BMJ Open

Feasibility of the Perceive, Recall, Plan and Perform system of intervention for persons with brain injury in community-based rehabilitation: a pilot for a multiple-baseline design study

Marte Ørud Lindstad ,[1] Aud Uhlen Obstfelder,[1] Unni Sveen,[2,3] Linda Stigen[1]

To cite: Lindstad MØ, Obstfelder AU, Sveen U, *et al*. Feasibility of the Perceive, Recall, Plan and Perform system of intervention for persons with brain injury in community-based rehabilitation: a pilot for a multiple-baseline design study. *BMJ Open* 2023;**13**:e067593. doi:10.1136/bmjopen-2022-067593

► Prepublication history and additional supplemental material for this paper are available online. To view these files, please visit the journal online (http://dx.doi.org/10.1136/bmjopen-2022-067593).

Received 19 August 2022
Accepted 14 June 2023

[1]Department of Health Science Gjøvik, Norwegian University of Science and Technology, Trondheim, Norway
[2]Department of Occupational Therapy, Prosthetics and Orthotics, Oslo Metropolitan University, Oslo, Norway
[3]Department of Physical Medicine and Rehabilitation, Oslo University Hospital, Oslo, Norway

Correspondence to
Marte Ørud Lindstad;
marte.lindstad@ntnu.no

ABSTRACT

Objectives This paper describes a pilot study investigating the feasibility of the Perceive, Recall, Plan and Perform (PRPP) system for persons with cognitive impairments after acquired brain injury in the context of community-based rehabilitation for older individuals.

Design The feasibility, acceptability and practicability of the research procedures were evaluated by exploring the effectiveness of the PRPP intervention with non-concurrent multiple baseline designs.

Setting and participants Three participants (63+years of age) from two health centres were included.

Intervention In the PRPP intervention, the occupational therapist (OT) supports the participant in applying cognitive strategies in everyday activities to enhance task mastery, with nine sessions of 45–60 min over 3 weeks.

Primary and secondary outcome measures The participants completed measurements of five everyday tasks in each phase as dependent variables. PRPP assessment stages 1 and 2 served as the primary and secondary outcome measures, respectively. The percentage of mastery of the tasks and the participants' application of cognitive strategies at baseline acted as a control and was therefore compared with the other phases within the participant. The Goal Attainment Scale and Barthel Index served as generalisation measures. The uncertainties and acceptability of the procedures were also investigated with a procedural checklist and qualitative statements reported in the procedures or noted in dialogue meetings with the conducting OTs.

Results The procedures were acceptable for the OT and the participants and were feasible if the steps in the research procedure were clearly understood. The target behaviour should be changed to the use of one task with five measurement points instead of measuring five tasks. This can enable the application of recommended analysis methods.

Conclusions The outcomes of this study led to a change in the target behaviour and clarification of the research procedure for the planned PRPP intervention study.

Trial registration number NCT05148247.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ The research procedure's closeness to real-world practice is a strength.
⇒ The pilot indicates that the Perceive, Recall, Plan and Perform intervention can contribute to meaningful improvements in task performance.
⇒ Information on the steps of the research procedure must be more precisely communicated between the researchers and the occupational therapists providing the intervention.
⇒ To enable the application of established analysis methods, we need to change the target behaviour for further data collection.

INTRODUCTION

Persons with acquired brain injury (ABI) report a need for rehabilitation to manage everyday activities due to cognitive challenges.[1 2] Although most ABIs occur in older individuals (65+ years of age), research often focuses on younger individuals.[3 4] With an ageing population, often with comorbidities, it is crucial that ABI survivors receive rehabilitation and reach their maximum level of independence.[5] In Norway, clients with ABI receive rehabilitation in regional specialised units and/or community-based programmes in the municipalities in health centres or in the clients' homes.[6]

The Norwegian welfare system is based on public funding and is built on principles of equal essential health services for the entire population. One of the mandates of municipal health services is to ensure that the population receives needed rehabilitation services.[6] Occupational therapy has been an obligatory profession in community health services since 2020[7] and generally concerns people's everyday lives. Occupational therapy is a central rehabilitation profession for reaching the political goal of ageing in one's

own home and local community as long as possible, both for sustainability reasons and for individual quality of life.[8] Community occupational therapists (OTs) in small-sized and medium-sized municipalities in Norway identify themselves as generalists, working with clients with a wide range of conditions and in various contexts, whereas there are opportunities to be more specialised in larger municipalities.[9]

Norwegian community OTs call for a focus on and development of assessment and interventions to meet clients' cognitive challenges.[10 11] Community OTs in Norway working with clients with cognitive impairments report persons with ABI to be a large client group.[12] The same sample of OTs frequently use interventions related to environmental modifications and assistive technology, with training of everyday activities reported as the third most provided intervention. This is comparable to the case for Norwegian ABI survivors, who report that they are given services to adapt the environment to cope with physical issues and to rehabilitate physical impairments, even if they experience problems in activities due to cognitive challenges.[1 2]

International studies describe a more nuanced picture of community OT interventions in rehabilitation for this client group. The most frequent interventions were task training, the use of external compensatory strategies, various types of cognitive strategy training, adaptation of the environment and exercises with paper and pencil/computer; however, only a few used standardised interventions.[13–16] Therefore, we should seek evidence for standardised interventions appropriate for use in community rehabilitation to meet the needs of heterogeneous clients with cognitive challenges after ABI.

