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To cite this article: Jo Clark-Wilson, Gordon Muir Giles & Doreen M. Baxter (2014) Revisiting the neurofunctional approach: Conceptualizing the core components for the rehabilitation of everyday living skills, *Brain Injury*, 28:13-14, 1646-1656, DOI: [10.3109/02699052.2014.946449](https://doi.org/10.3109/02699052.2014.946449)

To link to this article: <https://doi.org/10.3109/02699052.2014.946449>



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Published online: 25 Aug 2014.



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ORIGINAL ARTICLE

Revisiting the neurofunctional approach: Conceptualizing the core components for the rehabilitation of everyday living skills

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Abstract

Background: Introduced in the 1980s, the neurofunctional approach (NFA) is one of the few interventions designed primarily for clients with severe deficits following traumatic brain injury (TBI). Specifically the NFA was intended for those individuals who were limited in their ability to solve novel problems or generalize skills from one setting to another and whose lack of insight limited their engagement in the rehabilitative process.

Description of the approach: The NFA is a client-centred, goal-driven approach that incorporates the principles of skill learning and promotes the development of routines and competencies in practical activities required for everyday living. Programmes based on the NFA are developed specifically to meet each client's unique needs, using a range of evidence-based interventions.

Recent evidence: Recently the NFA has been found to be more effective than cognitive-retraining for some individuals with moderate-to-severe TBI who have deficits in activities of daily living. This paper aims to define the core features of the NFA, outline the theoretical basis on which it is founded and consider implications of the findings for rehabilitation after TBI in general. The NFA is highly relevant for clients living in the community who require a case manager to direct an integrated, rehabilitation programme or provide structured input for the long-term maintenance of skills.

Keywords

Brain injury, cognition, learning, neurofunctional approach

History

Received 2 August 2013
Revised 8 February 2014
Accepted 30 June 2014
Published online 25 August 2014

Introduction

Individuals with long-term disability from traumatic brain injury (TBI) are estimated to number between 3–5 million in the US [1, 2], with direct and indirect costs representing over 70 billion dollars. Over the past 40 years, a range of distinct rehabilitative models have been developed and refined [3]. A holistic neuropsychological rehabilitation approach (HNPR) has been identified as the gold-standard of therapy for persons with TBA [4–7]. HNPR generally incorporates a milieu-oriented, group-based approach and programmes designed to increase self-awareness and encourage the use of compensatory strategies for cognitive dysfunction [5, 8]. A number of HNPR programmes have been shown to be effective in increasing clients' self-awareness, self-efficacy for symptom management, perceived quality-of-life and community integration [4, 5]. Positive outcomes have also been reported in a number of programmes, which integrate cognitive, interpersonal and functional interventions in both in- and out-patients settings and at various stages in the recovery process [9–11]. However, these programmes typically exclude clients with significant deficits in activities of daily living (ADL), aphasia

or behavioural dysregulation (i.e. those with severe neurobehavioural deficits). Clients who lack insight have also been shown to have poor compliance and poorer rehabilitation outcomes with HNPR [12]. Many of these programmes focus on the use of global metacognitive strategies ('global strategies') to help clients overcome problems in everyday living.

Global strategies are designed to help clients develop a thinking routine, which enables them to find solutions to novel problems encountered in daily life (e.g. Cognitive Orientation to Daily Occupational Performance (CO-OP), incorporating goal/plan/do/check) [13]. The goal of global strategy-learning is to enable the client to use thinking routines independently in novel situations. There is some evidence to show global strategy-learning can be effective in helping clients manage situations for which they have not been trained [12, 14]. There is evidence that some types of cognitive interventions may be less effective with clients with more severe cognitive impairments after TBI [15, 16]. There are reasons to doubt that many 'thinking routines' requiring decisions can be effective for persons with severe lack of insight and neurobehavioural impairments [6, 17, 18]. To use these strategies, a client needs to be aware of limitations in their functioning, acknowledge the validity of such strategies [17] and have the cognitive capacity to learn the strategies [15]; these criteria exclude many severely impaired clients

[19]. Similarly, the client needs to recognize the circumstances in which implementation of the strategy would be useful [20]. Although global strategies may become easier to implement with continued use, no matter how often they are practiced [21], they may never become routine or generalize automatically to a wide range of situations, as they continue to require active cognitive control.

Other approaches exist in which there may be a closer match between what is trained and what the person has to do in his or her everyday life, such as domain-specific strategies and function-embedded cognitive retraining [22]. These approaches can be conceptualized along a hierarchy of generalization or 'transfer distances' relating to the gap between the strategy or training task and the activity that has to be undertaken in everyday life (see Table I) [23]. An approach that involves the least amount of transfer in this hierarchy is the Neurofunctional Approach (NFA).

