratt impulsiveness scale-11 for a sample of Italian high school students. *Perpetual and Motor Skills, 95,* 621-635. doi: 10.2466/pms.2002.95.2.621

Fredricks, J., McColskey, W., Meli, J., Mordica, J., Montrosse, B., & Mooney, K. (2011). *Measuring student engagement in upper elementary through high*

school: a description of 21 instruments. Retrieved from http://ies.ed.gov/ncee/edlabs.

Geier, C. F., Terwilliger, R., Teslovich, K., Velanova, K., & Luna, B. (2009). Immaturities in reward processing and its influence on inhibitory control in adolescence. *Cerebral Cortex, 20,* 1-17*.* doi:10.1093/cercor/bhp225

Gioia, G. A., Isquith, P. K., Guy, S. C., & Kenworthy, L. (2000). Test review behaviour rating inventory of executive function. *Child Neuropsychology: A Journal on Normal and Abnormal Development in Childhood and Adolescence, 6*, 235-238. doi:10.1076/chin.6.3.235.3152

Goodman, R. (2001). Psychometric properties of the strengths and difficulties questionnaire. *Journal of the American Academy of Child & Adolescent Psychiatry, 40*, 1337-1345.

Green, C. S., Strobach, T., & Schubert, Y. (2014). On methodological standards in training and transfer experiments. *Psychological Research, 78,* 756-772. doi:10.1007/s00426-013-0535-3

Jacobson, N. S., & Traux, P. (1991). Clinical significance: A statistical approach to defining meaningful change in psychotherapy research. *Journal of Consulting and Clinical Psychology*, *59*, 12-19.

Johnstone, S. J., Roodenrys, S., Blackman, R., Johnston, E., Loveday, K., Mantz, S., & Barratt, M. F. (2012). Neurocognitive training for children with and without AD/HD. *ADHD Attention Deficit Hyperactivity Disorders, 4,* 11-23. doi:10.1007/s12402-011-0069-8

Kenny, M. E., Blustein, D. L., Chaves, A., Grossman, J. M., & Gallagher, L. A. (2003). The role of perceived barriers and relational support in the educational and vocational lives of urban high school students. *Journal of Counseling Psychology, 50*, 142–155. doi: 10.1037/0022-0167.50.2.142

Krasny-Pacini, A., Chevignard, M., & Evans, J. (2014). Goal management training for rehabilitation of executive functions: A systematic review of effectiveness in patients with acquired brain injury*. Disability and Rehabilitation, 36*, 105-116. doi: 10.3109/09638288.2013.777807

Krasny-Pacini, A., Limond, J., Evans, J., Hiebel, J., Bendjelida, K., & Chevignard, M. (2014). Context-sensitive goal management training for everyday executive dysfunction in children after severe traumatic brain injury. *Journal of Head Trauma and Rehabilitation, 29,* 1-16. doi:10.1097/HTR.0000000000000015

Kratochwill, T. R., Hitchcock, J., Horner, R. H., Levin, J. R., Odom, S. L., Rindskopf, D. M., & Shadish, W. R. (2010). *Single-case designs technical documentation*. Washington DC: What Works Clearing House.

Kratochwill, T. R., & Levin, J. R. (2010). Enhancing the scientific credibility of single-case intervention research: randomization to the rescue. *Psychological Methods, 15,* 124–144. doi: 10.1037/a0017736

Leotti, L. A., & Wager, T, D. (2010). Motivational influences on response inhibition measures. *Journal of Experimental Psychology: Human Perception & Performance, 36,* 430-447. doi: 10.1037/a0016802

Levin, J. R., & Wampold, B. E. (1999). Generalized single-case randomization tests: Flexible analyses for a variety of situations. *School Psychology Quarterly*, *14*, 59-93.

Limond, J., Adlam, A., & Cormack, M. (2014). A model for pediatric neurocognitive interventions: considering the role of development and maturation in rehabilitation planning. *The Clinical Neuropsychologist, 28,* 1-18. doi:10.1080/13854046.2013.873083

Logan, G. D., & Cowan, W. B. (1984). On the ability to inhibit thought and action: A theory of an act of control. *Psychological Review, 91,* 295–327. doi: 10.1037/0033-295X.91.3.295

Manolov, R., Losada, J. L., Chacón-Moscoso, S., & Sanduvete-Chaves, S. (2016). Analyzing two-phase single-case data with non-overlap and mean difference indices: Illustration, software tools, and alternatives. *Frontiers in Psychology, 7*(32), 1-16. doi: 10.3389/fpsyg.2016.00032

Masui, K., & Nomura, M. (2011). The effects of reward and punishment on response inhibition in non-clinical psychopathy. *Personality and Individual Differences*, *50*, 69–73. doi:10.1016/j.paid.2010.08.024

Meltzer, H., Gatward, R., Goodman, R., & Ford, F. (2000). *Mental health of children and adolescents in Great Britain*. London: The Stationery Office.

Nigg, J. T. (2000). On inhibition/disinhibition in developmental psychopathology: Views from cognitive and personality psychology and a working inhibition taxonomy. *Psychological Bulletin, 126*, 220-46. doi:10.1037//0033-2909.126.2.220

Onghena, P., & Edgington, E. S. (2005). Customization of pain treatments: Single-case design and analysis. *Clinical Journal of Pain, 21*, 56–68. doi:10.1097/00002508-200501000-00007

Parker, R. I., & Vannest, K. (2009). An improved effect size for single-case research: Nonoverlap of all pairs. *Behavior Therapy, 40,* 357–367. doi: 10.1016/j.beth.2008.10.006

Patton, J. H., Stanford, M. S., & Barratt, E. S. (1995). Factor structure of the Barratt Impulsiveness Scale. *Journal of Clinical Psychology, 51*, 768–74. doi:10.1002/1097-4679(199511)51:6<768::AID-JCLP2270510607>3.0.CO;2-1

Riggs, N, R., Greenberg, M. T., Kusché, C. A., & Pentz, M. A. (2006). The mediational role of neurocognition in the behavioural outcomes of a social-emotional prevention program in elementary school students: Effects of the PATHS curriculum. *Prevention Science, 7,* 91-102. doi: 10.1007/s11121-005-0022-1

Riggs, N, R., Greenberg, M. T., & Rhoades, B. (2011). Early risk for problem behavior and substance use: targeted interventions for the promotion of IC. In M.T. Bardo, D. H. Fishbein & R. Milich*. Inhibitory control and drug abuse prevention* (pp. 249-262). New York: Springer.

Roach, A. T., & Elliot, S. N. (2005). Goal attainment scaling: An efficient and effective approach to monitoring student progress. *Teaching Exceptional Children*, *37*, 8-17. doi: 10.1177/004005990503700401

Romer, D., Betancourt, L. M., Brodsky, N. L., Giannetta, J. M., Yang, W., & Hurt, H. (2011). Does adolescent risk taking imply weak executive function? A prospective study of relations between working memory performance, impulsivity, and risk taking in early adolescence. *Developmental Science, 14*, 1119–1133. doi:10.1111/j.1467-7687.2011.01061.x

Ross, E. H., & Hoaken, P. N. S. (2010). Correctional remediation meets neuropsychological rehabilitation: How brain injury and schizophrenia research can improve offender programming. *Criminal Justice and Behavior*, *37*, 656-677. doi:10.1177/0093854810363104

Schubert, T., Strobach, T., & Karbach, J. (2014). New directions in cognitive training: On methods, transfer, and application. *Psychological Research, 78,* 749–755. doi:10.1007/s00426-014-0619-8

Simpson, A., Riggs, K. J., Beck, S. R., Gorniak, S. L., Wu, Y., Abbott, D., & Diamond, A. (2012). Refining the understanding of inhibitory processes: How response prepotency is created and overcome. *Developmental Science*, *15*, 62–73. doi:10.1111/j.1467-7687.2011.01105.x

Solanas, A., Manalov., & Onghena, P. (2010). Estimating slope and level change in n=1 designs. *Behavior Modification, 34*, 195-218. doi:10.1177/0145445510363306

Spierer, L., Chavan, C. F., & Manuel, A. L. (2013). Training-induced behavioral and brain plasticity in inhibitory control. *Frontiers in Human Neuroscience*, *7,* 1-9. doi: 10.3389/fnhum.2013.00427

Steinberg, L. (2007). Risk taking in adolescence: New perspectives from brain and behavioral science. *Current Directions in Psychological Science, 16,* 55-59. doi: 10.1111/j.1467-8721.2007.00475.x

Steinberg, L., Albert, D., Cauffman, E., Banich, M., Graham, S., & Woolard, J. (2008). Age differences in sensation seeking and impulsivity as indexed by behavior and self-report: Evidence for a dual systems model. *Developmental Psychology*, *44*, 1764-1778. doi: 10.1037/a0012955

Strobach, T., Becker, M., Schubert, T., & Kühn, S. (2015). Better dual-task processing in simultaneous interpreters. *Frontiers in Psychology, 6* (1590), 1-9. doi:10.3389/fpsyg.2015.01590

Taatgen, N. A. (2013). The nature and transfer of cognitive skills. *Psychological Review, 10*, 1-33. doi: 0.1037/a0033138

Tate, R. L., Perdices, M., Rosenkoetter, U., Shadish, W., Vohra, S., Barlow, D. H., … Wilson, B. (2016). The single-case reporting guideline In behavioural interventions (SCRIBE) 2016 statement. *Archives of Scientific Psychology, 4,* 1-9. doi: http://dx.doi.org/10.1037/arc0000026

Tennant, A. (2007). Goal attainment scaling: Current methodological challenges. *Disability and Rehabilitation, 29,* 1583 – 1588. doi: 10.1080/09638280701618828

Ter Kuile, M. M., Bulté, I., Weijenborg, P. T. M., Beekman, A., Melles, R., & Onghena, P. (2009). Therapist-aided exposure for women with lifelong vaginismus: A replicated single-case design. *Journal of Consulting and Clinical Psychology, 77,* 149–159. doi: 10.1037/a0014273

Thorell, L. B., Lindqvist, S., Nutley, S. B., Bohlin, G., & Klingberg, T. (2009). Training and transfer effects of executive functions in preschool children. *Developmental Science, 12,* 106 –113. doi:10.1111/j.1467-7687.2008.00745.x

Turner-Stokes, L. (2009). Goal attainment scaling (GAS) in rehabilitation: A practical guide. *Clinical Rehabilitation, 23,* 362−370. doi:10.1177/0269215508101742

Unsworth, N., Redick, T. S., McMillan, B. D., Hambrick, D. Z., Kane, M. J., & Engle, R. W. (2015). Is playing video games related to cognitive abilities? *Psychological Science, 26,* 759-74. doi:10.1177/0956797615570367

Urošević, S., Collins, P., Muetzel, R., Lim, K., & Luciana, M. (2012). Longitudinal changes in behavioral approach system sensitivity and brain structures involved in reward processing during adolescence. *Developmental Psychology, 48,* 1488–1500. doi:10.1037/a0027502

Velanova, K., Wheeler, M. E., & Luna, B. (2008). Maturational changes in anterior cingulate and frontoparietal recruitment support the development of error processing and inhibitory control. *Cerebral Cortex*, *18*, 2505-2522. doi:10.1093/cercor/bhn012

Verbruggen, F., Adams, R. C., & Chambers, C. D. (2012). Proactive motor control reduces monetary risk taking in gambling. *Psychological Science, 23,* 805-15. doi:10.1177/095679761143453

Verbruggen, F., Adams, R. C., van't Woult, F., Stevens, T., McLaren, I. P. L., & Chambers, C. D. (2013). Are the effects of response inhibition on

gambling long-lasting? *PLoS one,* 8, *e70155.* doi:10.1371/journal.pone.0070155.g001

Verbruggen, F., Chambers, C. D., & Logan, G. D. (2013). Fictitious inhibitory differences: how skewness and slowing distort the estimation of stopping latencies. *Psychological Science*, *24,* 352–362. doi:10.1177/0956797612457390

Verbruggen, F., & Logan, G. D. (2008). Automatic and controlled response inhibition: Associative learning in the go/no-go and stop-signal paradigms. *Journal of Experimental Psychology: General*, *137*, 649-672. doi:10.1037/a0013170

Weafer, J., Baggott, M. J., & de Wit, H. (2013). Test-retest reliability of behavioural measures of impulsive choice, impulsive action, and inattention. *Experimental and Clinical Psychopharmacology, 21,* 475-481. doi: 10.1037/a0033659

Wechsler, D. (2011). *Wechsler Abbreviated Scale of Intelligence, second edition (WASI-II).* San Antonio, TX: NCS Pearson.