The Perceive, Recall, Plan and Perform (PRPP) system is a standardised system of assessment and intervention with a focus on clients' everyday occupational performance.[17] The PRPP was developed by OTs to help clients apply cognitive strategies to enhance task mastery and focuses on both task training and cognitive strategy training within natural everyday tasks and contexts.[18] The uniqueness of the PRPP system is its focus on occupational performance both as an assessment and intervention, and it is designed for everyone experiencing information processing deficits, regardless of age, context and diagnosis.[17] The effectiveness of the PRPP intervention has been evaluated for adults with ABI[19] but has not yet been evaluated through systematic research for older individuals with ABI in community rehabilitation.

Systematic research investigating the effectiveness of interventions often excludes older individuals with comorbidities,[3 4] and there is not a strong research tradition in Norwegian community health services.[20] Therefore, we designed a pilot study to evaluate the feasibility of the PRPP intervention for older clients in an ordinary practice setting.

Aim and objectives

The main purpose of this pilot study was to evaluate the feasibility, acceptability and practicability of all research procedures for a planned PRPP intervention study to identify procedural, clinical and methodological uncertainties. We did this by exploring the effectiveness of the PRPP intervention in a community rehabilitation context with persons observed to have difficulties in everyday task performance due to cognitive challenges following ABI.

METHOD

To explore the planned PRPP intervention study design, we used a non-concurrent multiple-baseline design (n=3) with three lengths of the baseline phases and at least five data points within each phase. This design allows the collection of empirical data systematically close to ordinary practice, along with experimental control of the variables.[21] For expanded details of the planned intervention study, we refer to the protocol.[22] This pilot study used various methods to collect information about feasibility.

The Medical Research Council guidance for developing and evaluating complex interventions[23] has guided the planning of the pilot and the planned intervention study together with The Risk of Bias in N-of-1 Trials (RoBiNT).[24] To progress to the PRPP intervention study, our criteria for this feasibility study procedure are as follows: (1) the OTs and participants find the procedure acceptable regarding time consumed, comfort, respecting the rehabilitation goals and the context, and the fidelity checklist is met by at least 80%; (2) the measures are sensitive enough to show immediate changes in task mastery and cognitive strategy use and (3) the research design and data analysis methods are feasible for showing visually, statistically and clinically significant effects of the PRPP intervention.

Patient and public involvement

Planning of the pilot study took place in close dialogue between the participating community OTs that collected data and the first author to make the research procedures possible in a clinical setting. The first author had a dialogue with an organisation for stroke survivors[25] during which they confirmed the importance of focusing on cognitive rehabilitation and everyday tasks with no further comments.

Research setting

The pilot was conducted within community-based rehabilitation services in one medium municipality (15 000 inhabitants) and one large municipality (55 000 inhabitants) in Southeast Norway. The OTs that collected the data (n=4) and provided the PRPP intervention were not part of the research group. They worked hectic and multifaceted days at health centres that included short-stay units, rehabilitation units and residential units for older adults with very different diagnoses, conditions and service needs. The OTs (n=4) were all female with a range

Table 1 Overview of the participants' demographic and health characteristics at inclusion

	Anne	Carl	Birger
Sex, age	Female, 71	Male, 63	Male, 86
Marital status, living conditions	Lives with husband in own house	Lives with partner in own terraced house	Lives with wife in own apartment
Activity level prior to ABI	Retired teacher, active lifestyle, exercises regularly, assisting at previous workplace	Retired professional driver, handy man, always on his feet helping with household repairs	Retired, mostly quiet indoor activities, listen* to TV. Walks independently with walker in the flat but needs help transferring to the toilet at night, and his wife expressed she feels insecure leaving him alone for fear of falls
Home healthcare prior to ABI	No	No	Yes, once a day for providing medical cream, eating and morning routines
Reported cognitive challenges prior to ABI	No	No	No
ABI diagnosis	Cerebral infarct left side, basal ganglia	Traumatic brain injury, with subarachnoid haemorrhage bilaterally and frontal contusion injury	Cerebral haemorrhage right side, subcortical
Neurological challenges reported in patient record	Severe aphasia, attention, visual and arousal deficits, half side paresis right side, dysphagia with tube feeding	Post-traumatic amnesia for 2 months; half side paresis left side; poor tolerance and impulsive control; difficulties with planning, structure and attention; easily tired	Balance and mobility problems, orientation only to one side, impaired judgement and plan of action
Recruitment	12 days since ABI	93 days since ABI	18 days since ABI
Comorbidities	Fibromyalgia, hypertension, angina, lymphoedema and backpain	Diabetes mellitus 2, chronic obstructive pulmonary disease grade 1, backpain, cataract, hypertension, chronic pancreatitis. After the TBI, he had high scores on a depression scale	Blind in one eye, strongly reduced sight in other eye with tunnel vision, moderate hearing loss, age-decreased balance (uses a rollator)

*Because of reduced vision.
ABI, acquired brain injury; TBI, traumatic brain injury.

of 9–16 years of clinical experience. They were trained and certified in the PRPP system 6 years ago at the time of inclusion and have in the years since regularly used the system in their clinic with various clients with information processing challenges.