The NFA was designed for persons with severe functional deficits after TBI and similar approaches have been applied to persons with cerebrovascular accidents (CVA) and dementia [24, 25]. The NFA is occupation-based, focused on 'learning by doing' and occurs within the client's natural environment or as close to this environment as possible. It involves the development of retraining programmes designed to foster the development of habitual routines and automatic functional competencies in areas identified as important by the client. The NFA emphasizes bottom-up training in specific functional, behavioural and social skills and assumes that learning is based on implicit knowledge structures, which may or may not become explicit with practice. Few, if any, assumptions are made about the spontaneous transfer of skills (generalization): transfer is addressed by training *in situ* and by providing sufficient experience in different settings, to increase the likelihood of the use of the skill in similar situations (i.e. 'near' transfer distance such as a road-safety skills transferring to different types of road intersections) [24, 26–28].

The NFA attempts to develop competencies of high relevance to the individual and incorporates these 'islands' of competency into routines and a life-structure, which allow individuals to feel their needs are being met. Therapists may need to be highly creative in developing realistic ways to meet client goals and a life-style, which the person with TBI perceives as acceptable and normal. When successful, the creation of this kind of structure may reduce the amount of community support required and concomitant care costs.

This paper revisits the NFA 20 years after its introduction [26, 29] and describes recent developments in the theory and evidence-base. This study offers a simplified presentation of the NFA as a sequential process in which eight elements are identified. Other authors, such as Rotenberg-Shpigelman et al. [24] and Parish and Oddy [30], have distilled the approach in other ways. This study proposes that the NFA is applicable across a wide range of settings throughout recovery [27], from acute to community. It is client-centred, non-aversive and particularly powerful for persons with limited self-awareness and those living in the community [31] for whom a cognitive approach produces limited or no behavioural change. Over the past few years there has been a preponderance of cognitive and strategy-training approaches

Table I. Classification of therapeutic interventions, according to 'Transfer Distance'.

1. Global Metacognitive Strategy-Learning:
Therapy aims to improve awareness of the impaired cognitive processes and clients are taught to use 'higher-order' compensatory strategies, for instance using internal scripts intended to facilitate problem-solving, decision-making, executive functioning and reasoning. It is assumed that, with sufficient experience/training, clients will be able to generalize the application of these compensatory strategies to novel situations. The central focus of treatment is teaching the strategy and the actual tasks used in training are secondary [30,31].
2. Domain-Specific Strategy-Training:
Domain-specific strategies aim to help the client compensate for a specific perceptual or cognitive dysfunction. The focus is on the strategy, rather than the task itself (e.g. developing a routine for scanning, using an electronic memory aid). The strategy is applied in as many substantially-different settings as possible (e.g. scanning training may be taught in reading and in street crossing).
3. Function-Embedded Cognitive Retraining:
Cognitive retraining is focused on a cognitive deficit, but the strategy is taught within a contextual environment (e.g. driving simulators). Although the training is 'context specific', some authors propose that generalization of skills and improved performance in other tasks will occur [32], depending on the degree of overlap in processing operations between the training task and the new task, i.e. 'near' or 'far' transfer distance (the 'transfer-appropriate' processing hypothesis).
4. Specific task-training:
A specific functional behaviour is taught and the therapist attempts to circumvent cognitive deficits that hamper performance by providing a routine [26,33,34]. No assumptions are made in respect to generalization across activities. Skills trained may or may not have secondary effects on other aspects of functioning.
5. Environmental modifications & assistive technology:
Environmental modifications and simplifications are included in most of the approaches described above. Part of the process of intervention is to simplify task demands, so that skills can be practiced and cueing reduced as skills are learned. There are a number of technological aids that have been developed to facilitate task initiation, scheduling and to guide tasks in order to bypass memory impairments, e.g. smart phone applications, Neuropage or similar [35–37]. These cueing systems may be used permanently or as part of therapy and become redundant, as the client internalizes the routine.

in rehabilitation: this study attempts to redress the balance with the re-presentation of the NFA.

