Managing environmental dependency syndrome in a person with an acquired brain injury: a simple strategy evaluated using an ABABA design

Barbara A Wilson[a,b], Anita Rose[c], and Jessica Fish[a,d]

[a] The Oliver Zangwill Centre for Neuropsychological Rehabilitation, Cambridgeshire Community Services NHS Trust

[b] St George's University Hospitals NHS Foundation Trust

[c] Renovocare

[d] Mental Health and Wellbeing, Institute of Health and Wellbeing, University of Glasgow

Correspondence to: draerose@btinternet.com Renovo Care Group Neuropsychology, 13 Coventry Road, St. Leonards-on-sea, TN38 9ET, United Kingdom.

Abstract

This paper begins with a discussion about environmental dependency syndrome (EDS) and utilization behaviour (UB). Are there differences between the two or are they synonymous terms? Following a description of the two conditions, the case of KI, a 57-year-old man, with both UB and EDS is presented. An easy and inexpensive treatment strategy to reduce his inappropriate responses and increase his attention to rehabilitation is described, and data are provided in the form of an ABABA design to demonstrate the effectiveness of this treatment. The simple therapeutic strategy is advocated for people who use objects in the environment inappropriately.

Keywords

acquired brain injury, environmental dependency syndrome, utilization behaviour neurorehabilitation

Introduction

Several authors have drawn attention to an intriguing syndrome exhibited by some patients with frontal lobe damage. This syndrome manifests itself in an array of symptoms including imitation behaviour, utilization behaviour and inappropriate responses to cues in the environment, leading to the term *Environmental Dependency Syndrome* (EDS). In fact, both UB and EDS involve people using objects in the environment 'inappropriately'. Those with UB seem unable to resist the impulse to use or manipulate objects in their visual field and within reach, whereas people with EDS use objects in the environment to achieve goals (Lhermitte, 1983, 1986). Lhermitte himself named both UB and EDS. He saw the former as the result of the tactile stimulation applied to the palms of the patient's hands with various objects, in the absence of any instruction and any reply to eventual questions. The behaviour is then the patient grasping and using the objects not in an inappropriate *way* but in an inappropriate *situation*. They will grasp and continue the behaviour sometimes for a long time. Shallice et al. (1989) reported a case study in which it was noted that when engaged in a cognitive task, in the presence of irrelevant objects, the patient would present with UB despite having his attention directed to the task and not the objects. This led them to propose a redefinition of UB into two distinct forms, 'induced' utilization behaviours caused by someone else providing the stimulation and 'incidental' utilization behaviours occurring more spontaneously, even when the object is not relevant to the current situation and when attention is not directed towards it. Lhermitte (1983, 1986) described the EDS as an elaborate manifestation of utilization behaviour but guided by the cues provided by the environment. Others have reported the syndrome in children with ADHD (Archibald et al., 2005) and in people with frontotemporal dementia (Ghosh & Dutt, 2010). It has also been described in neuropsychiatric disorders (Marin & Gorovoy, 2014). Patients with EDS are described as reaching out and automatically using objects in the environment in an 'object-appropriate' manner that is inappropriate for the particular context. For example, in a neuropsychological testing session, a patient with EDS might automatically pick up the tester's pen and paper on a table and begin writing something without being told or asked to do so. There remain controversies with regard to the neuroanatomical basis of UB with it having been associated with lesions of different brain areas (Ishihara et al., 2002; Lagarde et al., 2013; Lhermitte et al., 1986). Initial studies considered the role of the frontal lobe being involved in UB (e.g., Brazzelli et al., 1994; De Renzi et al., 1996); however, there were equivocal results with some studies reporting UB being noted in 4% of patients with frontal lobe involvement through to 45%. In more recent studies, imaging has been used to evaluate the function of neuroanatomy in UB (Besnard et al., 2010 &, 2011); however, the results have been ambiguous. In considering the empirical evidence it can be said that the

UB is heterogeneous in terms of site and nature of affected brain regions (De Renzi et al., 1996).

In the context of rehabilitation, it can affect attention to task, thus impede on interventions both physical and cognitive and therefore reduce any positive outcomes of rehabilitation procedures. It is, perhaps, acceptable to see the two conditions as being very similar to one another with UB being a symptom of the broader EDS.

This current article reports a single-case experimental design study to investigate whether the frequency of grasping behaviour during rehabilitation sessions could be reduced using a simple replacement intervention, in a patient with an ABI (KI).