Participants

The first three clients (table 1) admitted to the health centres with a new ABI were informed about and asked to participate in the trial by their OT (online supplemental material—Patient Consent). The exclusion criteria were previous diagnosis of dementia, congenital brain damage or developmental disability. The participants also needed a minimum level of physical resources to manage everyday tasks, the ability to hear and/or understand simple instructions and to show mastery below 85% in PRPP assessment stage 1. The OT collected oral or written consent and allocated the participants (n=3) to a predefined baseline phase. The first participant included was allocated to a baseline phase of 3 days, the second participant 5 days and the third participant 7 days. Neither the researcher nor the OTs had influence on which clients were admitted to the health centres.

Please note, pseudonyms have been used to refer to the participants throughout.

Intervention to be studied

The aim of the PRPP intervention is to enhance mastery in the performance of the clients' needed or desired everyday tasks.[17] The PRPP intervention was developed based on the basic principles of the information processing approach[26] and evident theories of neural plasticity,[27] systematic instructions,[28] errorless learning[29] and task-oriented training.[30]

The OTs followed the PRPP intervention manual;[31] however, the intervention delivery was highly

individualised. This means that the PRPP assessment identified errors in the participants' cognitive strategy application behaviours that most impacted the mastery of tasks that were relevant or important to the client. On that basis, the OTs developed a plan for the use of systematic instructions of cognitive strategy training in extended traditional task training.[32]

The intervention phase started directly after the baseline phase. The PRPP intervention plan included a goal for the task, where the task was supposed to be performed, adaptations of the environment, timing and prompts from the OT. The OT started by making the goal of the task clear, which was followed by providing systematic instructions through graded verbal, visual or physical prompts and cues directly during the participants' task performance. The OT taught the participants to apply strategies in relation to 'stop/attend, sense, think, do'. 'Stop/attend' helped the participants initially to focus on details of the task, and 'sense' was prompted to assist the participants in perceiving the sensory information from the objects and environment required to perform the task. In relation to the strategy 'think', the OT prompted the participants to recall steps, develop a plan of action or evaluate as needed to 'do' the performance as fluently as possible. The application of 'do' also supported the participants in implementing the plan. As each participant improved mastery and internalised the strategies in their task performance, the OT decreased the number and frequency of prompts.

During all phases, the participants received other treatment 'as usual' from the interdisciplinary team. Other treatments and the degree to which the interdisciplinary team (or relatives) was supervised by the OT to provide prompts and cues varied and was described by the OT as a step in the research procedures.

Target behaviour: measures and data collection

The target behaviour consists of mastery across different daily tasks and capacity for the use of cognitive strategies in occupational performance. As a primary outcome and functional measure, the criterion-referenced PRPP assessment stage 1[33] was used. Five needed or desired everyday tasks in the context for the participants were chosen by the OT in cooperation with each participant; measuring them each at least once during each phase provided five measurement points all together. The tasks were divided into a series of significant steps. Performance was measured in percentage mastery (0%–100%) of the steps, and errors of omission, accuracy, repetition and timing were recorded. A score above 85% indicates independence in the target task, but with minor inefficiency in cognitive strategy application.[34]

The PRPP assessment stage 2[33] was used as a second outcome measure. The effectiveness of 35 observable cognitive strategy application behaviours (outer ring figure 1) in task performance was evaluated on a three-point criterion-referenced scale: (3) effective, (2) questionable or (1) not effective. The 12 subquadrants (middle ring figure 1) and the information processing of PRPP are illustrated in the central quadrants in the theoretical model (figure 1). Each subquadrant was then assigned a percentage score. PRPP assessment stages 1 and 2 were scored in the same observation and were used to collect data from all five tasks in all four phases.