Elements of the NFA

The NFA is presented as a structured, multi-dimensional, eight-stage rehabilitation process. No single feature is unique to the approach: what is unique is the combination of these elements in the context of the application of learning principles [24]. The stages of the NFA are:

- (1) Development of a positive therapeutic alliance, focused on the client's perspective, their values and goals and what he or she wants to do (i.e. client-centred);
- (2) Gathering and assimilating relevant information in order to understand the clients' current functioning in their natural environment and identifying their likely responses to intervention;
- (3) Observation of performance in everyday situations, with reference to the nature of the task, the client characteristics, environmental resources and constraints;
- (4) A case formulation of the client's goals and a reconciliation of these with resources available and current constraints;

- (5) Operational performance goals that can be translated into retraining programmes (i.e. goals stated in behaviourally-explicit terms);
- (6) Creation of skill-retraining programmes (incorporating aids or environmental supports where appropriate), developed from an analysis of the person, activity and environment;
- (7) Development of automaticity, generalization and the maintenance of skills in the client's everyday life; and
- (8) The provision of feedback, appropriate to the client, to encourage progress and engagement.

If goals are successfully met, the client's experience of success may lead to improved self-efficacy and further engagement in the rehabilitation process [30]. If the client fails to show progress, each stage in the NFA needs to be reviewed. Objective measurement and recording systems, fundamental to the application of learning-based approaches, are used to facilitate this process. The client's own views about their progress are central to maintaining a collaborative, client-centred approach.

The neurofunctional approach

Stage 1. Development of a positive therapeutic alliance, focused on the client's perspective and goals (i.e. client-centred)

The quality of the therapeutic relationship, the working alliance and the client's general experience of therapy are predictive of a positive outcome, irrespective of theoretical orientation [32–41]. The quality of the therapeutic alliance has been shown to predict TBI rehabilitation outcome [42], client self-awareness and treatment compliance [43].

The first step of the NFA is the creation of a positive therapeutic relationship in which clients feel psychologically safe. The therapist tries to see the 'person' behind the symptoms, 'entering the patient's world' [44] through 'respectful listening', in an effort to appreciate the client's perspective and goals, without making judgements. The therapist adopts an attitude of relentless kindness and accepts that the client's view is one way of seeing his or her situation, taking into account the client's pre- and post-accident cultural and social values. Confronting or overtly challenging the client's position is avoided as this undermines the relationship and puts the client in a position of self-justification, creating further barriers to engagement in rehabilitation.

The client's ability to maintain self-efficacy is an important condition for change [45, 46]. The therapist needs to understand what the client experiences as psychologically threatening in order to avoid conflicts in which the client withdraws from therapeutic engagement. Riley et al. [47] postulated that impaired self-awareness was a response to a perceived threat to self-identity, although impaired cognition and severity of injury also play a role in self-awareness [48]. Behaviours labelled as 'denial' or lack of insight may represent a way that clients cope with catastrophic changes in their lives. A high degree of personal awareness is required by the therapist to avoid negative attitudes being projected through verbal and non-verbal communication [49].

Motivational interviewing (MI) is a non-confrontational approach shown to be effective in a range of situations, where

clients are ambivalent about engaging in the therapeutic process [50–52]. In the TBI population, motivational interviewing has been used to address substance abuse [53] and anxiety [15, 54, 55] and to promote recovery [56] and engagement in the rehabilitation process in individuals with impaired awareness [57, 58]. The principles of motivational interviewing incorporate concepts such as empathy, collaboration ('drawing out' rather than imposing ideas) and developing discrepancies. MI recognizes that the power of change rests within the client and supports self-efficacy. These principles are entirely consistent with the NFA at times when negotiation and engagement are required. MI facilitates acceptance of the changed self after injury, incorporating goal-setting and enhancing motivation [15, 54, 55, 59].

Stage 2. Gathering and assimilating relevant information in order to understand the client's current functioning and likely responses to intervention

In order to design effective rehabilitation programmes, the therapist needs to consult key figures in the injured person's life [60]. Family, friends and colleagues provide unique perspectives and allow a more complete picture of the person with TBI, both before and after the injury. Key people may also identify possible triggers to unhelpful behaviours and predict likely responses to different situations. Irrespective of the 'accuracy' of the various perspectives, the attitudes and cultural beliefs of the family and relevant others need to be taken into account, as their behaviour will significantly influence the rehabilitation outcome of the person with TBI [61–66]. The views of family members about the injured person and their needs are central to establishing a stable and viable life routine for the client, especially in the community [18]. Approximately 30–50% of adults who provide support to a person with TBI report clinically significant distress [18]. The need for caregiver support and the nature of the interaction patterns with caregivers and family members must be established in order to understand the functioning of the person with TBI in context.