Ylvisaker, M., & Feeney, T. (2002). Executive functions, self-regulation, and learned optimism in paediatric rehabilitation: A review and implications for intervention. *Pediatric Rehabiliiation, 5,* 51-70. doi:10.1080/1363849021000041891

Yu, R., Branje, S. J. T., Keusers, L., & Meeus, W. H. J. (2011). Psychometric characteristics of Carver and White's BIS/BAS scales in Dutch

adolescents and their mothers. *Journal of Personality Assessment, 93,* 500–507. doi:10.1080/00223891.2011.595745

Appendices

Appendix A. Proof of University Ethics Approval

From: apache@exeter.ac.uk <apache@exeter.ac.uk> on behalf of Ethics Approval System <D.M.Salway@exeter.ac.uk>
Sent: 26 May 2015 18:21
To: Green, Joanna
Subject: Your application for ethical approval (2015/905) has been accepted

Ethical Approval system

Your application (2015/905) entitled Direct and transfer effects of inhibitory control training in young people. has been accepted

Please visit http://www.exeter.ac.uk/staff/ethicalapproval/

Please click on the link above and select the relevant application from the list.

Appendix B. Research Risk Protocol

Identified Risk	*Management of risk*
Vulnerable Population: Age of participants – 16 years and under	Fully informed and voluntary written consent was obtained from the participants' parent/carers, and written assent was obtained from all of the participants. All parent/carers were given information sheets detailing the purpose of the research, and the nature and duration of the study. Participants received age appropriate information sheets detailing the study's aims and the tasks they would complete, to ensure that informed consent was possible. It was made clear to each participant that they had the right to withdraw at any time without giving reason, even if their parent/carer(s) had consented for them to participate. Both the participants and their parent/carer(s) were assured that withdrawal from the research would not prejudice any future service they might receive. As the data collection involved time commitment from each participant they were made aware of what was involved at the start of the study and they were reminded that they were free to withdraw at any time. Following the study the participants received a debrief and were offered details of support agencies should they have felt distressed by the study or any of the issues the study raises which are outside of the competencies of the researcher.
Vulnerable Population: Maintaining confidentiality and anonymity	The researcher obtained limited information regarding the participant (name, age, contact details and previous diagnoses of mental illness/disorder and brain injury). Any information provided (consent forms, assessments and measures) was stored securely and available only to the researcher and supervisors. Confidentiality was preserved by the use of participant numbers on measures and completed data. The storage of identifiable information (consent forms and screening information) was separate to data. All identifiable information was stored in a locked cabinet. All

	data was stored in a separate locked cabinet and electronic data was stored on a password protected computer.
Vulnerable Population: Breaking confidentiality (e.g., due to risk of self-harm or injury)	The confidentiality of a participant would have been breached only if any concerns regarding their safety or the safety of others were raised. In this instance the information related only to the risk concerns would have been shared with the person supporting the participant on a daily basis (parent or carer), the teacher supporting that participant and the research supervisor. This confidentiality clause was communicated to the participants at the initiation of participation and if clinically feasible and beneficial at the time of the breach.

Appendix C. Example of Goal Attainment Scale (GAS).

Participant number: 1. **Date : ……**

Goal scale

Goal 1. To be able to stop myself when I want to.

+2	+1	0	-1	-2
I have been able to meet this goal 75-100% of the time today	I have been able to meet this goal 56-75% of the time today	I have been able to meet this goal 45-55% of the time today	I have been able to meet this goal 30-44% of the time today	I have been able to meet this goal less than 30% of the time today

Goal 2. To focus in my lessons.

+2	+1	0	-1	-2
I have been able to meet this goal 75-100% of the time today	I have been able to meet this goal 56-75 % of the time today	I have been able to meet this goal 45-55% of the time today	I have been able to meet this goal 30-44% of the time today	I have been able to meet this goal less than 30% of the time today

Goal 3. To avoid being distracted by my brothers.

+2	+1	0	-1	-2
I have been able to meet this goal 75-100% of the time today	I have been able to meet this goal 56-75 % of the time today	I have been able to meet this goal 45-55% of the time today	I have been able to meet this goal 30-44% of the time today	I have been able to meet this goal less than 30% of the time today

Appendix D. Further Technical Details of Measures Used

Characterisation measures. To characterise participants' cognitive, executive and behavioural functioning, an assessment battery was conducted at the start of the study. The battery included neuropsychological assessments, selected to provide measures of general intellectual function and executive function. The measures were used to characterise the participant's cognitive profile only, and were not used to evaluate the intervention.

The YP's cognitive functioning was assessed using the Wechsler Abbreviated Scale of Intelligence – second edition (WASI-II) which is a well established, validated and standardised measure of general cognitive functioning. The assessment utilised 4 subtests which provide indices of verbal comprehension, perceptual reasoning, and a full scale intelligence quotient (FSIQ). Normative data is based on a sample of 2,300 individuals from which the data from 11 years (N=100), 12 years (N=100), 13 years (N=100), 14 years (N=100) and 15 years (N=100) of age was used (Wechsler, 2011).

The Behavior Rating Inventory of Executive Function (BRIEF) was used to provide a measure of everyday general executive function, behaviour regulation, and metacognition. The BRIEF is a standardised, ecologically-valid measure with good reliability, internal consistency and moderate correlations between parent/carer and teacher ratings. Each BRIEF questionnaire contains eighty-six items in eight non-overlapping clinical scales and two validity scales measuring negativity and inconsistency in responses. Item responses range from 1-3 and are age and gender standardized. Scale T scores are used with a mean of 50 and a standard deviation of 10, with higher scores reflecting greater executive dysfunction. Normative data was based on a sample of 10,438

children and young people aged 5-15 years (50% male) and 8208 of their teachers (79% of sample; Gioia, Isquith, Guy, & Kenworthy, 2000). The BRIEF-T was completed by the YP's main teacher and the self-report (BRIEF-SR) was completed by the participant.

The strengths and difficulties questionnaire (SDQ) was used to provide a measure of general strengths and behavioural difficulties. The SDQ is a standardised, widely-available brief behavioural screening questionnaire for 3-16 year olds with moderate to high reliability (Goodman, 2001). Each SDQ contains twenty-five items scored from 0-2, in five non-overlapping clinical age and gender standardized scales and an impact scale Total scale scores range from 0- 40, internalising and externalising scale scores range from 0-20 and impact scale scores range from 0-10, with higher scores reflecting greater difficulties. The prosocial scale ranges from 0-10 with lower scores reflecting greater difficulties. Normative data was based on a sample of 10,438 children and YP aged 5-15 years (50% male) and 8208 of their teachers (79% of sample; Meltzer, Gatward, Goodman, & Ford, 2000). The SDQ-T 17 was completed by the YP's main teacher and the self-report (SDQ S11-17) was completed by the participant.

Outcome measures.

Phase-change measures. The following five measures were taken at baseline onset, at intervention onset and termination. Near transfer effects of IC (H1) were measured using the D-KEFS Color-Word Interference Test (CWIT). The CWIT demonstrates good reliability, moderate to high internal consistency (Delis, Kaplan, & Kramer, 2001). Age standardised normative data was based

on a sample of 1750 people (50% male) of which data from 11 years (n = 75), 12 years (n = 100), 13 years (n = 100), 14 years (n = 100) and 15 years (n = 100) of age was used. Good-acceptable reliability has been demonstrated by this scale with test-retest reliability coefficients for completion times of .79 for Colour naming, .77 for Word reading, .90 for Inhibition, .80 for Inhibition/Switching (Delis, Kaplan, & Kramer, 2001).

The Stoplight task provides a non-trained, mid-transfer measure of IC (H1) and risk-taking behaviour (H2; Chein, Albert, O'Brien, Uckert, & Steinberg, 2011; Steinberg et al., 2008). This task involves a computer-simulated driving task with the participant controlling the vehicle as it approaches 32 intersections to reach a radio station who are giving out money to those reaching the station first. The amount of money available decreased as time lapses with a maximum of 510 seconds to reach the station. The cars travel at a set speed and the participants are required to press the space bar to brake. At each intersection the participants decide whether to continue through or brake to stop. Each intersection was controlled by a standard traffic light which on approach was showing green. As the participants approach the intersection the light turns to amber and then red, at a set delay. At this point the participants decide if they would continue and make it through the intersection safely (no time lost), to continue or brake too late and get hit by another car (resulting in a delay of six seconds) or to brake and stop the car at the intersection (resulting in a delay of three seconds; Steinberg, et al., 2008). The brake latency is the elapsed time between the appearance of the amber light and the application of the brakes (in milliseconds; msec). The outcome variables for each participant were the number of safe stops, crashes and intersections crossed successfully and the

brake latency. The Stoplight task has documented age appropriate norms to enable standardisation of scores, with slower brake latencies or higher failures to brake (including more crashes and intersections crossed successfully) indicative of increased risk taking behaviour (Steinberg, et al., 2008). Normative data was based on a sample of 935 participants (49% male) or which data was used for the following age divisions: 10-11 years (*N*=116), 12-13 years (*N*=137), 14-15 years (*N*=128; Steinberg, et al., 2008). As there is limited data regarding the reliability of the measure and to enable RCI calculations, Pearson correlations were calculated from the participants' responses to assess test-retest reliability at each phase-change. Questionable - acceptable reliability was found for pre-baseline to phase-change safe stops (*r*= .85), crashes (r=.85), intersections crossed successfully (*r*=.57) and brake latencies (*r*=.67), phase-change to post-training safe stops (*r*=.77), crashes (r=.65), intersections crossed successfully (*r*=.72) and brake latencies (*r*=.81) and pre-baseline to post-training safe stops (r=.95), crashes (r=.79), intersections crossed successfully (r=.96) and brake latencies (r=.44; Weafer, Baggott, & de Wit, 2013).

The self-report Barratt Impulsiveness Scale for Adolescents-11 (BIS-A-11) was used to provide a measure of the participants' level of everyday impulsivity and a far-transfer measure of IC (H1).The BIS-A-11 is the age standardised version of the well-established adult scale, which demonstrates acceptable validity and reliability (Cronbach's alpha = .78; Fossati, Barratt, Acquarini, & Di Ceglie, 2002; Patton, Stanford, & Barratt, 1995). The BIS-A-11 contains thirty items across two factors (general and non-planning impulsiveness), scored on a four-point scale with higher scores indicating

increased impulsivity. Normative data was based on a sample of 596 secondary school students aged 13-19 years (Mean age = 16.4 years, SD = 1.5, 37.1% male; Fossati, Barratt, Acquarini, & Di Ceglie, 2002).

The Behavioural Inhibition/Behavioural Activation Scale (BIS/BAS; Carver & White, 1994) was used as an experimental measure to supplement the BIS-A-11 scale and as a far-transfer measure (H1 and H2). The BIS/BAS provides self-report measurement of behavioural inhibition and has demonstrated use in adult populations. However it currently has limited documented use with adolescent populations (Yu, Branje, Keusers, & Meeus, 2011) and accordingly this measure was included as an experimental, supplementary measure. The BIS/BAS contains twenty-four items across four factors (behavioural inhibition, behavioural activation reward responsiveness, drive and sensation seeking), scored on a four-point scale with higher scores on the BIS scale indicating higher IC and higher scores on the BAS scales indicating increased behavioural activation (Carver & White, 1994). Age standardised normative data was based on 184 young people (44% male) of which data from 117 young people, aged 9-17 years was used. Questionable-acceptable reliability has been demonstrated by this scale (Cronbach's alpha of .66 for BIS, .73 for BAS Drive, .59 for BAS Reward Responsiveness, and .61 for BAS Fun Seeking; Urošević, Collins, Muetzel, Lim, & Luciana, 2012).

The school engagement questionnaire (SEQ) provided a far transfer self-report measure of difficulties at school (H2). The SEQ is a standardised, widely available, brief, behavioural screening questionnaire for secondary education students with high reliability (Fredricks et al., 2011). The measure consists of eight items over four factors related to school engagement (homework,

attention, attendance and concentration). Item responses range from 1 to 6 with low scores reflecting problems with school engagement. Age standardised normative data was based on 174 secondary school students, aged 13-17 years (mean age = 14.71 years, 51% male) from which the scale demonstrated acceptable reliability (Cronbach's alpha = .77; Kenny, Blustein, Chaves, Grossman, & Gallagher, 2003).