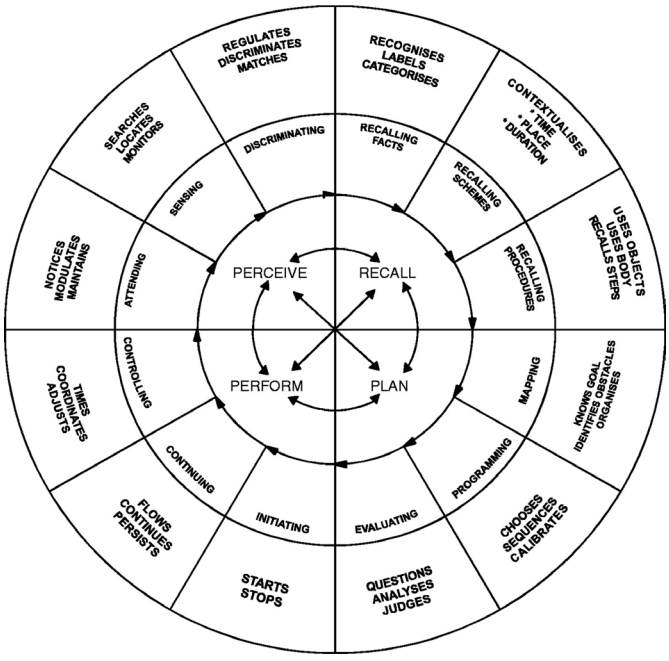

Figure 1 The Perceive, Recall, Plan and Perform system of task analysis, the four quadrants Perceive, Recall, Plan and Perform, the 12 subquadrants and the outer circle with observable descriptors.[43]

As a generalisation measure, the participants were evaluated with the Goal Attainment Scale (GAS)[35] and the Barthel Index (BI).[36 37] The five target behaviours were inserted into the GAS. Based on observations made by the OT, a score of −2 is the baseline value, 0 represents the expected short-term goal attainment, better outcomes are indicated by scores of +1and +2, and outcomes below the expected short-term goal attainment are indicated by scores of −1. The BI includes 10 tasks: eating, bathing/showering, personal hygiene, dressing, bowel and bladder control, toileting, transfer between bed and chair, mobility and walking stairs. The index uses a score of 0, 1 or 2 points, with a maximum score of 20 indicating independence in the tasks and the lowest score of 0 indicating total dependency[36] based on observations made by a member of the interdisciplinary team. The GAS and the BI were used to collect data at baseline, postintervention and follow-up phases (reported in table 2).

Demographic information used to describe the participants and their contexts and qualitative statements from the client or relatives, journals or the interdisciplinary team were noted by the OT in the procedure document and contributed to evaluating clinically meaningful changes. Clinically meaningful changes reflect the rehabilitation goals and the potential difference the treatment

Table 2 Description of the participants' data at baseline

	Rehabilitation process after ABI until inclusion	Assistance and challenges at baseline	Tasks chosen. End goal: mastery above 85%	Cognitive strategy focus	GAS score	Barthel Index total score	Other treatment
Anne	Admitted to short stay unit, rehabilitation potential questioned after 12 days of minimal recovery, received rehabilitation services in the short stay unit	She needed help with everything and could barely sit up straight in a wheelchair and had a short attention span. Could answer simple questions.	OT chose tasks after clinical reasoning and agreement from Anne and her husband, due to aphasia: sitting in wheelchair in front of wash tub and mirror to (1) wash face, (2) wash rest of upper body, (3) put on deodorant, (4) brushing teeth, (5) brushing hair	Recalled and knew the goal before each task and then prompted 'attend, notice, search, locate, recall steps and continue'	Task no.: B/P/F 1: –2/+2/lost data 2: –2/+1/lost data 3: –2/+1/lost data 4: –2/+1/lost data 5: –2/+2/lost data	B: 1/ P: 5/ F: lost data	Physiotherapy, speech therapist, nursing
Carl	Transferred to community rehabilitation unit after 3 months of specialised rehabilitation, good physical outcomes, no cognitive screening possible at specialised rehabilitation due to cooperation, recovery curve stagnated	He needed close assistance for all morning and meal routines, including guidance of the well arm/hand. He walked 5–10 m with a walker and close assistance due to uncritical behaviour. Did not manage to drive the wheelchair.	Clearly, expressed desired tasks: (1) take a shower, (2) dry after shower, (3) put on t-shirt, (4) stand up from wheelchair, (5) put on trousers and (6) put on shoes	Worked mostly in the planning-quadrant, with focus identify obstacles by prompting 'stop, analyse, choose and do'. Additionally, 'recall steps, use body, analyse, choose, continue, persist'	1: –2/+1/+1 2: –2/+1/+1 3: –2/+1/+1 4: –2/+1/+1 5: –2/+2/+1 6: –2/0/0	B: 9 P: 15 F: 17	Physio-therapy, speech therapist, nursing

Continued

Table 2 Continued

	Rehabilitation process after ABI until inclusion	Assistance and challenges at baseline	Tasks chosen. End goal: mastery above 85%	Cognitive strategy focus	GAS score	Barthel Index total score	Other treatment
Birger	Admitted to short stay unit for the first 14 days and then transferred to the rehabilitation unit. Minimal spontaneous recovery, staff members questioned rehabilitation potential and expressed he would still need help at home.	He needed close assistance for safe mobility with a walker, always walked towards the left direction, bumped into objects and had a fall caused by uncritical behaviour during transfer to a chair. Received help for most of his morning routines.	The OT had a thorough discussion with Birger about important tasks: (1) transfer to toilet, (2) transfer to chair, (3) orientation when coming into a room, (4) put on t-shirt and (5) put on shoes	Modified environment with contrasts and put stuff in same place. Then, prompting 'stop, notice, monitor, continue'	1: –2/+2/+2 2: –2/+2/+2 3: –2/0/0 4: –2/+1/+1 5: –2/+2/+2	B: 10 P: 16 F: 15	Physio-therapy, nursing