During the rehabilitation process, numerous specialists undertake diagnostic tests. The immediate relevance of these tests to the client's everyday functioning and the rehabilitation process may not be obvious and may need translating in a way that is meaningful to the client and family. Throughout the process of data collection, the therapist is sensitive to any potential mismatches between expectations and therapy goals, which will need to be considered in the Case Formulation (stage 4).

Stage 3. Observation of performance in everyday situations, with reference to the nature of the task, client characteristics, environmental resources and constraints

Central to the NFA is the exploration and analysis of the client's performance in the 'real world' through direct observation, i.e. performance-based assessment. Having established a positive therapeutic relationship and agreed the purpose of observations, the therapist is more likely to be accepted as an observer and active enabler in treatment. At first, observations focus on the whole task or functional activity (macro-level) and preliminary observations determine

what the client can do within a specific setting and context, without interference. Particular note is made of the client's self-structured performance, how activity is initiated, the organizational sequence, preserved movement patterns and strategies used to overcome problems that arise (adaptive and maladaptive). During assessment, the grading of task difficulty should ensure the clients' motivation is maintained and assessment activities chosen, that are relevant to the client's lifestyle. Expectations are gradually increased to demonstrate the client's proficiency in a particular skill or alternatively to highlight areas to be addressed in rehabilitation.

The therapist considers a wide range of variables that may influence performance, including aspects of the environment, features of the person and the nature of the task demands and the dynamic relationship between these three variables. Familiarity with the people involved, general layout of the environment, equipment, temperature, time of day and the duration of the activity are just some of the factors that may influence performance and require evaluation. Therapists need to be conscious of how their presence and interactional style may influence the client's performance, through prompts, encouragement, physical assistance and other subtle signals.

As the therapist gains more understanding of factors and constraints underpinning the client's performance, the focus changes to the micro-level and aspects of performance such as movement, scanning, attention, memory and behaviour. The task sub-components are analysed in detail in order to understand the physical, cognitive and behavioural skills required for a successful performance and how these map on to the client's profile: detailed formal assessments from different disciplines may be particularly helpful at this stage. Task or environmental modifications are gradually introduced to explore how they might facilitate client performance. The therapist may explore variables such as style of communication, the content of the language and the need for encouragement, whilst monitoring client responses and environmental factors. The process is one of hypothesis-testing *in situ*, to define in detail the most effective forms of facilitation.

Observational baseline measures are identified which can evaluate rate of progress. For instance, in ADL, the duration of the overall task, the sub-tasks completed independently and those requiring facilitation by others will guide rehabilitation efforts and identify when modifications to the training programme are needed. The use of antecedent/behaviour/consequence (ABC) charts and frequency data will allow a more precise definition of any maladaptive behaviours and the circumstances in which they occur.

Stage 4. A case formulation of the client's goals and a reconciliation of these with resources available and current constraints

Wilson et al. describes a formulation as 'a map or guide to intervention that combines a model derived from established theories and best evidence with the client and family's own personal views, experiences and stories' ([3], pp. 53–54).

Information from professionals, family and friends, gathered from previous stages, is used to develop a case formulation [15, 54, 55], which defines the professional rehabilitation plan and is relevant and understandable to the

client and family. The formulation includes a brief summary of the facts of the case, but integrates these into a higher level of abstraction, making inferences and identifying patterns to help understand the person, not just the 'brain injury'. The case formulation constructs a story, which takes into account the everyday challenges encountered by the client, the constraints influencing performance and the client's view of the world. The case formulation represents the shared understanding between professionals, family and client, which guides the rehabilitation process and forms the basis for rational treatment planning and the development of ecologically-valid programmes and operational goals.

Case formulations can be created at both a micro- and macro-level. For instance, if the client has reading difficulties, the micro-level might focus on the analysis of the reading task and the specific contributions of physical/sensory, cognitive or emotional/behavioural factors, which act as barriers to successful performance. Alternatively, at a macro-level, the client may consider reading to his child is central to a life-goal of 'being a good father'.

Because of the complex nature of TBI rehabilitation and the number of professionals involved, it is advantageous if one person is assigned responsibility for integrating information and also liaising with the family. When there is a large gap between family and professionals' expectations about prognosis, it is advisable to agree on the 'next step' in treatment rather than disagree about ultimate goals and get involved in confrontational attempts to get the family to be 'more realistic'. It is important that the case formulation identify something in the life of the client that can improve: the sense of 'hope' is important to families and has been associated with better outcomes [67, 68].