***Continuous measures of change*.** Performance on the stop-signal training was used as a continuous measure with session stop-signal reaction time (SSRT) used to determine any direct improvements in IC (H1).

The goal attainment scale (GAS; Roach & Elliot, 2005) was completed by the participants on a daily basis as a far-transfer measure of perceived ability to refrain from impulsive, risky and difficult behaviour (H2). The GAS is an approach to rehabilitation that relies on individualised treatment goals and has been shown to be effective in generalising effects of interventions in neurorehabilitation (Krasny-Pacini, Chevignard, & Evans, 2014). The GAS utilises the participants own determined outcome goals and quantified scoring. Whilst the GAS is considered an individualised outcome measure and cannot be standardised there is evidence for the reliability, validity and responsiveness of the measure (Tennant, 2007). The GAS utilised three outcome goals with scores between -2 and +2 for each goal resulting in a total score between -6 and +6 per day. The responses can be transformed into composite scores, which have a mean of 50 and a standard deviation of 10, with higher scores reflecting greater goal attainment (Turner-Stokes, 2009).

Appendix E. Further Technical Details of Training Used

The daily stop-signal training utilised the stop-signal paradigm. Specifically, the daily training task included 4 training blocks, each including 48 trials, with a 15 second break in between each block. The participants completed between 10 and 15 training sessions (each with 4 blocks of 48 trials per block). The number of trails per day (196) and minimum number of days of training (10) was determined by the minimum number of trials and days shown to have any direct or transfer effects within the literature (Dunning & Holmes, 2014; Spierer, Chavan, & Manue, 2013).

The training used visual stimuli for both the go and stop processes provided on a laptop computer screen. Each block consisted of the start cue and then 48 go signals (trials). Each trial began with the presentation of a central fixation spot. The fixation spot disappeared and was replaced by a green arrow (go-signal) in the central location, pointing left or right. The participants were instructed to respond to the go-signal as quickly as possible by pressing the corresponding direction arrow on the keypad, using their index fingers on the respective hand. The time taken to elicit the appropriate response is measured as the go reaction time (RT).

On 50% of the trials the go signal (green arrow) was followed by a stop signal as the green arrow changed colour (but not direction) to red. Participants were told to respond to the go-signal as quickly as possible, but to inhibit their response when the stop-signal was produced and thereby stop the response that was already in the process of being performed (prepotent response inhibition).

The stop signal or colour change occurred at varying latencies (stop-signal delay; SSD). The SSD was initially set at 250msec following the presentation of the go-signal for every new training day. The SSD was adjusted by 50msec, using the staircase function, to increase the delay for successful stops and decrease the delay for failed stops.

The stop-signal reaction time (SSRT) was the time taken for response inhibition to be successfully completed after a stop signal has been presented. The SSRT cannot be directly measured and is usually estimated using the tracking procedure by determining a SSD at which the participant inhibits their response 50% of the time. At the start of the trial the SSD was set at a specific value (250msec) and then constantly adjusted depending on the outcome of the race (i.e., if inhibition was successful the SSD was increased by 50msec) until the race between the stop process and go process was tied, as demonstrated in figure 5. The SSRT is a measure of the efficiency of the IC process as an estimate of the time needed to respond to the stop-signal and cancel the response (Logan & Cowan, 1984). The SSRT was estimated using the quantile method which has been shown to be reliable and robust against violations of assumptions underpinning the model (Congdon et al., 2012).

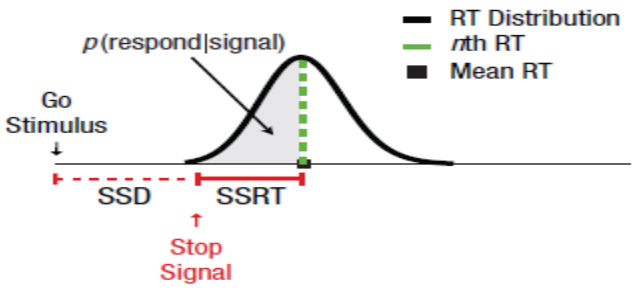


Figure 5. Distribution of RT, proposed SSD, stop and go signals and SSRT (Verbruggen, Chambers and Logan, 2013, p. 353).

Appendix F. Eligibility Screening Tool

Eligibility Screening Tool

Surname:	**Forenames:**
DOB: **Age:**	**Gender:**
Date & time of Assessment:	
Completed by (print your name): **Your signature:**	
History of Mental Health Diagnoses/ Brain Injury	
Have you received a diagnosis of a mental illness or disorder? E.g. depression, anxiety psychosis, ADHD. If Yes, are you currently receiving treatment and/or support for this? **Have you ever had an injury to the head that caused you to be knocked out?** E.g. fro a fall, blow to the head (including boxing or fighting) or road traffic accident. If **Yes**, please explain:	

Appendix G. Initial Contact Letter and Consent to Contact Form

Dear ……..

My name is Joanna Green. I am a Trainee Clinical Psychologist at the University of Exeter and I am conducting some research into training in inhibitory control. I would like to invite you to participate in this research. Before you decide whether you would like to join, please read the following information carefully. If you have any further questions about the research you can contact me on the details given below.

This study is investigating whether training in inhibitory control can improve impulsivity and behaviour. This training is new and we are looking to investigate whether this is useful for young people of your age. This study is investigating whether training in inhibitory control can help in managing impulses and risk taking behaviour.

This study will involve you completing some assessments. These aren't tests but are ways of us finding out a bit about you. You will be asked some questions and asked to do some tasks. We will also be asking your teacher some questions about you. You will then carry on as normal for a number of days but complete a scale every day to let us know how able you feel you are able to manage impulses and risks.

We will then invite you to start the training. This will be for a short session every day (5 days a week) for between 10-15 days. We will tell you exactly how many when we meet. This training will be mainly on the computer. You will need to log into the training every day to complete the training session. This will last around 20 minutes. Some people find these sessions fun and treat it as a game. Once you have finished the number of days training we will complete some more assessments together. These are to see how the training has been for you. We will ask your teacher some questions about you again.

Everyone who participates in this study will be given a participant number as shown on the top of this form. This is a way of making sure everything you do and tell me is kept anonymous. The information you give will be kept confidential and only viewed by the researchers. Once we have finished we will look at all of the results and write them up into a report. Your name and personal information will not be used in this.

However, if we have reason to be concerned about your safety or the safety of someone else we will need to tell other people about this to make sure you are safe. If this needs to happen we would tell the teacher supporting you. If we are able to we will tell you if we need to do this.

You do not have to complete this research if you don't want to. If this is the case you can withdraw at any time. If you choose to do this the information that you have given will be destroyed.

What if I have some questions?

This research is being conducted by the University of Exeter, by Joanna Green, Huw Williams and Jenny Limond. If you have any questions please feel free to contact us on jg421@exeter.ac.uk, W.H.Williams@exeter.ac.uk or J.Limond@exeter.ac.uk.

Thank you for considering this study.

CONSENT TO CONTACT FORM

Please return this form to: Joanna Green at the University of Exeter,

1. I have read and understood the information about the research provided in the letter enclosed in this pack.
2. I consent to be contacted by Joanna Green about this research.
3. I consent to being screened by my teacher to make sure that I am suitable for this research.
4. I consent to my teacher sharing the screening information with Joanna Green.
5. I am aware that I can contact Joanna Green to ask any further questions about the study and that I will be given more information about the study before agreeing to take part.
6. I am aware that I have the right to withdraw from this study at any time by contacting Joanna Green.

Name_____
Contact details:
Address_____

_____

_____

_____

Telephone no_____

Email address_____

Preferred contact method (telephone, email, post)_____

Signature_____

Date_____

Appendix H. Young Person's Information Sheet

YOUNG PERSON INFORMATION SHEET

Please keep this sheet for your reference.

This research is being conducted by Joanna Green, Trainee Clinical Psychologist at the University of Exeter, under the supervision Dr Jenny Limond and Professor Huw Williams, at the University of Exeter. The research is being completed to fulfil the requirements of the University of Exeter Doctorate in Clinical Psychology.

Aims of the study

The aim of the study is to investigate whether training in inhibitory control can help with impulsivity and behaviour. Inhibitory control is the ability to control our impulses. Managing to stop ourselves doing something that we are tempted to do, but isn't good for us, is important. This skill develops with time which can make it easier to avoid doing or saying things that could get us into trouble. There is some evidence that some people, who struggle with their impulses can be taught to do this better. We are looking to test a new training for inhibitory control. This training has not yet been used with young people. Before we use this training with young people with behaviour difficulties, we first want to know if the training can improve inhibitory control in young people **without** behavioural difficulties. This will tell us if the new training can improve inhibitory control.

Why have I been invited to take part?

You have been invited to take part because you are aged between 11 – 16 years and **you do not** have any difficulties with behaviour. Only 12 young people can participate in this study, therefore, not everyone who expresses an interest will be able to take part.

What will I be asked to do?

This study will involve you completing some assessments. These aren't tests but are ways of us finding out a bit about you. You will be asked some questions and asked to do some tasks. You will complete some 'screening' questionnaires. This will take approximately 10-minutes. Not everyone who completes the screening questionnaires will be invited to take part in the full study. If you are not invited to take part in the full study, the reasons for this will be clearly explained to you.

If you are invited to complete the full study, then you will be asked to complete some more assessments. This will take up to 90-minutes. We will also be asking your teacher some questions about you. You will then carry on as normal for a number of days but during this time we will ask you to keep a record of how able to cope with impulses you feel. This will take no more than 5 minutes.

We will then invite you to start the training. We will meet to complete some assessments for around 45 minutes and I will introduce you to the training. The training will be for a short session (approximately 20 minutes) every day (5 days a week) for between 10 and 15 days. We will tell you exactly how many when we meet. This training will be mainly on the computer and with a workbook. You will need to log into the training every day to complete the training session. Some people find these sessions fun and treat it as a game.

Once you have finished training we will meet again to complete some more assessments, these will take around 45 minutes. These are to see how the training has been for you. We will ask your teacher some questions about you again.

Who will know if I am taking part?

Everyone who participates in this study will be given a participant number as shown on the top of this form. This is a way of making sure everything you do and tell me is kept anonymous. The information you give will be kept confidential and only viewed by the researchers. Once we have finished we will look at all of the results and write them up into a report. Your name and personal information will not be used in this.

However, if we have reason to be concerned about your safety or the safety of someone else we will need to tell other people about this to make sure you are safe. If this needs to happen we would tell the teacher supporting you. If we are able to we will tell you if we need to do this.

What if I change my mind?

You do not have to complete this research if you don't want to. If this is the case you can withdraw at any time. If you choose to do this the information that you have given will be destroyed.

Will I receive any payment for my time?

In return for completing the study you will receive a payment of 50 pence per day up to the maximum of £10 for completing the full 20 days. This amount does not mean that you need to continue to take part, so if you choose to withdraw you will still be entitled to payment for the days in the study that you have completed. For example if you complete 4 days in the study but then choose to withdraw you will be entitled to payment of £2 (4 x 50p per day).

Questions?

If you have any queries or problems regarding the research or the tasks, then please contact me at: jg421@exeter.ac.uk (Joanna Green; trainee clinical psychologist), or:W.H.Williams@exeter.ac.uk (Huw Williams; supervisor) or J.Limond@exeter.ac.uk (Jenny Limond; supervisor).

Appendix I. Parent/Carer's Information Sheet

PARENT/CARER INFORMATION SHEET

Please keep this sheet for your reference.

This research is being conducted by Joanna Green, Trainee Clinical Psychologist at the University of Exeter, under the supervision of Dr Jenny Limond and Professor Huw Williams, at the University of Exeter. The research is being completed to fulfil the requirements of the University of Exeter Doctorate in Clinical Psychology.

Aims of the study

The aim of the study is to investigate whether training in inhibitory control can help with impulsivity and behaviour. Inhibitory control is the ability to control our impulses. Managing to stop ourselves doing something that we are tempted to do, but isn't good for us, is important. This skill develops with time which can make it easier to avoid doing or saying things that could get us into trouble. There is some evidence that some people, who struggle with their impulses can be taught to do this better. We are looking to test a new training for inhibitory control. This training appears to work in adults and reduces problematic behaviours; including gambling, however it is not yet clear if this would work for young people. These young people are not specifically people who have problems with controlling their impulses as first of all we want to check that this training is suitable for young people.