The numbers for the GAS score are the same as the task numbers.
B, baseline; F, follow-up; GAS, Goal Attainment Scale; OT, occupational therapist; p, postintervention.

contributes to practical, social, or applied value in the everyday life of the participants.[21]

Procedural fidelity

Data concerning feasibility were gathered by the first author, who counted the procedure steps completed by each OT and compared them with the procedure checklist. An agreement of at least 80% indicates high fidelity.[21] Treatment adherence was secured by the fact that the OT provided the intervention together with the participant according to the research procedure.

Information concerning the acceptability and practicability of the procedure was collected in regular dialogue meetings with the OTs and the first and last authors. The OTs were free to give overall feedback, but the dialogue was focused on the steps in the procedure compared with their regular practice and to the PRPP manual. Because of the long distances, Microsoft Teams were chosen as a digital meeting platform to communicate with all the OTs at the same time. Notes were made by the first author during the meetings, with the possibility of email for clarification. During the various research phases, the OTs noted qualitative observations and statements from the individual participants, relatives and team members in the procedural document. The content of these qualitative data was related to task performance, improvements or acceptability of the intervention or research procedure.

Blind rating and inter-rater agreement

To monitor observer drift,[24] an external, independent and blinded PRPP-trained OT assessed 20% of the PRPP stage 1 measurements from each phase by video recordings from the assessment situations. When video recording was not possible, a second PRPP-trained OT at the unit assessed 20% of the measurement, but it was not possible to blind the phases for this assessor. An inter-rater agreement of at least 80% is considered acceptable.[21]

Ethics

It was desirable to keep the research procedures close to real-world practice. This minimised ethical challenges but could also threaten the research validity that we needed to address in this pilot. The participants had to wait for the PRPP intervention to start for up to 7 days, but they received all other treatment as usual. Because there are only a few community OTs delivering PRPP intervention, that was considered acceptable.

Data analysis

We explored the feasibility of the outcome measures by analysing the data patterns of all five tasks in fixed order in a visual graph for each participant. With guidance from Lane and Gast,[38] each graph was visually inspected. The purpose was to determine whether the outcomes and graphs were appropriate to show immediate improvement in the target behaviours when the intervention was introduced and whether this improvement was maintained to the postintervention phase. Furthermore, the mastery of task performance and cognitive strategy application

was maintained when tasks were performed in another context and was generalised to other tasks in the follow-up phase. Decisions regarding whether improvements were seen in the graphs were indexed as yes, no, or unsure.[21]

Clinically meaningful changes were explored by noting whether the participants' percentage mastery in the everyday tasks was above 85%, the goal attainment scores for each task, and qualitative statements from the participants, relatives or team members. It was important to consider whether independence in certain tasks also led to fewer service needs or other impacts. The independence in the target tasks was linked to the progress in the overall independence of self-care and mobility skills from the BI score.

The formula 'number of agreements' × 100 shared in (number of agreements) + (number of disagreements)[21] (p. 200) was used to calculate the inter-rater agreement and the feasibility of the procedural checklist, together with the OTs' expressed experience of managing the procedure in a busy clinical setting.

RESULTS

Participants

From the two municipalities, two participants were recruited within 2 months after inclusion start-up (spring 2021), and the third participant was recruited 1 week after completing data collection for the first participant (table 2). They were allocated in staggered baseline phases (table 3).

Effectiveness of intervention on task mastery and cognitive strategy application

The graphs demonstrate an immediate effect from the baseline to the intervention phase within the individual and between the participants' staggered baselines (figure 2). Further improvements are shown in the graphs throughout the phases for the primary (figure 2) and secondary outcomes (figure 3). Figure 3 shows how the 12 subquadrants, which reflect effective cognitive strategy use, improve from the baseline (inner blue ring).

The mean achievement and change in task mastery for the five tasks collapsed can be calculated and/or presented with visible changes in the graphs (figure 2). However, the calculation of the stability of the baseline data, overlap and consistency of the data pattern across similar phases, and trend lines within each phase[38] cannot be used when there is only one measurement point for each of the five separate tasks, even though they constitute five measurement points all together.

Meaningful clinical changes

Anne showed improvements during the 3 weeks and managed morning routines related to her face, teeth and hair independently at postintervention. Although she improved, she still needed assistance to complete her entire morning routine. At the same time, her improvements led to her transfer to specialised rehabilitation, while she was considered for palliative care instead of rehabilitation at inclusion. Carl exhibited clinically meaningful improvements and needed less personal assistance for safe independent mobility. At follow-up, Birger received some assistance for his morning routines and eating due to visual impairments present before ABI. His wife reported that he uses the toilet independently at night and expressed that she was more confident leaving him at home alone, as he walked safely with a walker and transferred with caution. That improvement was beyond his level prior to the ABI. For both Anne and Birger, the nursing staff expressed surprise regarding the participants' recovery and achievements.