Stage 5. Operational performance goals that can be translated into retraining programmes (i.e. goals stated in behaviourally-explicit terms)

Operational goals represent a sub-set of higher-order life goals and form the focus of rehabilitation. Vague or abstract client life-goals are broken down and translated into more concrete, functional activities and performance goals, that can be achieved within a specified time-frame. This process of negotiating goals can be difficult when a mismatch exists between client/family and professional goals, particularly for clients with more serious language, memory and insight problems. The therapeutic relationship and negotiation skills of the therapist are critical at this stage, to guide the client successfully through steps, linking operational and personal goals in a way that maintains commitment to the rehabilitation process. Motivational interviewing can be especially useful here to facilitate the engagement of the client to affect behaviour change.

Throughout the process of goal-negotiation and goal-setting, the therapist needs to confirm that the client feels that the work is collaborative. Faulty, 'unhelpful' beliefs and fears may act as barriers to rehabilitation. For instance, clients may believe that having breaks during the day impedes recovery, assuming that 'more is better': this view is counterproductive when fatigue management needs to be undertaken. Changing attitudes takes time and must be undertaken carefully, in a

low-key manner, to avoid the client feeling threatened [57]. If goals are negotiated insensitively and the client does not understand their relevance, performance deteriorates and participation may be short-lived [69]. Client participation in goal-setting increases overall satisfaction with rehabilitation [70] and the process of information exchange and formulation of task strategies appear to increase feelings of self-efficacy [71, 72].

For clients with more serious cognitive impairments, re-establishing rapport and briefly repeating the significance of an activity or strategy may be required in every rehabilitation interaction to promote engagement. Written or auditory reminders, diagrams, pictures and photos may be needed to help the individual maintain the link between the rehabilitation task and the personal goal to keep the person on target. For clients who are able to anticipate barriers to the achievement of a specific activity, discussing specific coping strategies in advance can reduce fear and may increase feelings of self-efficacy.

Stage 6. Creation of skill-retraining programmes, developed from an analysis of the person, activity and environment

It is helpful to conceptualize any functional activity or skill as a series of multiple stimulus-response units, performed in sequence: this is irrespective of the complexity or nature of the task, whether social, cognitive or practical. The completion of one act serves as the stimulus for the initiation of the next step in the series or 'chain' [73]. After a significant TBI, the client's responses to naturally-occurring cues or prompts are disrupted: everyday cues no longer serve to guide behaviour, which can become stimulus-bound and impulsive [74]. Thus, a busy intersection no longer triggers road-safety behaviour and the therapist may need to provide an additional cue *in situ* to elicit the required response.

The design of any skill-retraining programme (SRP) incorporates knowledge of the person (person analysis) and the cognitive, behavioural, sensory and motor requirements for the activity (activity analysis), in the context of the particular environment in which the activity is performed (environmental analysis). The target task is analysed into those separable steps required for the individual to successfully and consistently complete the task (task analysis). Observation of how the individual performs a task will allow the incorporation of spontaneously-occurring sequences into the SRP to reduce new learning. An analysis of the cause of performance breakdown will be particularly important in designing treatment programmes and identifying when prompts, modifications and aids are needed.

For a person with amnesia and intact motor skills, an SRP for personal hygiene may require as few as five steps, specifying the order of sub-tasks to be undertaken: a simple client check-list might be provided to encourage self-monitoring and ensure that sub-tasks are carried out in the same sequence. In contrast, the most physically-impaired clients may require over 100 steps in the SRP and each movement specified in relation to positioning and sequencing: a description of the manner in which staff can support the client to reduce spasticity and abnormal movements may also

be needed. For the client with visual agnosia, staff may need to provide sufficient information to facilitate the recall of meaning for the objects used in the task. Altering the environment and establishing antecedent stimulus control may be required for individuals with challenging behaviour, when other approaches have failed [75, 76].

The therapist defines the sequence of sub-steps required for training, the nature of prompts, type of equipment and environmental modifications. The precise repetition of actions in areas of impairment is required to foster the development of automatic routines. The relevant steps and type of support can only be identified from direct observation and experimenting with cues and support (i.e. cue experimentation). Inconsistent response to a cue should alert the therapist to revise that step in the programme and provide alternate ways to facilitate consistent and accurate client performance. In clients with multiple and complex disabilities, the most effective SRPs are designed with input from a multidisciplinary team.

As learning takes place, cues can be gradually combined or delayed (faded) and the SRP revised: this process will be guided by the objective documentation of task performance, e.g. whether a step was achieved consistently without prompts. Even in the absence of awareness of previous learning trials, the most severely injured persons can re-learn effective habit-sequences, if their experience is appropriately structured and responses are managed to minimize errors, using procedures such as errorless learning [77–81]. Structuring the learning experience is particularly relevant to clients with amnesia and those with severe executive dysfunction (see [82] for a case study).