Case Report

KI was a 57-year-old man seen at an independent rehabilitation hospital which specializes in providing slow-stream rehabilitation for people with brain injury. In 2016 he sustained a brain haemorrhage following a period of headaches. He was admitted to his local hospital with what was considered to be a mild stroke and then discharged. He deteriorated and returned to the same hospital, when a CT scan identified a bleed and an aneurysm which was subsequently clipped. A repeat scan a few days later showed a large area of infarction in the right hemisphere together with hydrocephalus. This required a ventriculoperitoneal (VP) shunt insertion. He had one seizure soon after surgery but no further seizures after this. He was left with physical difficulties, so was assessed in a wheelchair, together with cognitive deficits and some behavioural problems. KI had a long and complex history of mental health difficulties including a pre-existing diagnosis of bipolar disorder. KI's mother described him as being different to her other son and to his school friends. She thought he may have been autistic and stated that he occupied himself with puzzles and model-making, and did not enjoy team games or sports.

KI was referred for a neuropsychological assessment, and the assessment took place over six occasions for an average of 30 minutes each session. He spoke quietly and kept his head turned to the right. There were some behaviours observed that were inconsistent with the setting; for example, he began the first session by asking for a kiss. When asked what he thought his main problems were, he said 'problems with [the] opposite sex'. On the whole, he cooperated with the assessment. The conclusions to the initial assessment were as follows:

1. KI is a man of at least average premorbid ability.

2. He has a severe neglect of the left-hand side of space (associated with right hemisphere damage). Not only is this evident on tests, including those of single-word reading, but KI keeps his head turned to the right.

3. His anterograde memory is poor and he has a significant retrograde amnesia.

4. Finally, he shows evidence of environmental dependency syndrome, with frequent utilization behaviour. This means he is likely to grab anything in the environment and use it even when it is not his or not part of the task in hand. For example, whenever he is wheeled into the neuropsychology office, he grabs the umbrella or the walking stick in the right-hand corner of the room and tries to use it; if a pen is on the table, he will pick it up and try to write something.

The report concluded that baselines for the utilization behaviour had started prior to commencing a possible treatment.

Pilot Study

It was thought that giving KI something to hold could stop his constant grabbing of anything in the environment, so the pilot study, carried out in one session of 40 minutes, investigated whether or not this was the case. KI was asked to describe a picture, and for each five-minute chunk of time, measures were taken of his attempts to grab objects on the table in front of him while holding or not holding a pen. The results are shown in Table 1.

Table 1. Frequency of grasping behaviour in each condition within the pilot study

Condition	N grabbing gestures observed
No Pen	4
Pen	0
Pen	0
No Pen	2
Pen	0
No Pen	3
Combined No Pen Phases	*9*
Combined Pen Phases	*0*

On the basis of these pilot data, it was considered that giving him something to hold would reduce his utilization behaviour and consequently improve his engagement in subsequent psychology sessions.

Method

The treatment employed an ABABA (i.e., a reversal) single-case experimental design. The first baseline (A) consisted of observations of KI's environmental dependency, as indexed by grasping behaviours, defined as grabbing, touching, picking up and playing with inappropriate objects in the environment, e.g., pens, pen holder or umbrella, during his planned psychology sessions over eight occasions. Each session was 30 minutes in length and was administered by an Assistant Psychologist (AP); however, an observer (another AP or the Consultant Clinical Neuropsychologist) were employed during the sessions to measure the behaviours.

The first treatment phase (B) involved providing KI with a 12-sided 'fiddle toy' during clinic sessions, with continued observations of grasping behaviour. This treatment phase was conducted over 12 sessions.

During the second baseline (A), the fiddle toy was removed and observations continued over four sessions. The second treatment (B) phase was the same as the first though conducted over seven sessions. Following the second treatment phase, a final baseline (A) was taken. The total number of sessions over which observations were made was 41, and these took place over a period of five months.

As this work was conducted as part of routine clinical practice, no ethical approval was necessary.

Results

During the eight sessions of the first baseline, the average number of grasping behaviours observed was 16.9 (*SD* = 5.64, range 9–26). When KI was provided with the fiddle toy, the average number was 1.2 (*SD* = 1.75, range 0–6). Compared to the first baseline, the second baseline reduced to an average of 8.8 (*SD* = 1.26, range 7–10) observed grasping behaviours, and in the second intervention the number of grasps observed reduced to its lowest level, an average of 1 (*SD* = 1.53, range 0–4). In the final A phase, the number of grabs was just over six (*SD* = 1.80, range 4–9). The results for each session and each phase can be seen in Figure 1.