The GAS showed improvements in line with the percent task mastery, which was expected because the tasks were exactly the same as the target behaviours (see table 2). The BI showed overall improvements and was in line with the task mastery where the tasks observed were the same.

Table 3 Timeline and completed intervention sessions

Tier 1/Anne	Baseline 3 days	Intervention: 9 sessions PRPP, 45–60 min each, 3 sessions a week for 3 weeks	Postintervention measurement, incomplete and after 14-day delay due to hospital admission	Lost to follow-up measurement.
Tier 2/Carl	Baseline 5 days	Intervention: 30 sessions PRPP, 45–60 min each, 3 sessions a week for 9 weeks and then 2 weeks with a total of 3 sessions before postintervention 2	Postintervention measurement after 10 and 13 weeks	Follow-up measurement; 4 weeks after discharge
Tier 3/Birger	Baseline 8 days	Intervention: 7 sessions PRPP, 45–60 min each, 3 sessions a week for 3 weeks	Postintervention measurement the last 2 days of admission	Follow-up measurement; 4 weeks after discharge

PRPP, Perceive, Recall, Plan and Perform.

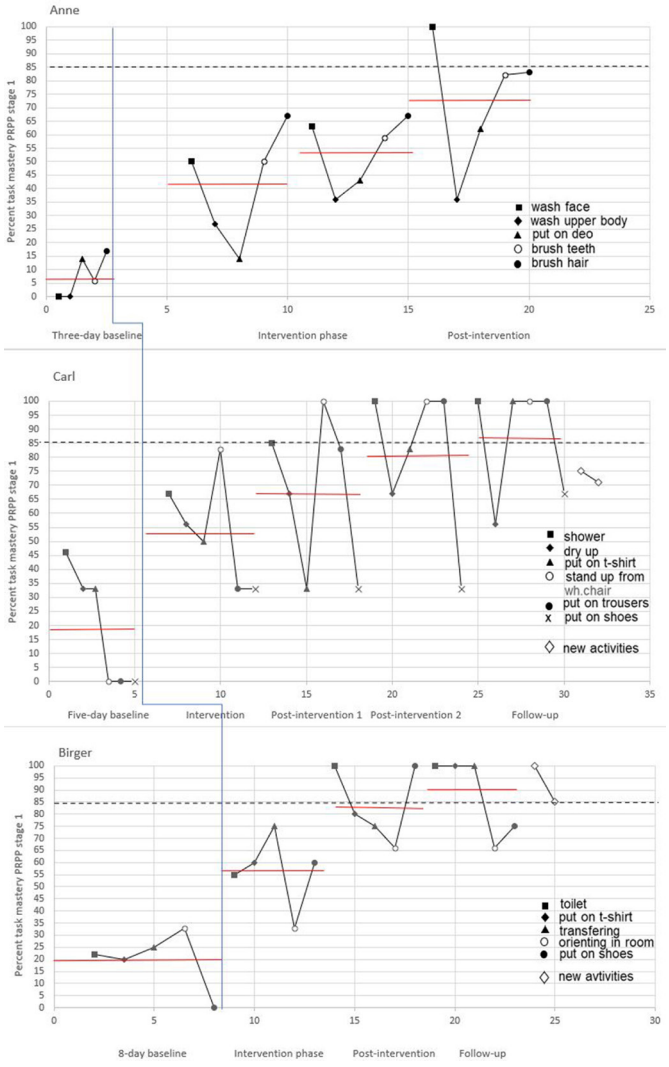

Figure 2 Primary outcome: percent task mastery of each of the five tasks presented as dots of different shapes in a fixed order. The blue vertical line through all three graphs illustrates the staggered baseline phases. The horizontal red lines illustrate the mean value, and the reference line is 85%, indicating independence. The numbers on the X-axis indicate sessions.

This may contribute to external validity but give otherwise small benefits to lighten the measure of generalisation.

Procedural fidelity, inter-rater agreement, acceptance, and practicability

The procedural checklist could be followed as long as no unforeseen incidents occurred (see online supplemental material for checklist). Birger had an 8 day baseline instead of a 7 day baseline due to OTs' work schedule. Two misunderstandings of the checklist resulted in the following: (1) inter-rater observations through video recording were only collected for the postintervention and follow-up phases for Birger, and (2) Carl attending as many as 27 PRPP sessions before postintervention outcomes were measured. To score a basis at discharge for the follow-up measurement, the OTs scored a second postintervention phase. This means that it was not the