Although SRPs involve task breakdown, a *whole task method* is most often used in training, rather than practising parts of an activity. The whole task is generally more meaningful to the client, as it preserves the integrity of the functional goal and has been shown to be equivalent or superior to other chaining methods [83–85]. If a task leads to high levels of fatigue, forward or backward chaining may be indicated.

The SRP is recorded as a checklist, which guides and structures not only client responses, but those of staff. This checklist is used to record client performance on each sub-task on every occasion the SRP is undertaken and provides objective evidence of change over time.

Stage 7. Development of automaticity, generalization and the maintenance of skills in the person's everyday life

For automaticity to develop, actions must be repeated in the same order to become linked or 'chunked' [86, 87]. Practice increases the availability of target responses, such that conscious decision-making, which places a heavy cognitive 'load' on compromised executive functions, is replaced by the implementation of automatic action sequences [88]. When a skill becomes automatic, it becomes the easiest behaviour to initiate from the array of possible behaviours, interference errors are reduced and the action is perceived as effortless.

The development of automaticity not only requires repetition and the linking of sequential, functional, behavioural units, but also the pairing of the same stimulus

configuration to the same response. The latter is referred to as *consistent mapping* (CM) and is central to the concept of automaticity [89, 90]. In contrast, when a range of responses is required to one or more stimuli, this is referred to as *varied mapping* (VM). In the latter condition, tasks do not become automatic and performance shows little improvement after practice [89, 91].

There is increasing evidence that practicing tasks leads to cortical re-structuring [92–94]. Therapists and clients may under-estimate the amount of practice required for skill development [95, 96]. In a recent review of critical training variables, high treatment dosages (minimum of 6–30 or more practice sessions) were shown to be associated with successful outcomes, when training clients with memory disorders in multi-step tasks [95]. Tasks undertaken frequently, on a daily basis, are more likely to be self-maintaining once acquired (e.g. washing and dressing). Tasks that are engaged in less frequently will be learned more slowly, will be less stable and are more likely to extinguish [97, 98].

In the neurologically-impaired population, it is generally accepted that a skill should be practiced at least 100% past the number of trials required to reach mastery [99]. With extensive practice, the performance of individuals with severe TBI approximates that of controls [89, 91]. Once achieved, automaticity may be robust and enduring [100]. Different schedules of practice produce different effects: blocked practice facilitates acquisition and random practice promotes transfer of skills, once a certain level of skill has been acquired [101]. In the initial acquisition stages, it appears advantageous to reduce task demands, use blocked practice and provide relatively high feedback for each component, after which less frequent feedback and random practice is more effective [102]. In sports skills, the performer's focus of attention and the type of feedback also appears to have a decisive influence on the learning. Directing the client's attention to an external focus and to the outcome of movement rather than to the movement itself reduces attentional demands, encourages greater self-organization and facilitates the development of automaticity [103].

Once adequate performance has been reliably established, practice of the target skill in a range of different, everyday settings reduces the 'hyperspecificity' of learning [95]. For instance, good posture and appropriate breathing patterns needed to support speech should be encouraged throughout the day. Similarly, regular facilitation to prompt the use of memory aids will also be needed at every relevant opportunity. All staff and relevant family members will need to be trained in the appropriate techniques to facilitate automaticity and encourage the client to maintain a mental set, which promotes the continued use of rehabilitation methods. Providing 'attitudinal support' is particularly important on discharge, to promote those skills that require an element of conscious decision-making, such as the use of a memory aid.

Stage 8. The provision of feedback, appropriate to the client, to encourage progress

In the context of success, feedback, which is objective, specific and constructive, can facilitate progress and client engagement. A range of feedback formats can be used,

depending on the individual's preferences, for instance, diagrams, progress charts, graphs. Most importantly, as clients develop new competencies, the newly-acquired skills should increase meaningful choices and expand the individual's natural lifestyle, a situation which is reinforcing in itself and can promote further engagement in rehabilitation [30, 96]. If goals are realistic and achievable, a self-perpetuating reinforcing cycle may be created.