What will my young person be asked to do?

Initially, your young person will be asked to complete some assessments to look at their skills and difficulties, functioning and impulsivity. Their teacher will also be asked some questions about the young person. The young person will be asked to rate daily how they feel about how they manage their impulses.

I will then invite the young person to come back and meet me again to start the training. The young person will be asked to complete around 20 minutes of training a day with a computer. They will meet with to do this the first time and then will have a workbook to support them with this for the other days. Lots of people enjoy this training and treat it like a game that they play everyday.

What are the possible disadvantages and risks of taking part?

Being part of this research involves your young person giving up some time to complete these activities. Some people do not enjoy these activities and may find them difficult or frustrating to complete. If this is the case your young person will be given the opportunity to take a break or to stop completing the activities.

Everyone who participates in this study will be given a participant number which is a way of making sure everything your young persons does and tells me is kept

anonymous. The information they and you give will be kept confidential and only viewed by the researchers. Once we have finished we will look at all of the results and write them up into a report. You and your young person's name and personal information will not be used in this.

However, if we have reason to be concerned about the safety of your young person or the safety of someone else because of something they have said or done, we will need to tell other people about this to make sure that they are safe. If this needs to happen we would tell the teacher supporting your young person initially. If we are able to we will tell your young person if we need to do this.

What are the possible benefits of taking part?

Some might find the training not only enjoyable but also helpful in managing their impulses. Whilst this is positive and many aspects of the training can be used in everyday life (which will be encouraged within the training) the computer training is not currently available for everyday use. However, by completing the research the benefits of the training can be found and this will increase the likelihood of the training becoming available in the future.

The training is designed to help the young person manage their impulses and behaviour and can be enjoyable. The results of this study should help us to know more about whether this type of training is useful and how long the training should be used for. This will help us design training that will be useful for young people who have difficulties with managing their impulses and behaviour.

You and your young person can withdraw from this study at any time and you do not need to give a reason for this. Withdrawing from the study will not affect any current or future services your young person may receive.

In addition, all participants will receive payment of 50 pence per day that they complete, up to the maximum of £10 for young people who choose to complete the full 20 days. This payment is not dependant on their ongoing participation so if they choose to withdraw they will still be entitled to the payment for the number of days they have completed.

Questions?

If you have any queries or problems regarding the research or the tasks, then please contact me at: jg421@exeter.ac.uk (Joanna Green; trainee clinical psychologist), or:W.H.Williams@exeter.ac.uk (Huw Williams; supervisor) or J.Limond@exeter.ac.uk (Jenny Limond; supervisor).

Appendix J. Young Person's Consent Form

CONSENT FORM

Inhibitory Control Training

Please answer the following questions to the best of your knowledge

Have you:	**Yes**	**No**
• been given information explaining about the study?	□	□
• had an opportunity to ask questions and discuss the study?	□	□
• received satisfactory answers to all questions you asked?	□	□

Do you understand:

• that you are free to withdraw your consent for the study at any time during the study prior to publication without giving a reason?	□	□
• all data collected at part of this study will be kept securely?	□	□
• Your data will be anonymised by removing all links between your participation number and study data?	□	□

Young person's signature_____

Young person's name_____

Date_____

Appendix K. Parent/Carer's Consent Form

Consent Form for Adult with Parental Responsibility.

Inhibitory Control Training

Please answer the following questions to the best of your knowledge

Do you confirm that your young person:	**Yes**	**No**
• is able to use a computer keyboard and mouse?	□	□

Have You:

• been given information explaining about the study?	□	□
• had an opportunity to ask questions and discuss the study?	□	□
• received satisfactory answers to all questions you asked?	□	□

Do you understand:

• that you are free to withdraw your consent for the study at any time during the study prior to publication without giving a reason?	□	□
• all data collected at part of this study will be kept securely?	□	□
• your young person's data will be anonymised by removing all links between their participant number and study data?	□	□

Parent/Carer signature_____

Parent/Carer name_____ **Date**_____

Child's name_____

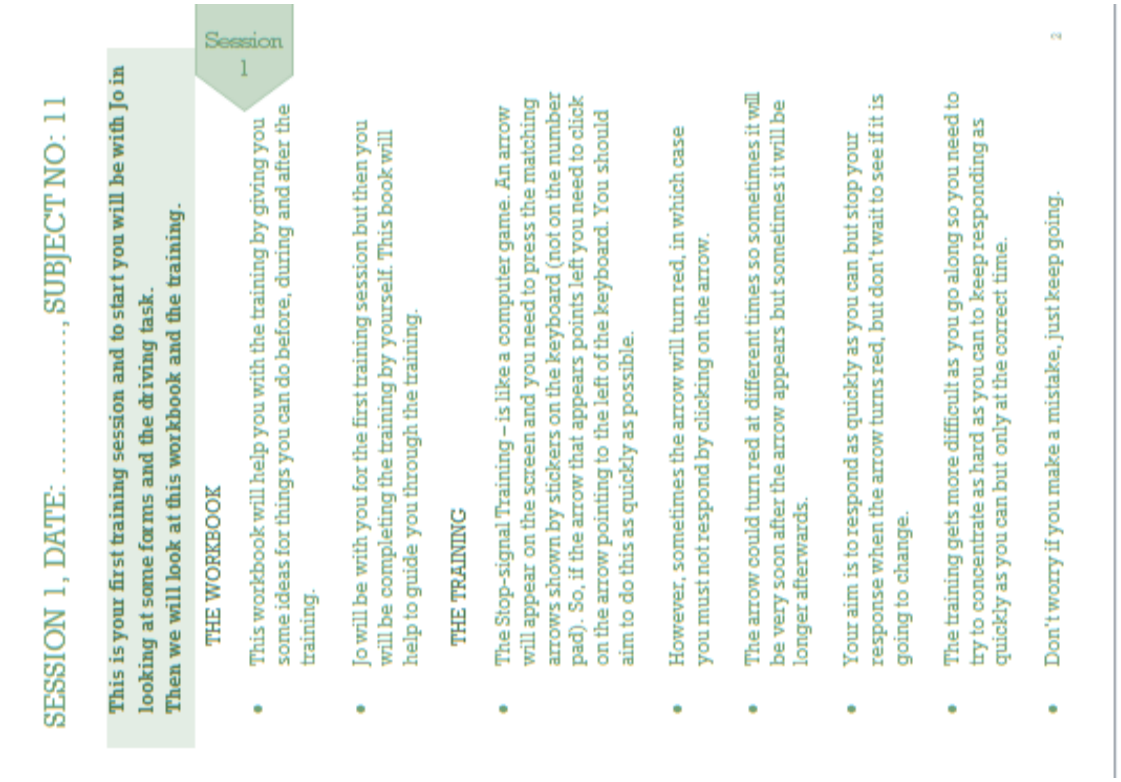
Child's DOB_____

Appendix L. Baseline and Intervention Phase Allocation

							Study day:									
P:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1							A	A	A	A	A	B	B	B	B	B
2				A	A	A	A	A	A	B	B	B	B	B	B	B
3					A	A	A	A	A	A	A	B	B	B	B	B
4						A	A	A	A	A	A	A	A	B	B	B
5													A	A	A	A
6	A	A	A	A	A	A	A	A	A	A	B	B	B	B	B	B
							Study day continued:									
P:	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
1	B	B	B	B	B	B	B	B	B	B						
2	B	B	B	B	B	B	B									
3	B	B	B	B	B	B	B	B								
4	B	B	B	B	B	B	B	B	B							
5	A	A	A	A	A	B	B	B	B	B	B	B	B	B	B	B
6	B	B	B	B												

N.B. P=Participant, A=Baseline-phase, B=Intervention-phase.

Appendix M. Metacognitive Workbook Example



SESSION 1, DATE: ....., SUBJECT NO: 11

Session 1

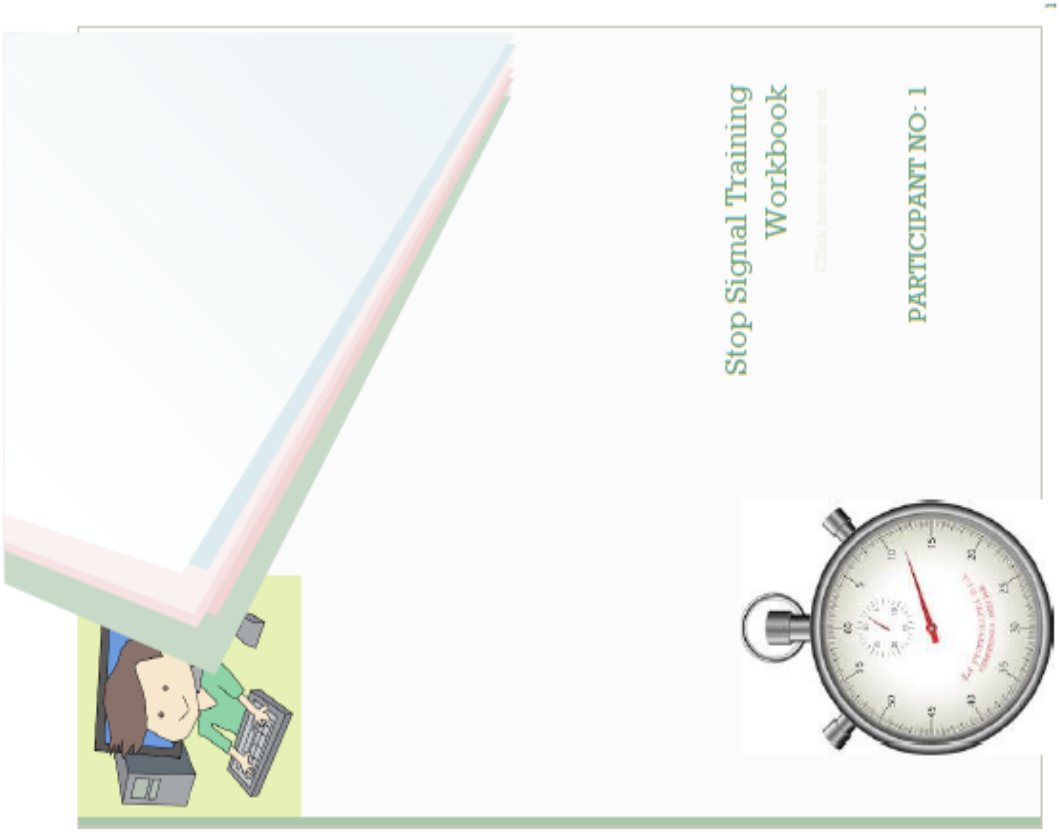
This is your first training session and to start you will be with Jo in looking at some forms and the driving task.
Then we will look at this workbook and the training.

THE WORKBOOK

- This workbook will help you with the training by giving you some ideas for things you can do before, during and after the training.
- Jo will be with you for the first training session but then you will be completing the training by yourself. This book will help to guide you through the training.

THE TRAINING

- The Stop-signal Training – is like a computer game. An arrow will appear on the screen and you need to press the matching arrows shown by stickers on the keyboard (not on the number pad). So, if the arrow that appears points left you need to click on the arrow pointing to the left of the keyboard. You should aim to do this as quickly as possible.
- However, sometimes the arrow will turn red, in which case you must not respond by clicking on the arrow.
- The arrow could turn red at different times so sometimes it will be very soon after the arrow appears but sometimes it will be longer afterwards.
- Your aim is to respond as quickly as you can but stop your response when the arrow turns red, but don't wait to see if it is going to change.
- The training gets more difficult as you go along so you need to try to concentrate as hard as you can to keep responding as quickly as you can but only at the correct time.
- Don't worry if you make a mistake, just keep going.



Stop Signal Training Workbook

PARTICIPANT NO: 1

THE TRAINING

This page is a guide to help you open and run the training. It is important that you don't start the training until you are ready, so only go as far as the instructions tell you.

- If it is not already, open the laptop and log in. The login details are written on the laptop.
- You should see an icon on the desktop called: STOP SIGNAL TASK:

- Open the task by doubling clicking on the icon.
- Once MATLAB has opened press the F5 key on the keypad or click on the tab labelled "Run" at the top of the screen.
- A box will open at the bottom of the screen called "Command Window".