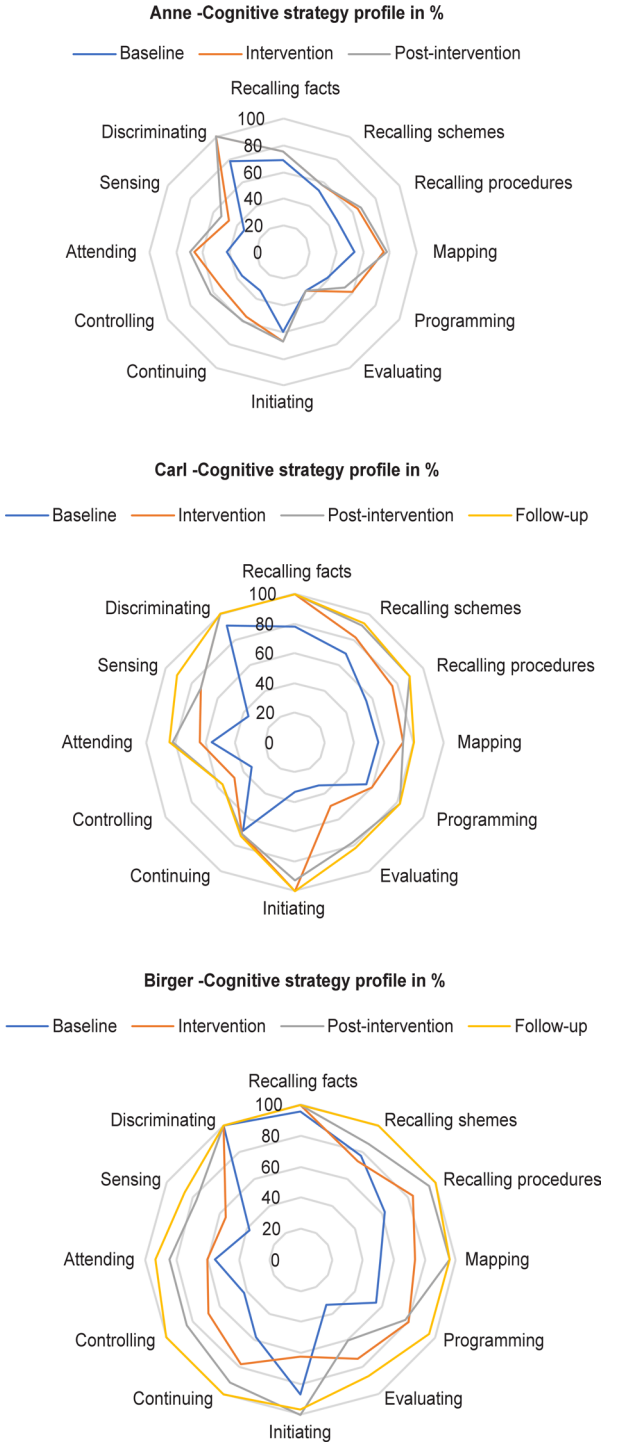

Figure 3 Secondary outcome: cognitive strategy application measured as the mean scores for the five target tasks.

practice setting or acceptability that hindered the procedure but rather issues with unclear communication from the researcher to the participating OTs. The procedural checklist was followed by the OT in 91% and 89% of the steps for Birger and Carl, respectively, but follow-up errors after the misunderstandings with Carl's intervention sessions were not taken into account. For Anne, the procedural checklist was followed by 84% for the three phases completed.

For Anne, the observations to be assessed for inter-rater agreement in PRPP stage 1 were collected for two tasks at baseline (agreement range 83%–94%) and five tasks in the intervention phases (range 55%–100%) by direct observations. Carl's observations for inter-rater comparison were collected by video-recording and blinded assessment for two tasks in the follow-up phase, and 100% agreement was noted. Birger's data were collected for one task in the postintervention phase and two tasks in the follow-up, all through video recording and blinded assessment; the rate of agreement was 100%. Observations for inter-rater comparisons were lost for some of the phases due to a transfer to specialised rehabilitation (Anne), refusal of planned video recording (Carl) and misunderstanding of the procedure (Birger). The tasks evaluated for inter-rater agreement were chosen by the OT based on feasibility.

The OTs confirmed the general acceptability for the procedures on behalf of themselves, the participants and the practice setting, even if they reported a greater workload, such as the time needed to administer scores and documentation. At the same time, the OTs reported that the research procedures helped them to practice the intervention more systematically with benefits for the clients. There were unexpected circumstances, such as participants being transferred to other health facilities and OTs being on sick leave. To cope with these circumstances, the OTs were forced to have a flexible attitude, but it also resulted in a lost PRPP stage 2 score at postintervention and lost follow-up data for Anne.

For all three participants, all five tasks were worked on sequentially in each session. For all participants, the nursing staff followed a simplified intervention plan made with suggested strategies; however, this plan was followed to various degrees and not recorded in detail.

DISCUSSION

This study examined the feasibility of a planned intervention study by exploring the effectiveness of the PRPP intervention in people experiencing problems with everyday task mastery due to ABI with cognitive problems. Our data suggest that the PRPP intervention used with older clients was largely feasible in terms of the procedural checklist, acceptability and practicability for clients and therapists, sensitive outcome measures and benefits of the intervention. We suggest important changes in the research procedure that can minimise the risk of bias. First, we need to clarify information around some steps in the procedure with the conducting OTs. Second, we need to adjust the use of target behaviours to meet design criteria, and in the same context, adjust the selection of graphs and associated analysis methods. This will be discussed below.