For clients who are not achieving their goals, a review of the NFA steps and barriers to success should be undertaken: finding a small area of success and enjoyment is often central to continued engagement. Negative feedback and repeated failure will erode client self-confidence and trust in the therapeutic relationship and the rehabilitation process in general. Promoting an atmosphere of shared experiences and the idea that any difficulty provides an 'opportunity for learning' may reduce anxiety about failure. Creating a small, relevant, peer group can also be an influential way of changing attitudes, sharing experiences and promoting goals. The group setting provides an opportunity for a public statement of goals, a public acknowledgement of achievement by the group and an appreciation of the rewards of success [26].

Encouraging clients to voice their own reasons for change can be especially powerful and is a basic premise of motivational interviewing. Clients are also more likely to remember what they tell themselves than what others tell them. Within the NFA, therapists develop a framework in which the environment supports and rewards participation in rehabilitation in a natural and unobtrusive manner. Clients may also participate in developing motivation schemes which can help them focus on their goals [46]. Creating opportunities and choices for clients can provide them with a sense of hope for the future, whether this is in the form of achieving a particular task, developing a skill or relationship or participating in social events or community activities. A sense of progress and feeling of control is important for clients in order to maintain participation in the rehabilitation process.

Although the eight stages in the NFA are presented as if they occur in a linear fashion, the process is dynamic. New information or altered circumstances may lead to a change in perspectives and priorities, thereby necessitating a revaluation of each stage and a revision of the case formulation, client goals and skill-retraining programmes.

NFA evidence-base

Functionally-based neurobehavioural treatment approaches have been shown to improve day-to-day performance outcomes in individuals after TBI [9, 10, 104]. However, in the majority of randomized clinical trials (RCTs), interventions have been non-specific and poorly defined, e.g. 'post-acute TBI rehabilitation' and 'holistic neuropsychological rehabilitation' [4, 5, 104, 105]. The NFA has been evaluated in single-case and small group studies, supporting the view that the approach has wide applicability and leads to robust treatment effects [26, 30, 77, 106–108]. Models, which are conceptually similar to the NFA, have been developed recently by others, who may be unaware of the NFA, and suggest a confluence of evidence and opinion supporting this type of functional approach [109, 110].

Evidence for the effectiveness of the NFA in larger group studies is documented in two randomized controlled trials [24, 27]. Vanderploeg et al.'s [27, 111] research represents the largest randomized controlled trial (RCT) of interdisciplinary acute rehabilitation after TBI conducted to date. This large multi-centre trial included individuals aged between 18–65 years from four Veteran Administration acute inpatient centres ($n = 360$), if they had sustained a moderate-to-severe TBI within the preceding 6 months. Clients were randomly allocated to either 'cognitive–didactic' or 'functional–experiential' treatment, which constituted an additional 1.5–2.5 hours of treatment above the standard rehabilitation programme. The cognitive–didactic treatment was individually-based and followed the cognitive rehabilitation model of Sohlberg and Mateer [112, 113]. The functional–experiential treatment was based on the NFA, but was conducted in a group setting.

At 1-year follow-up, there was no difference between the two groups in primary outcome measures (i.e. return to full- or part-time competitive work; living independently with less than 3 hours of domestic help). However, the study did find significant differences in a pre-planned, sub-set, outcome analysis; younger participants (<30 years) and those with less education who participated in the cognitive–didactic intervention group had better work-related outcomes; older participants (>30 years) and those with more education who participated in the functional–experiential group (NFA) had better independent living outcomes than participants in the cognitive–didactic group.

As originally described by Giles and Clark-Wilson [26], the NFA was designed for persons who were severely cognitively impaired and compromised in their independent living skills. It was applied over a considerably longer period than the 20–60 days in the RCT study of Vanderploeg et al. [26, 27, 82, 111]. In addition, the application of the NFA was designed to be primarily individual rather than group-based, although it is entirely compatible with incorporating group components when appropriate. Given these protocol variations, the RCT study of Vanderploeg et al. [27, 111] provided a 'hard test' of the NFA. Vanderploeg et al. [27] provide too little detail of the way in which the NFA was implemented to evaluate whether all important elements of the NFA were included. There were no descriptions of how specific tasks were identified and analysed, how individual strengths were utilized in the development of SRPs and an absence of information in relation to individual goal-setting.

The NFA is targeted to improve only those activities that are similar to skills practiced in rehabilitation and does not expect generalization to other skills. Participants in the RCT study, who had superior outcomes in independent living skills, may well have achieved this success precisely because these were the activities they practiced: work-related activities were not practiced and therefore would not be expected to show improvements within the NFA. However, it is not entirely clear why younger persons would fail to show improvements in community living and ADL skills, after undertaking NFA training. It is possible that there were ceiling effects in the younger population or that work remained a higher priority for younger people and domestic independence a higher priority for older people. It is also

possible that the demands of both domestic life and work are incompatible for individuals with limited capacity after a moderate-to-severe TBI. These ideas are, however, speculative.