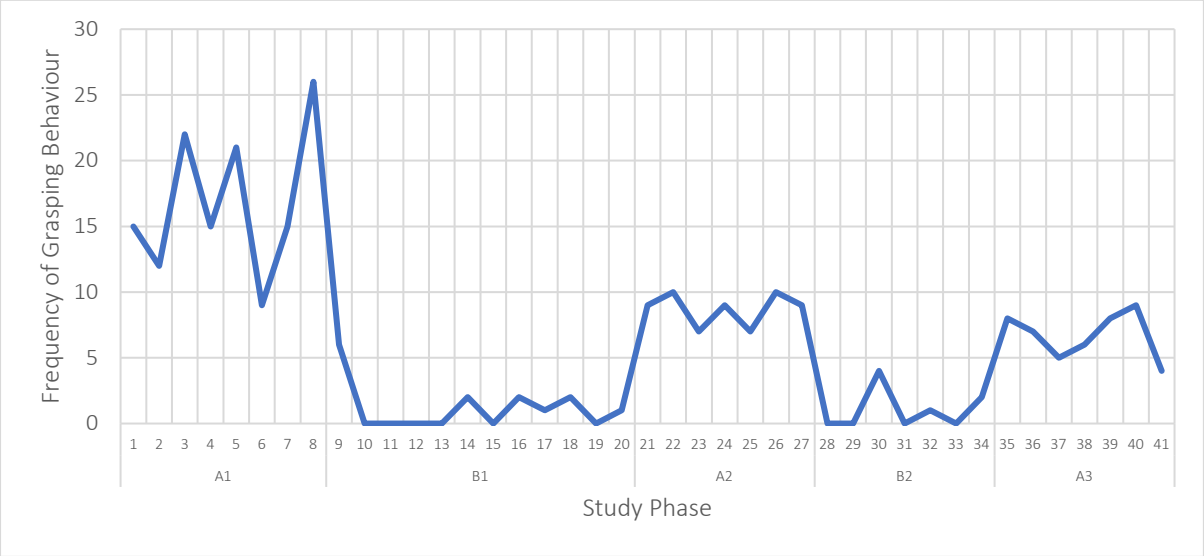

Figure 1. Mean number of grasping behaviours by study phase. A phases represent baseline, and B phases treatment. Note the number of observations per phase varies from 4–12 (see method for further detail).

Tau-U analysis using Manolov's software (singlecaseresearch.org) showed, as is clear from **Figure 1**, a declining trend over the three baseline phases (Tau = −.84, $p < .001$). There was no such difference between the two baseline phases, with the occurrence of the behaviour being virtually at floor (Tau = −.06, $p = .83$). The combined contrast for all baseline phases versus all intervention phases, correcting for the baseline trend, was significant

(Tau = −.93, $p < .001$). Hence, though grasping behaviour became less frequent over time, it was present and highly frequent in all baseline sessions, and either absent or at a much lower level in all treatment sessions.

Discussion

EDS is very disruptive to a patient's involvement in rehabilitation. The constant grabbing and using things in the environment that do not belong to the patient and are not relevant for the task being completed prevents adequate assessment. In this SCED study, a simple behavioural strategy of providing the person with EDS something to hold reduced the problem behaviours. Though task-relevant behaviours were not directly measured, the impression was that this increased attention to the relevant tasks within the session. Furthermore, this strategy was informally observed to generalize to tasks within his daily life, i.e., outside of structured sessions. For example, he grabbed food from other people's plates or would use the incorrect toothbrush if not closely supervised, and once the effectiveness of the strategy was established, it could be used to good effect by all staff members.

This study's strengths include the application of the reversal design that established a clear and specific effect, and extensive sampling of behaviours that were easily operationalized and amenable to measurement via an in-session tally chart. We have also attempted to include as much detail as possible relevant to the domains of the Risk of Bias in N-of-1 Trials scale (RoBiNT scale; Tate et al., 2015) and associated guidelines for reporting results from single-case experimental studies. However, we acknowledge that the study did not incorporate randomization, blinding nor measures of generalization, and these are clear limitations of the work.

Conclusion

Providing a patient who presents with environmental dependency with a fiddle toy is a simple, cheap and effective way of reducing such behaviours and increasing attention to rehabilitation tasks.

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