- Type the number which is written in your workbook for today. This is your participant number (i.e. 1) followed the by session number (i.e session 1) which in this case would be a subject number of 11. This will change every day so make sure you are using the correct number.
- Press enter. The training will tell you it is ready to start. Do not press anything else yet.
- It is very unlikely, but if you have any problems using the number you have been given use the emergency code of 99 after your participant number and before your session number. Write down that you have done this in your workbook.

PREPARING YOURSELF

Before starting the training you should spend a few minutes preparing yourself. Here are some ideas to help you prepare and focus on what you are about to do. .

- Sit up straight.
- Clear your mind of everything else that is happening today and focus on the training.
- Tell yourself "I can do this" "I won't make mistakes" "I will be fast, faster than last time" or maybe something else positive that you find helps you.

  Say each statement 5 times.
- Stretch.
- Take 5 deep breaths, in through your nose and out through your mouth.
- Imagine yourself doing the task as though you can see the task in front of you. Picture yourself clicking in response and again, quickly and correctly.

- Write down your goal for the training:
  .....
  .....
  .....
- Write down what strategy you will use for training: *I will respond as quickly as I can, trying to not make any mistakes.*
  .....
  .....
  .....
- Write down what you will do if you start to feel distracted:
- .....
  .....
  .....
- Write down what you will do if you start to feel bored or annoyed:
- .....
  .....
  .....

Now it is time to focus on the task and try to ignore everything else that is happening.

APPROACHING THE TRAINING

Now it is time for the training.
Here are some things that can help you do your best during the training.

You will see the same screen and images as you have used before, but the order of the arrows and the delay in the colour change will be different each time.

Approaching Training

The colour change might be faster or slower so you need to keep concentrating to make sure you click quickly but not if the arrow changes to red.

Don't worry too much if you make a mistake or think you are going too slowly. Keep going through the training until you reach a break or the end.

APPROACHING THE TRAINING

Task 1

You should aim to be as fast as possible in responding but stop if the arrow turns red.

Say to yourself: I will be quick, I will be faster than I was before and make fewer mistakes.

Press S to start when you are ready.

Once the first block is complete you will get a break.

The Break

- You will get a 15 second break between each training block.
- A timer will tell you how long you have left.

During the break

- Quickly think about any times you think you might have gone too slowly, made a mistake or become distracted
- What could you do differently the next time to avoid this happening again.
- But more importantly keep going!

Approaching Training

Task 2

You should aim to be as fast as possible in responding but stop if the arrow turns red.

Say to yourself: I will be quick, I will be faster than I was before and make fewer mistakes

Once the block is complete you will get a break

Break

APPROACHING THE TRAINING

Task 3

You should aim to be as fast as possible in responding but stop if the arrow turns red.

Say to yourself: I will be quick, I will be faster than I was before and make fewer mistakes.

Once the block is complete you will get a break.

Break

- Quickly think about any times you think you might have gone too slowly, made a mistake or become distracted
- What could you do differently the next time to avoid this happening again.
- But more importantly keep going!

Approaching Training

Task 4

You should aim to be as fast as possible in responding but stop if the arrow turns red.

Say to yourself: I will be quick, I will be faster than I was before and make fewer mistakes.

Once the block is complete you will have finished the computer training for today.

Well done! Please close the training.

7

REVIEWING THE TRAINING

Now that the training for today has finished you should spend some time thinking about how the training has gone and what you could use the skills you have used in the training for, in the rest of your day.

What have you been doing during the training?

.....

Did you do anything to stop you from becoming distracted?

.....

What did you do to help yourself if you were feeling annoyed?

.....

What did you tell yourself before the training started?

.....

What did you do when you had a break from the training?

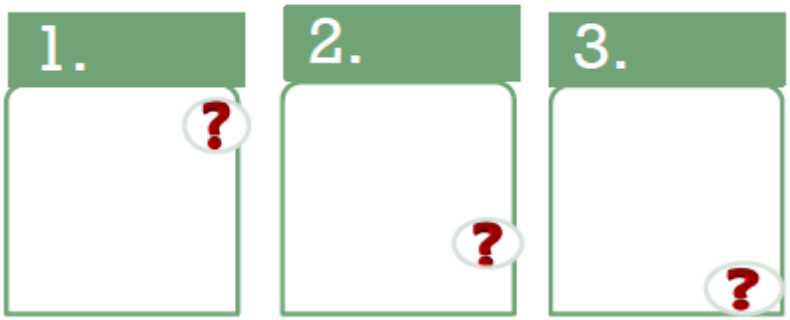
.....

Is speed always the main priority?

.....

Reviewing Training

How could you use the training in your everyday life?
What 3 ways could you use the training for? There are some ideas on the next page if you get stuck!



REVIEWING THE TRAINING

How could you use the training outside of the training? Here are some ideas.

Well done. You have finished for today.
Don't forget to fill in your goals form.

SESSION 2, DATE: ....., SUBJECT NO: 12

This is your second training session and you will be working alone using this book as a guide. Get the training ready, as shown on page 3.

PREPARING YOURSELF

- Before starting the training you should spend a few minutes preparing yourself. Try the ideas for ways of preparing yourself on page 4.
- Write down your goal for the training:

.....

APPROACHING THE TRAINING

- Write down what strategy you will use for training:

.....

.....

- Write down what you will do if you feel distracted:

.....

.....

- Write down what you will do if you feel annoyed:

.....

.....

Once you are ready you can start the training. Press S to start.

REVIEWING THE TRAINING

- Once you have finished the training you should spend some time thinking about how the training has gone and what else you could use the skills for. The following questions might help:
- What have you been doing during the training?

.....

.....

SESSION 2

REVIEWING THE TRAINING

- What did you tell yourself before the training started?

  .....

  .....

- What did you do during the breaks?

  .....

  .....

- What did you do if you felt distracted?

  .....

  .....

Session 2

How could you use the training in your everyday life?

1.	2.	3.
• e.g. I got angry with someone earlier, but instead of reacting to them I was able to stop myself until I felt calm. ?	?	?

Well done! You have finished for today.
Please close the training.
Don't forget to fill in your goals form.

SESSION 3, DATE: ....., SUBJECT NO: 13

This is your third training session and you will be working alone using this book as a guide. Get the training ready, as shown on page 3.

PREPARING YOURSELF

- Before starting the training you should spend a few minutes preparing yourself.
- Try the ideas for ways of preparing yourself on page 4.
- Write down your goal for the training:

  .....

APPROACHING THE TRAINING

- Write down what strategy you will use for training:

  .....

  .....

- Write down what you will do if you feel distracted:

  .....

  .....

- Write down what you will do if you feel annoyed:

  .....

  .....

Session 3

Once you are ready you can now start the training. Press S to start.

REVIEWING THE TRAINING

- Once you have finished the training you should spend some time thinking about how the training has gone and what else you could use the skills for. The following questions might help:
- What have you been doing during the training?

  .....

  .....

SESSION 3

REVIEWING THE TRAINING

- What did you tell yourself before the training started?

  .....

  .....

- What did you do during the breaks?

  .....

  .....

- What did you do if you felt distracted?

  .....

  .....

What have you been able to use the training for in your everyday life?

Session 3

Example.	1.
• *I waited until I had a clear sight of the goal in PE and so my goal went in, otherwise I could have struck too early.* ?	?

Well done! You have finished for today.
Please close the training.
Don't forget to fill in your goals form.

SESSION 4, DATE: ....., SUBJECT NO: 14

This is your fourth training session and you will be working alone using this book as a guide. Get the training ready, as shown on page 3.

PREPARING YOURSELF

- Before starting the training you should spend a few minutes preparing yourself.
- Try the ideas for ways of preparing yourself on page 4.
- Write down your goal for the training:

  .....

APPROACHING THE TRAINING

- Write down what strategy you will use for training:

  .....

  .....

- Write down what you will do if you feel distracted:

  .....

  .....

- Write down what you will do if you feel annoyed:

  .....

  .....

Session 4

Once you are ready you can now start the training. Press S to start.

REVIEWING THE TRAINING

- Once you have finished the training you should spend some time thinking about how the training has gone and what else you could use the skills for. The following questions might help:
- What have you been doing during the training?

  .....

  .....

SESSION 4

REVIEWING THE TRAINING

- What did you tell yourself before the training started?

  .....

  .....

- What did you do during the breaks?

  .....

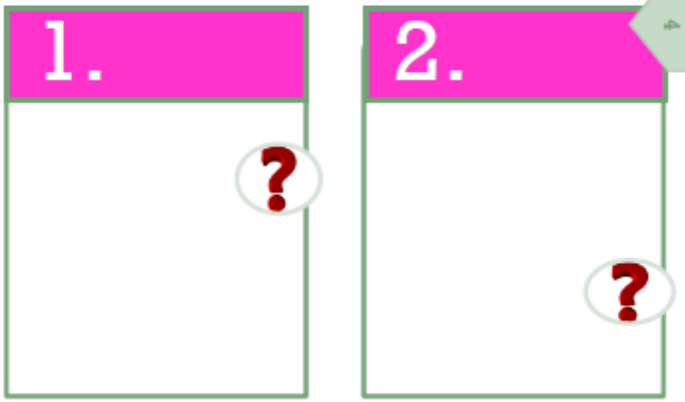
  .....

- What did you do if you felt distracted?

  .....

  .....

How could you use the training in your everyday life?
What 2 ways could you use the training for?



Session 4

Well done! You have finished for today.
Please close the training.
Don't forget to fill in your goals form.

SESSION 5, DATE: ....., SUBJECT NO: 15

This is your fifth training session and you will be working alone using this book as a guide. Get the training ready, as shown on page 3.

PREPARING YOURSELF

- Before starting the training you should spend a few minutes preparing yourself. Try the ideas for ways of preparing yourself on page 4.

- Write down your goal for the training:

  .....

APPROACHING THE TRAINING

- Write down what strategy you will use for training:

  .....

  .....

- Write down what you will do if you feel distracted:

  .....

  .....

- Write down what you will do if you feel annoyed:

  .....

  .....

Session 5

Once you are ready you can now start the training. Press S to start.

REVIEWING THE TRAINING

- Once you have finished the training you should spend some time thinking about how the training has gone and what else you could use the skills for. The following questions might help:

- What have you been doing during the training?

  .....

  .....

  .....

SESSION 5

REVIEWING THE TRAINING

- What did you tell yourself before the training started?

  .....

  .....

- What did you do during the breaks?

  .....

  .....

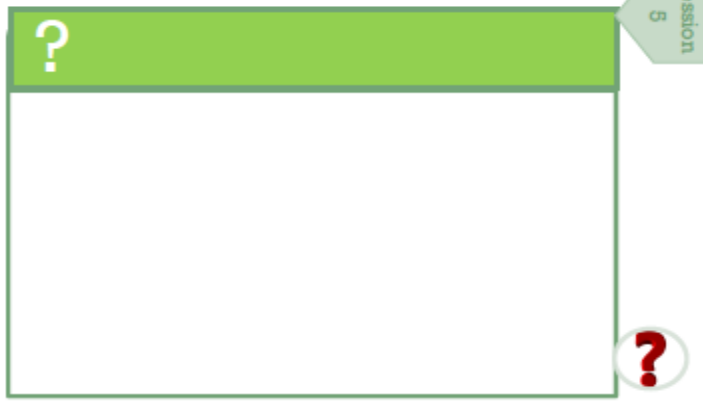
- What did you do if you felt distracted?

  .....

  .....

What else have you used the training for in your everyday life?

Session 5



Well done! You have finished for today.
Please close the training.
Don't forget to fill in your goals form.

SESSION 6, DATE: ....., SUBJECT NO: 16

This is your sixth training session and you will be working alone using this book as a guide. Get the training ready, as shown on page 3.

PREPARING YOURSELF

- Before starting the training you should spend a few minutes preparing yourself. Try the ideas for ways of preparing yourself on page 4.

- Write down your goal for the training:

  .....

APPROACHING THE TRAINING

- Write down what strategy you will use for training:

  .....

  .....

- Write down what you will do if you feel distracted:

  .....

  .....

- Write down what you will do if you feel annoyed:

  .....

  .....

Session 6

Once you are ready you can now start the training. Press S to start

REVIEWING THE TRAINING

- Once you have finished the training you should spend some time thinking about how the training has gone and what else you could use the skills for. The following questions might help:

- What have you been doing during the training?

  .....