Participants in the Vanderploeg et al. [27] study were described as having moderate-to-severe brain injury. The NFA was designed for persons with severe *outcome* and were usually individuals at the extreme end of the injury-severity spectrum. Indeed, the NFA has been described as the only functional approach to be effective in improving independence skills in clients over 10 years after a severe TBI [30, 77]. It is also one of the very few interventions effective in improving daily living skills amongst individuals living in the community after a CVA. The success in improved community and ADL skills evident from the study of Vanderploeg et al. [27] using the NFA in a more acute and less impaired population, as well as the effectiveness in a population with CVA, suggests a wider application of the NFA than was originally envisaged [24].

Conclusion

The NFA has been presented as a structured, multi-dimensional, eight-stage rehabilitation process, designed for people with severe impairments. It is especially applicable to individuals who lack awareness and are likely to require ongoing support [24]. There is an emphasis on the repetition and training of functional skills *in situ*, encouraging adaptive routines and habits, thereby avoiding problems associated with transfer and generalization.

A key concept of the NFA is training real-world skills, which are age-appropriate and important to clients in their social and cultural environment and are seen as advancing their personal goals. It is hoped that the successful acquisition of such skills will increase the individual's feeling of efficacy, which in turn is reinforcing and fosters further engagement in the rehabilitation process. In this way, islands of competence can be created and integrated into a daily and weekly schedule of activities, which is meaningful and normalizing for the client and family.

The NFA highlights the importance of non-threatening communication, fostering a working alliance and shared purpose between therapist, client and family, a collaborative approach in which there is genuine respect for the experience and views of others. Families are generally the major long-term support system for persons with TBI and often have a critical role in influencing rehabilitation outcomes. The views of the client and family are incorporated into a case formulation, in order to identify relevant goals and avoid unnecessary confrontation. The case formulation is phrased in a language that is relevant to functional activities, understandable to the family and includes a sense of hope and of moving forward.

Inherent in the NFA is the recognition that an intervention is most effective when the client is ready to engage. In normal circumstances people do not learn things against their will or when highly anxious [114, 115]. Therapists may find themselves in a conflict between the demands of health services to get results as quickly as possible and the needs of the client to progress at a slower pace to avoid disengagement. For clients

who lack awareness, a confrontational approach is likely to be counterproductive and motivational interviewing may be particularly helpful to facilitate treatment engagement [52].

Core features of the NFA include a positive therapeutic alliance, gathering information, performance-based assessment, case formulation, individualized goals, skill-retraining programmes, extensive practice *in situ* and positive feedback. Through structured repetition of everyday living skills, the skills become automatic and the behaviours that are most available to the individual, thereby reducing problem-solving and reasoning demands. In order to achieve positive outcomes, an appropriate management structure is required to facilitate good communication and collaboration between all relevant parties (client, family and the various disciplines involved), thereby promoting the consistency required to enhance learning.

There is nothing unique in any of the NFA interventions: it is the application of the techniques together that separates the NFA from other approaches. There is evidence for the effectiveness of separate elements of the NFA, although the relative contribution of each element is unknown. Further studies are required to determine which, if any, elements are especially effective. Most trials of the NFA conducted by groups, other than the current authors, have involved various sub-sets of the principles incorporated within the NFA, but not the complete set [24, 27, 30, 111]. This may be due partly to the demands of a RCT, but may also be due to the fact that the populations under study were more amenable to engagement in rehabilitation than the difficult-to-treat individuals that have been studied previously by Giles and colleagues [46, 82].

Recent evidence suggests that the NFA has a wider applicability than originally envisaged, is practical and can be taught relatively easily by therapists treating less difficult-to-manage clients [24]. In the authors' experience, successful application of the approach to the more difficult client requires experience, a high degree of 'psychological mindedness' and ongoing clinical supervision. Despite accumulating evidence for the efficacy of the NFA, further research is required to define more precisely the optimal duration and intensity of rehabilitation and to identify which NFA elements are essential when treating specific sub-populations. More research is also required to identify how to best match individual clients to the most appropriate type of therapeutic intervention [9] and accurately distinguish those clients for whom global strategy-learning is more effective and those who respond best to the type of intensive, *in situ* skill-practice used in the NFA. It is the authors' view that the NFA is more suitable for clients who are unable to solve novel problems and generalize skills, but this needs to be explored in future research.

Declaration of interest

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

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