  .....

SESSION 6

REVIEWING THE TRAINING

- What did you tell yourself before the training started?

  .....

  .....

- What did you do during the breaks?

  .....

  .....

- What did you do if you felt distracted?

  .....

  .....

How could you use the training in your everyday life?

Session 6

Well done! You have finished for today.
Please close the training.
Don't forget to fill in your goals form.

SESSION 7, DATE: ....., SUBJECT NO: 17

This is your seventh training session and you will be working alone using this book as a guide. Get the training ready, as shown on page 3.

PREPARING YOURSELF

- Before starting the training you should spend a few minutes preparing yourself. Try the ideas for ways of preparing yourself on page 4.
- Write down your goal for the training:

  .....

APPROACHING THE TRAINING

- Write down what strategy you will use for training:

  .....

  .....

- Write down what you will do if you feel distracted:

  .....

  .....

- Write down what you will do if you feel annoyed:

  .....

  .....

Session 7

Once you are ready you can now start the training. Press S to start

REVIEWING THE TRAINING

- Once you have finished the training you should spend some time thinking about how the training has gone and what else you could use the skills for. The following questions might help:
- What have you been doing during the training?

  .....

  .....

SESSION 7

REVIEWING THE TRAINING

- What did you tell yourself before the training started?

  .....

  .....

- What did you do during the breaks?

  .....

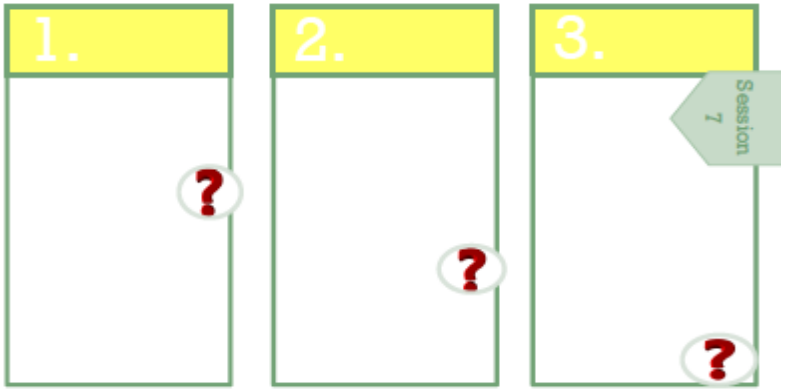
  .....

- What did you do if you felt distracted?

  .....

  .....

How could you use the training in your everyday life?
What 3 ways could you use the training for? i.e. Helping you with working with others? Helping you concentrate on your homework?



Session 7

Well done! You have finished for today.
Please close the training.
Don't forget to fill in your goals form.

SESSION 8, DATE: ....., SUBJECT NO: 18

This is your eighth training session and you will be working alone using this book as a guide. Get the training ready, as shown on page 3.

PREPARING YOURSELF

- Before starting the training you should spend a few minutes preparing yourself. Try the ideas for ways of preparing yourself on page 4.
- Write down your goal for the training:

  .....

APPROACHING THE TRAINING

- Write down what strategy you will use for training:

  .....

  .....

- Write down what you will do if you feel distracted:

  .....

  .....

- Write down what you will do if you feel annoyed:

  .....

  .....

Once you are ready you can now start the training. Press S to start.

Session 8

REVIEWING THE TRAINING

- Once you have finished the training you should spend some time thinking about how the training has gone and what else you could use the skills for. The following questions might help:
- What have you been doing during the training?

  .....

  .....

SESSION 8

REVIEWING THE TRAINING

- What did you tell yourself before the training started?

  .....

  .....

- What did you do during the breaks?

  .....

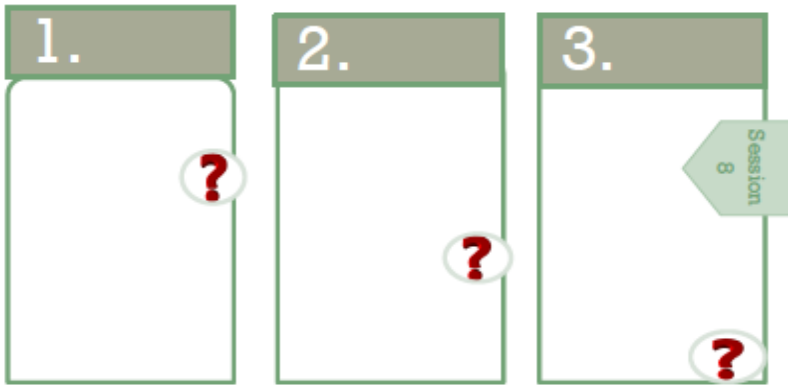
  .....

- What did you do if you felt distracted?

  .....

  .....

How have you already managed to use the training in your everyday life? What 3 times have you used it? I.e. Yesterday whilst walking home, today in the lunch queue.



Session 8

Well done! You have finished for today.
Please close the training.
Don't forget to fill in your goals form.

SESSION 9, DATE: ....., SUBJECT NO: 19

This is your ninth training session and you will be working alone using this book as a guide. Get the training ready, as shown on page 3.

PREPARING YOURSELF

- Before starting the training you should spend a few minutes preparing yourself. Try the ideas for ways of preparing yourself on page 4.
- Write down your goal for the training:

  .....

APPROACHING THE TRAINING

- Write down what strategy you will use for training:

  .....

  .....

- Write down what you will do if you feel distracted:

  .....

  .....

- Write down what you will do if you feel annoyed:

  .....

  .....

Once you are ready you can now start the training.
Press S to start.

Session 9

REVIEWING THE TRAINING

- Once you have finished the training you should spend some time thinking about how the training has gone and what else you could use the skills for. The following questions might help:
- What have you been doing during the training?

  .....

  .....

SESSION 9

REVIEWING THE TRAINING

- What did you tell yourself before the training started?

  .....

  .....

- What did you do during the breaks?

  .....

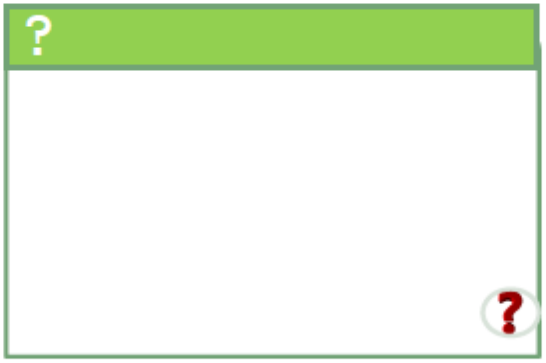
  .....

- What did you do if you felt distracted?

  .....

  .....

What else could you use the training for in your everyday life? If you are not sure, how about any of the ideas on page 8?



Session 9

Well done! You have finished for today.
Please close the training.
Don't forget to fill in your goals form.

SESSION 10, DATE: ....., SUBJECT NO: 110

This is your tenth training session and you will be working alone using this book as a guide. Get the training ready, as shown on page 3.

PREPARING YOURSELF

- Before starting the training you should spend a few minutes preparing yourself. Try the ideas for ways of preparing yourself on page 4.
- Write down your goal for the training:

  .....

APPROACHING THE TRAINING

- Write down what strategy you will use for training:

  .....

  .....

- Write down what you will do if you feel distracted:

  .....

  .....

- Write down what you will do if you feel annoyed:

  .....

  .....

Once you are ready you can now start the training.
Press S to start.

Session 10

REVIEWING THE TRAINING

- Once you have finished the training you should spend some time thinking about how the training has gone and what else you could use the skills for. The following questions might help:
- What have you been doing during the training?

  .....

  .....

SESSION 10

REVIEWING THE TRAINING

- What did you tell yourself before the training started?

  .....

  .....

- What did you do during the breaks?

  .....

  .....

- What did you do if you felt distracted?

  .....

  .....

Thinking about a time when you have been able to use the training in your everyday life, what helped you do this? I.e. preparing yourself beforehand, taking a break to stop and think about what you had done and what you were about to do, thinking about what you have done previously and what you wanted to do differently?

Session 10

Well done! You have finished for today.
Please close the training.
Don't forget to fill in your goals form.

SESSION 11, DATE: ....., SUBJECT NO: 111

This is your eleventh training session and you will be working alone using this book as a guide. Get the training ready, as shown on page 3.

PREPARING YOURSELF

- Before starting the training you should spend a few minutes preparing yourself. Try the ideas for ways of preparing yourself on page 4.
- Write down your goal for the training:

  .....

APPROACHING THE TRAINING

- Write down what strategy you will use for training:

  .....

  .....

- Write down what you will do if you feel distracted:

  .....

  .....

- Write down what you will do if you feel annoyed:

  .....

  .....

Once you are ready you can now start the training.
Press S to start.

REVIEWING THE TRAINING

Session 11

- Once you have finished the training you should spend some time thinking about how the training has gone and what else you could use the skills for. The following questions might help:
- What have you been doing during the training?

  .....

  .....

SESSION 11

REVIEWING THE TRAINING

- What did you tell yourself before the training started?

  .....

  .....

- What did you do during the breaks?

  .....

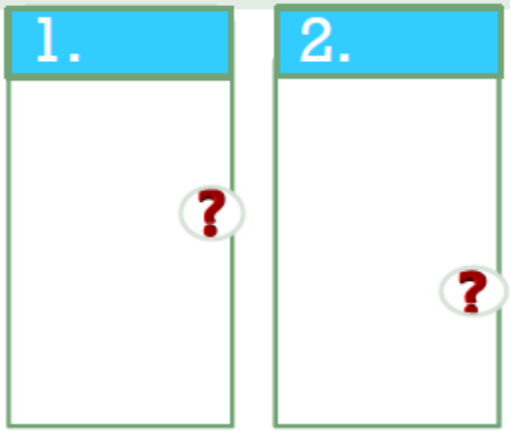
  .....

- What did you do if you felt distracted?

  .....

  .....

How could you use the training in your everyday life?
What 2 ways could you use the training for?



Session 11

Well done! You have finished for today.
Please close the training.
Don't forget to fill in your goals form.

SESSION 12, DATE: ....., SUBJECT NO: 112

This is your twelfth training session and you will be working alone using this book as a guide. Get the training ready, as shown on page 3.

PREPARING YOURSELF

- Before starting the training you should spend a few minutes preparing yourself. Try the ideas for ways of preparing yourself on page 4.
- Write down your goal for the training:

  .....

APPROACHING THE TRAINING

- Write down what strategy you will use for training:

  .....

  .....

- Write down what you will do if you feel distracted:

  .....

  .....

- Write down what you will do if you feel annoyed:

  .....

  .....

Once you are ready you can now start the training.
Press s to start.

REVIEWING THE TRAINING

- Once you have finished the training you should spend some time thinking about how the training has gone and what else you could use the skills for. The following questions might help:

Session 12

- What have you been doing during the training?

  .....

  .....

SESSION 12

REVIEWING THE TRAINING

- What did you tell yourself before the training started?

  .....

  .....

- What did you do during the breaks?

  .....

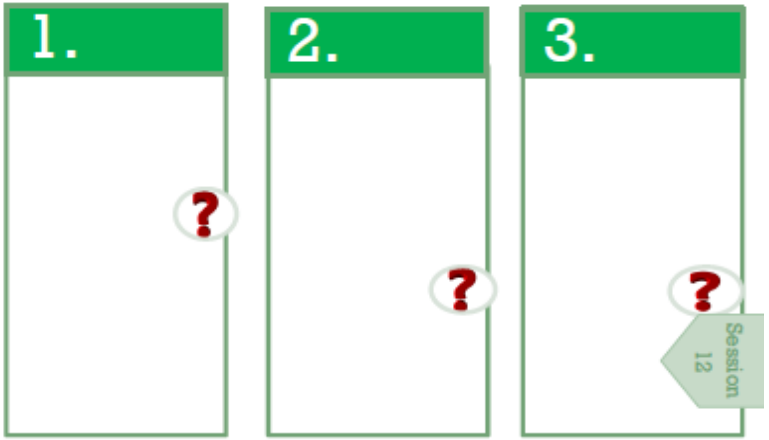
  .....

- What did you do if you felt distracted?

  .....

  .....

When have you been able to use the training in your everyday life? List 3 times.



Session 12

Well done! You have finished for today.
Please close the training.
Don't forget to fill in your goals form.

SESSION 13, DATE: ....., SUBJECT NO: 113

This is your thirteenth training session and you will be working alone using this book as a guide. Get the training ready, as shown on page 3.

PREPARING YOURSELF

- Before starting the training you should spend a few minutes preparing yourself. Try the ideas for ways of preparing yourself on page 4.
- Write down your goal for the training:

  .....

- Before starting the training you should read the approaches on pages 4, 5 and 6 to help you do your best in the training.

APPROACHING THE TRAINING

- Write down what strategy you will use for training:

  .....

  .....

- Write down what you will do if you feel distracted:

  .....

  .....

- Write down what you will do if you feel annoyed:

  .....

  .....

Once you are ready you can now start the training.
Press S to start.

REVIEWING THE TRAINING

- Once you have finished the training you should spend some time thinking about how the training has gone and what else you could use the skills for. The following questions might help:

Session 13

- What have you been doing during the training?

  .....

  .....

  .....

SESSION 13

REVIEWING THE TRAINING

- What did you tell yourself before the training started?

  .....

  .....

- What did you do during the breaks?

  .....

  .....

- What did you do if you felt distracted?

  .....

  .....

When else could you use the training for in the future? i.e. if I am starting to feel annoyed with someone or somethings in the future I can try and stop myself from responding.

Session 13

Well done! You have finished for today.
Please close the training.
Don't forget to fill in your goals form.

SESSION 14, DATE: ....., SUBJECT NO: 114

This is your fourteenth training session and you will be working alone using this book as a guide. Get the training ready, as shown on page 3.

PREPARING YOURSELF

- Before starting the training you should spend a few minutes preparing yourself. Try the ideas for ways of preparing yourself on page 4.
- Write down your goal for the training:

  .....

APPROACHING THE TRAINING

- Before starting the training you should read the approaches on pages 4, 5 and 6 to help you do your best in the training.
- Write down what strategy you will use for training:

  .....

  .....
- Write down what you will do if you feel distracted:

  .....

  .....
- Write down what you will do if you feel annoyed:

  .....

Once you are ready you can now start the training.
Press S to start.

REVIEWING THE TRAINING

- Once you have finished the training you should spend some time thinking about how the training has gone and what else you could use the skills for. The following questions might help:
- What have you been doing during the training?

  .....

  .....

Session 14

SESSION 14

REVIEWING THE TRAINING

- What did you tell yourself before the training started?

  .....

  .....

- What did you do during the breaks?

  .....

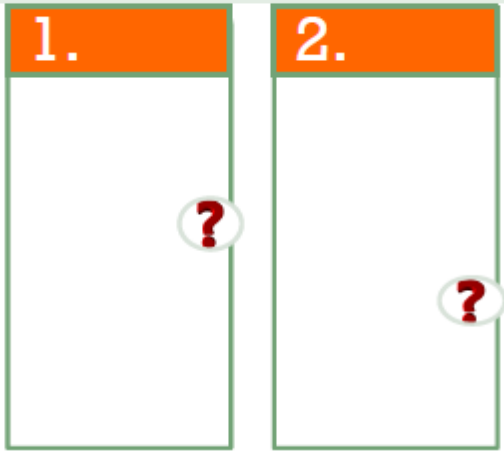
  .....

- What did you do if you felt distracted?

  .....

  .....

How could you use the training in your everyday life?
What 2 ways could you use the training for?



Well done! You have finished for today.
Please close the training.
Don't forget to fill in your goals form.

Session 14

SESSION 15, DATE: ....., SUBJECT NO: 115

This is your fifteenth training session and you will be working alone using this book as a guide. Get the training ready, as shown on page 3.

PREPARING YOURSELF

- Before starting the training you should spend a few minutes preparing yourself. Try the ideas for ways of preparing yourself on page 4.
- Write down your goal for the training:

  .....

APPROACHING THE TRAINING

- Before starting the training you should read the approaches on pages 4, 5 and 6 to help you do your best in the training.
- Write down what strategy you will use for training:

  .....

  .....
- Write down what you will do if you feel distracted:

  .....

  .....
- Write down what you will do if you feel annoyed:

  .....

Once you are ready you can now start the training.
Press S to start.

REVIEWING THE TRAINING

- Once you have finished the training you should spend some time thinking about how the training has gone and what else you could use the skills for. The following questions might help:
- What have you been doing during the training?

  .....

  .....

  .....

Session 15

SESSION 15

REVIEWING THE TRAINING

- What did you tell yourself before the training started?

.....

.....

- What did you do during the breaks?

.....

.....

- What did you do if you felt distracted?

.....

.....

How have you been able to use the training in your everyday life?

1.	2.	3.
• I.e. I have been able to stop myself from answering back when I am getting annoyed with my family/teachers. ?	?	?

Well done! You have now finished the training! You will now meet with Jo again and complete some final questions! We will meet on:.....
Please close the training and don't forget to fill in your goals form.

Appendix N. Debrief Information

Debrief: Inhibitory control training

Joanna Green, Doctorate in Clinical Psychology

This study was investigating whether training in inhibitory control can improve impulsivity and behaviour. You were invited to join this study because we wanted to see if it is suitable for people of your age.

This study has involved a number of tasks, including completing some assessments and tests and then completing some training over a number of days. Your teacher has also been completing some assessments. We were looking to find out if this training could have an impact on your impulses and if you behaved any differently whilst you were doing this training.

The training you have been completing is called stop signal training and has been found to improve the impulses of adults and stop them from taking big risks whilst gambling. This training has not been used in people of your age before and we were interested to find out what impact it had on you. We believe it works by encouraging strategies to develop which make you slow down and think about your choices or options before acting. We were interested in whether this would have an impact on your daily life as well. Now you have completed this research we will look at all of the information you and the other participants have provided to see if this training has been useful to you, or not. It is possible that the training will not have worked for you, or you may have got better at the training but not noticed any other differences. This is quite normal and could be for a number of reasons. It could be that you are already really good at controlling your impulses, so the training has had no effect. The training also may have not been right for you. This information will help us to change the training to make it work at its best for people of your age.

Once the results has been looked at and written up, I (Joanna Green) will return to the school to tell you and your teachers what we have found across all of the people who have taken part, if you would like to find out.

You were assigned a participant number before you started completing this study. This is the only way that we will identify your results. This is to make sure your results are anonymous.

We would like to thank you for taking part in this study, I hope you have enjoyed the training and found it useful. If you feel upset or distressed in anyway related to this study I would ask that you contact one of the specialist support agencies detailed below. Also if this is the case please remember that you have the right to withdraw from the study at any stage in which case any information you have provided will be destroyed.

If you have any queries or problems regarding the research or the tasks, then please contact us at: jg421@exeter.ac.uk (Joanna Green; trainee clinical psychologist), W.H.Williams@exeter.ac.uk (Huw Williams; supervisor) or J.Limond@exeter.ac.uk (Jenny Limond; supervisor). You also can contact the head (currently Dr Tim Kurz) of the University of Exeter's psychology research ethics committee at t.r.kurz@exeter.ac.uk or 01392 72 4657 if you have any additional concerns about this research.

If you have any concerns about your wellbeing or mood, then we recommend that you contact your GP. Alternatively, the Samaritans provide a confidential service when young people feel distressed: 08457 909090

Finally, we thank you for your time and participation in this study.

Joanna Green

Appendix O. Full Characterisation Measure Data

		Participant No:					
		1	2	3	4	5	6
Assessment:	Domain assessed:						
Wechsler Abbreviated Scale of Intelligence (WASI-II)	Full Scale Intelligence Quotient (FSIQ)[a]	81	110	108	108	110	121
	Verbal Comprehension Index[a]	84	110	103	92	113	120
	- Vocabulary[b]	39	65	54	45	60	68
	- Similarities[b]	41	48	50	45	57	58
	Perceptual Reasoning Index[a]	83	108	112	123	104	116
	- Block Design[b]	41	53	60	55	60	58
	- Matrix Reasoning[b]	38	57	55	72	45	61
Behaviour Rating Inventory of Executive Function (BRIEF)	Executive Function Global Composite (SR/T)[b]	73/ 68	63/ 43	45/ 60	52/ 63	59/ 45	52/ 54
	Behavioural Regulation Index (SR/T)[b]	73/ 66	60/ 45	41/ 61	55/ 63	64/ 49	51/ 60
	- Inhibit (SR/T)[b]	64/ 66	64/ 45	49/ 63	51/ 67	49/ 49	59/ 53
	- Shift (SR/T)[b]	68/ 60	49/ 45	40/ 61	60/ 62	72/ 49	40/ 71
	- Emotional Control (SR/T)[b]	77/ 66	59/ 46	37/ 60	52/ 56	73/ 50	59/ 55
	- Monitor (SR)[b]	67	53	47	58	47	37
	Metacognition Index (SR/T)[b]	70/ 67	64/ 42	50/ 58	49/ 60	52/ 43	52/ 50
	- Initiate (T)[b]	69	43	56	72	43	44
	- Monitor (T)[b]	64	42	55	68	45	55
	- Working Memory (SR/T)[b]	73/ 76	61/ 44	48/ 55	46/ 56	46/ 44	56/ 48
	- Plan/Organize (SR/T)[b]	61/ 68	58/ 43	47/ 65	61/ 48	54/ 43	49/ 56
	- Organisation of Materials (SR/T)[b]	59/ 48	70/ 46	54/ 53	43/ 44	49/ 46	54/ 53
	- Task Completion (SR)[b]	76	61	52	42	58	49
Strengths and Difficulties Questionnaire (SDQ)	Total Difficulties (SR/T)[c] (Maximum = 40)	18**/ 15*	11/ 6	7/ 2	11/ 10	21***/ 0	11/ 3
	Externalising Problems (SR/T)[c] (Maximum = 20)	9/10	6/0	4/2	3/7	7/0	6/0
	- Conduct Problems (SR/T)[c] (Maximum = 10)	5**/ 3*	2/0	1/0	0/1	5**/0	1/0
	- Hyperactivity (SR/T)[c] (Maximum = 10)	4/7*	4/0	3/2	3/6*	2/0	5/0
	Internalising Problems (SR/T)[a] (Maximum = 20)	9/5	5/6	3/0	8/3	14/0	5/3
	- Emotional Problems (SR/T)[c] (Maximum = 10)	2/3	3/3	2/0	6*/1	8**/0	4/1
	- Peer Problems (SR/T)[c] (Maximum = 10)	7***/ 2	2/ 3*	1/ 0	2/ 2	6**/ 0	1/ 2
	Impact Score (SR/T)[c] (Maximum = 10)	7***/ 3***	0/0	0/0	0/0	4***/0	0/0
	Prosocial Behaviour (SR/T)[c] (Maximum = 10)	2***/ 3***	9/ 10	9/ 8	5**/ 4**	7/ 7	8/ 10

Note. SR = Self-report, T=Teacher report, [a]Composite Score, [b]T score, [c]Raw score, *High Score Categorisation, **Very High Score Categorisation, ***Very Low Score Categorisation.

Appendix P. Stop Signal Reaction Times per Training Day per Participant

			Participant No:					
Measure:	Domains assessed:	Day:	1	2	3	4	5	6
Stop-Signal Training: Stop-Signal Reaction Time (SSRT)	Inhibitory Control	1	199.18	224.88	203.03	160.79	251.96	177.01
		2	235.46	239.48	252.01	132.03	183.15	201.10
		3	213.69	232.86	255.38	163.43	246.04	177.44
		4	177.92	235.35	221.74	175.27	261.01	161.71
		5	233.11	239.97	266.95	196.18	244.91	230.19
		6	268.15	232.61	258.51	183.79	266.63	166.34
		7	270.22	248.98	250.02	211.47	145.14	118.73
		8	361.49	185.54	217.81	463.67	206.84	186.23
		9	349.95	236.20	244.33	269.53	188.67	230.27
		10	275.59	217.03	214.10	280.46	241.45	135.83
		11	367.19	226.78	284.26	278.97	190.46	
		12	354.43	226.39	229.34	214.69		
		13	332.41	227.66	236.71			
		14	226.01	205.30				
		15	228.27					
		Mean:	272.87	227.07	241.09	227.52	220.57	178.49
		SD:	64.39	15.98	23.27	88.78	39.53	36.13

Appendix Q. Raw and Scaled Phase-Change IC/Impulsiveness Scores for each Participant and RCIs for each Phase-Change

				Participant No:						Reliable Change Indices (RCI):				
Measure:	Domains assessed:	Subdomains assessed:		1	2	3	4	5	6	Raw mean	SD	Pre-Phase Change	Phase-Change - Post	Pre-Post
BIS-11-A	Impulsiveness	Total[a(b)]	Pre	0.70 (75)	-0.42 (62)	0.12 (67)	0.89 (77)	-0.63 (60)	-0.10 (65)	67.67	6.92	8.99		
			Phase-Change	0.70 (75)	0.23 (68)	0.33 (69)	1.26 (81)	-0.20 (64)	-0.10 (65)	70.33	6.50		8.45	
			Post	0.23 (70)	0.12 (67)	0.23 (68)	1.08 (79)	-0.40 (62)	-0.30 (63)	68.17	6.11			8.99
BIS/BAS	Behavioural Inhibition System (BIS)	Total[a(b)]	Pre	0.11 (19)	-2.07 (13)	-1.07 (16)	-3.4 (9)	-3.4 (9)	-2.74 (11)	12.83	4.02	6.50		
			Phase-Change	0.11 (19)	-0.74 (17)	-0.40 (18)	-3.07 (10)	-4.07 (7)	-1.40 (15)	14.33	4.80		7.76	
			Post	0.68 (21)	-2.40 (12)	-1.07 (16)	-4.07 (7)	-4.07 (7)	-2.07 (13)	12.67	5.39			6.50
CWIT	Colour-Naming	Completion Time[c(b)]	Pre	1 (73)	6 (42)	10 (30)	10 (29)	4 (47)	6 (38)	43.17	16.17	4.43[e]		
			Phase-Change	1 (68)	8 (38)	12 (25)	13 (24)	6 (42)	9 (31)	38.00	16.31		5.53[e]	
			Post	2 (63)	9 (35)	12 (24)	12 (25)	8 (38)	12 (25)*	35.00	14.93			4.43[e]
		Errors[d(b)]	Pre	50 (1)	100 (0)	35 (1)	40 (1)	100 (0)	100 (0)	0.50	0.55			
			Phase-Change	100 (0)	40 (1)	100 (0)	100 (0)	100 (0)	100 (0)	0.17	0.41			

		Post	5 (4)	100 (0)	100 (0)	100 (0)	100 (0)	100 (0)	0.67	1.63			
Word-Reading	Completion Time[c(b)]	Pre	3 (47)*	12 (20)	11 (22)	11 (21)	10 (24)	11 (22)	26.00	10.37	4.42[e]		
		Phase-Change	8 (35)	11 (23)	12 (20)	13 (18)	10 (24)	11 (21)	23.50	6.02		2.29[e]	
		Post	7 (40)	11 (23)	12 (20)	13 (18)	10 (25)	11 (21)	24.50	7.97			4.42[e]
	Errors [d(b)]	Pre	30 (1)	100 (0)	20 (1)	20 (1)	25 (1)	100 (0)	0.67	0.52			
		Phase-Change	100 (0)	100 (0)	100 (0)	20 (1)	100 (0)	100 (0)	0.17	0.41			
		Post	100 (0)	100 (0)	100 (0)	100 (0)	100 (0)	100 (0)	0.00	0.00			
Inhibition	Completion Time[c(b)]	Pre	1 (152)	6 (87)	10 (55)	13 (42)	7 (80)	9 (58)*	79.00	39.45	3.58[e]		
		Phase-Change	1 (158)	9 (70)	11 (48)	13 (39)	9 (71)	13 (42)	71.33	44.64		3.91[e]	
		Post	5 (115)*	11 (58)*	12 (43)	13 (40)	10 (65)	13 (41)*	60.33	28.65			3.58[e]
	Errors [c(b)]	Pre	12 (2)	10 (3)*	11 (2)*	9 (3)*	13 (0)	13 (0)	1.67	1.37	1.43[e]		
		Phase-Change	11 (3)*	8 (5)*	13 (0)	11 (2)	13 (0)	13 (0)	1.67	2.07		1.73[e]	
		Post	14 (0)*	12 (1)*	13 (0)*	12 (1)*	13 (0)	13 (0)	0.33	0.52			1.43[e]

Inhibition / Switching	Completion Time[c(b)]	Pre	1 (145)	5 (90)	11 (59)	11 (55)	6 (88)	11 (55)	82.00	34.80	5.19[e]		
		Phase-Change	4 (127)	7 (80)	12 (53)	14 (40)	10 (64)	13 (47)	68.50	31.90		4.77[e]	
		Post	6 (107)	10 (65)	13 (48)	14 (38)	8 (72)	13 (44)	62.33	25.41			5.19[e]
	Errors [c(b)]	Pre	10 (3)	12 (1)*	12 (1)	6 (5)*	11 (2)	13 (0)	2.00	1.79	3.10[e]		
		Phase-Change	13 (0)	7 (6)*	13 (0)	10 (3)	10 (3)	13 (0)	2.00	2.45		3.04[e]	
		Post	13 (0)	12 (1)	13 (0)	11 (2)*	10 (3)	13 (0)	1.00	1.26			3.10[e]

Note: BIS-11-A = Barratt Impulsiveness Scale 11 for adolescents, BIS/BAS = Behavioural Inhibition/ Activation Scale, CWIT = Colour-Word Interference Test, [a]z scores, [b]Raw Scores, [c]Scaled scores, [d]Cumulative percentile rank, [e]RCI based on scaled scores with mean of 10 and SD of 3. *highlights indices reaching RCI threshold.

Appendix R. Raw and Mean Goal Attainment Scale (GAS) Scores for each Participant

		Participant No:					
Measure:	Day:	1	2	3	4	5	6
Goal Attainment Scale (GAS)	1	0	3	0	0	-2	2
	2	2	5	1	0	-1	4
	3	1	4	0	1	3	0
	4	0	4	2	1	3	2
	5	2	4	-1	0	4	4
	6	-2	5	-3	0	2	3
	7	-1	5	2	1	1	-2
	8	-1	3	3	0	3	-3
	9	-1	5	2	0	1	1
	10	0	5	2	1	1	1
	11	-2	2	0	0	-1	1
	12	-2	6	2	1	1	0
	13	-1	5	2	0	4	5
	14	0	4	2	0	0	0
	15	2	6	1	0	2	1
	16	1	4	-1	1	0	1
	17	1	5	2	0	0	-3
	18	1	3	2	1	3	3
	19	1	3	3	0	3	4
	20	0	5	3	0	3	2
	Mean:	0.05	4.30	1.20	0.35	1.50	1.30
	SD:	1.32	1.08	1.58	0.49	1.76	2.25

Appendix S. Raw and Scaled Phase-Change Behavioural-Control Scores for each Participant and RCIs for each Phase-Change

				Participant No:						Reliable Change Indices (RCI):				
Measure:	Domains assessed:	Subdomains assessed:		1	2	3	4	5	6	Mean	SD	Pre-Phase Change	Phase-Change - Post	Pre-Post
BIS/BAS	Behavioural Activation System (BAS)	Reward Responsiveness[a(b)]	Pre	-4.00 (7)	-6.80 (6)	-5.03 (9)	-6.21 (7)	-6.80 (6)	-4.44 (10)	7.50	1.64	2.37		
			Phase-Change	-4.00 (7)	-6.21 (7)	-3.25 (12)*	-6.21 (7)	-7.40 (5)	-6.21 (7)*	7.50	2.35		3.38	
			Post	-3.58 (8)	-5.62 (8)	-3.25 (12)*	-6.21 (7)	-7.40 (5)	-6.21 (7)*	7.83	2.32			2.37
		Drive[a(b)]	Pre	-0.49 (8)	-1.03 (8)	1.06 (13)	-0.20 (10)	-0.20 (10)	-0.20 (10)	9.83	1.83	3.26		
			Phase-Change	-0.49 (8)	-0.20 (10)	0.64 (12)	0.64 (12)	0.22 (11)	-0.20 (10)	10.50	1.52		2.69	
			Post	0.28 (10)	-1.03 (8)	0.22 (11)	1.48 (14)*	0.22 (11)	0.22 (11)	10.83	1.94			3.26
		Fun Seeking[a(b)]	Pre	-4.35 (4)	-2.97 (6)	-0.98 (10)	-1.48 (9)	-1.48 (9)	-2.47 (7)	7.50	2.26	3.91		
			Phase-Change	-4.35 (4)	-2.97 (6)	-2.47 (7)	-1.98 (8)	0.01 (12)	-2.47 (7)	7.33	2.66		4.60	
			Post	-2.01 (8)*	-2.97 (6)	-1.48 (9)	-1.98 (8)	0.01 (12)	-3.46 (5)	8.00	2.45			3.91
SEQ	School-engagement	Total[a(b)]	Pre	-0.58 (27)	0.50 (33)	1.04 (36)	0.32 (32)	0.67 (34)	0.14 (31)	32.17	3.06	4.04		
			Phase-Change	-0.58 (27)	0.32 (32)	1.04 (36)	-0.04 (30)	-0.04 (30)	-0.04 (30)	30.83	2.99		3.98	

			Post	0.14 (31)*	0.32 (32)	0.86 (35)	0.14 (31)	0.32 (32)	-0.04 (30)	31.83	1.72			4.04
Stoplight Task	Risk-taking	Safe-stops[a(b)]	Pre	0.72 (23)	-0.14 (18)	1.7 (29)	1.88 (30)	1.26 (27)	-1.34 (12)	23.17	7.03	7.56		
			Phase-Change	1.72 (30)	0.33 (21)	1.7 (29)	2.24 (32)	1.73 (30)	0.63 (23)*	27.50	4.42		5.88	
			Post	1.44 (28)*	0.95 (25)*	2.06 (31)	1.70 (29)	1.89 (31)	0.09 (20)*	27.33	4.23			4.36
		Crashes[a(b)]	Pre	-0.43 (5)	0.41 (8)	-1.42 (1)	-1.16 (2)	-1.16 (2)	0.42 (8)	4.33	3.14	3.36		
			Phase-Change	-1.32 (1)*	-0.38 (5)	-1.16 (2)	-1.68 (0)	-1.68 (0)	-0.11 (6)	2.33	2.58		4.24	
			Post	-0.88 (3)	-0.90 (3)*	-1.68 (0)	-0.89 (3)	-1.68 (0)	-0.11 (6)	2.50	2.26			4
		Intersections crossed successfully[a(b)]	Pre	0.25 (4)	0.96 (6)	-0.04 (2)	-0.75 (0)	0.11 (3)	3.48 (12)	4.50	4.18	7.6		
			Phase-Change	-0.54 (1)	0.96 (6)	-0.39 (1)	-0.75 (0)	-0.17 (2)	0.31 (3)*	2.17	2.14		3.04	
			Post	-0.54 (1)*	0.39 (4)	-0.39 (1)	-0.75 (0)	-0.45 (1)*	1.37 (6)*	2.17	2.32			2.72
		Latency to brake[a(b)]	Pre	2.28 (1802.75)	0.16 (916.91)	0.38 (1124.86)	0.57 (1195.72)	0.51 (1044.79)	2.36 (1850.18)	1322.54	401.46	639.25		
			Phase-Change	2.16 (1755.17)	1.66 (1469.0)	1.41 (1502.83)	1.32 (1469.94)	0.43 (1016.87)	1.71 (1612.32)	1471.02	248.18		299.86	
			Post	2.18 (1765.42)	1.62 (1454.39)	1.63 (1585.10)	2.38 (1856.81)*	0.70 (1115.00)	1.61 (1576.45)	1558.86	260.91			832.74

Note: BIS/BAS = Behavioural Inhibition/ Activation Scale, SEQ = School Engagement Questionnaire, [a]z scores, [b]raw score, *highlights indices reaching 1.96 RCI threshold.

Appendix T. Dissemination Statement

The results of this study will be disseminated to interested parties through feedback, journal publication and presentation.

Dissemination to participants and schools

As stated on the participant information sheet participants will be informed of the results of the study. Participants were provided with details of who to contact, should they require further information.

A presentation of the research findings has been offered to the teaching staff and participants within the school involved with recruitment, to indicate what the research and literature search findings suggest.

Journal Publication

It is expected that the study and systematic review will be submitted for publication with the Neuropsychological Rehabilitation Journal. See Appendix B of literature review for instructions for authors.

Presentation

On 8th June 2017, my research findings will be presented to an academic audience, for peer review, as part of the Doctorate in Clinical Psychology at the University of Exeter.