Strengths and limitations of this study

The strength of this study is the close relationship to ordinary practice and measuring the outcome of cognitive challenges directly via everyday task performance. The included participants were considered to have low rehabilitation potential due to the severity of their cognitive challenges, comorbidities and extant home health services. Studies show that adults 65+ years of age with ABI receive less intensive rehabilitation than younger adults and are often excluded from research due to age or comorbidities.[3] When research participants do not reflect diverse real-world conditions, this could fail to translate research into practice.[5] Cicerone *et al*[39] call for outcome measures that address cognition when performing everyday activities. The PRPP stages 1 and 2 are sensitive to changes in everyday activity performance and were acceptable for the participants and the community OTs. This shows that it is possible to include older participants with comorbidities in research and assess cognition in everyday tasks. One of the advantages of the PRPP intervention is its usefulness for any difficulties with information processing across practice settings, diagnoses and ages.[31]

There are limitations that should be considered when interpreting the data and planning for a full trial. The procedural checklist is acceptable to follow if the key functions in the procedure are clearly understood and no unforeseen events occur. Unclearly communicated procedures resulted in missing data for inter-rater agreement for Birger and Carl for some of the phases. Measuring inter-rater agreement reminds us of its role in minimising reactivity and observational bias and plays a role in internal validity.[40] As long as the postintervention and follow-up phases include a blinded inter-rater assessor and show increasing improvements, we can assume that the measures in the intervention phase do not err in the direction of false positives.

Unclear communicated procedures also led to the postintervention measurement for Carl being collected first after 27 interventions. Incomplete implementation of the research plan is a threat to validity.[41] For Carl's prolonged intervention phase, the limitation did not affect the immediate change in task performance and cognitive strategy application between baseline and the intervention phase, as shown in the visual graph. The results in the postintervention and follow-up phases have a clear bias compared with those of other participants in the sample, but in a practice setting, the improvements will be valuable. Nevertheless, the procedural checklist was followed at least 80% of the time, which indicates high fidelity for all the participants.[21]

A second limitation is the choice of using five tasks. Although the immediate visual effects across the five tasks are clear, the choice minimised the opportunity to apply the most recognised analysis methods. Analysis of stability, overlap and consistency and trend lines in the various phases from the widely used systematic inspection analysis from Lane and Gast[38] or statistical analysis methods are therefore not applicable. Even if all tasks are a part of, for example, morning routines, they demand different cognitive strategy applications and functions. The decision to measuring five tasks once each instead of

the same task five times was to make data collection unobtrusive for the participant and keep the procedures close to ordinary practice, but this decision led to important bias in the analysis process. It is possible that OTs can strive to use at least three, but optimally five,[42] measurement points in each phase for the same task without much extra effort or burden on the participants. This can be held close to a real-world context, when the chosen task can be performed naturally more than once during the day, such as using a cell phone or put on shoes. Nevertheless, it is important that the participant is guided to choose a task that is needed or desired.

The procedures secured the systematic delivery of the PRPP intervention. As trained PRPP therapists, the OTs have a manual to follow but must react with flexibility regarding what each situation requires. Our judgement is that comparing or predeciding a treatment adherence checklist as recommended in RoBiNT[24] is complicated because of the contextualised nature of the intervention. The intervention plan is based on the assessment, and the plan is a dynamic process in which the initiative of the OT fades when the client internalises the strategies.

CONCLUSION

This pilot shows that the planned procedures for the PRPP intervention study are acceptable and practically feasible for community OTs and older clients with decreased mastery of everyday tasks due to cognitive challenges after ABI. This pilot study also reveals important issues requiring modification of the research procedure for future studies. It is important to communicate the research procedure steps clearly to the data-collecting OTs to minimise the risk of bias. One substantial change was made to enable the application of established systematic visual inspection and statistical analysis methods: attempting to include at least three and preferably five measurement points in each phase of the same task. The outcome measures are both manageable and sensitive to changes, and the effectiveness of the PRPP intervention appears promising for continuing data collection with the suggested modification.

Contributors MØL, AUO, US and LS all contributed to planning and designing the study, critically revised the manuscript and approved the final version. MØL and LS held contact with the conducting occupational therapists (OTs). MØL wrote the first draft of the manuscript, act as guarantor and is the submitting author. We thank the collaborating municipalities, the OTs collecting the data and the participants.

Funding The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

Competing interests None declared.

Patient and public involvement Patients and/or the public were involved in the design, or conduct, or reporting or dissemination plans of this research. Refer to the Methods section for further details.

Patient consent for publication Consent obtained directly from patient(s).

Ethics approval This study involves human participants and was approved by The Norwegian Regional Ethics Committee, project no: 215391. Participants gave informed consent to participate in the study before taking part.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available upon reasonable request. The data shared in open publications are free to use; however, they should be used with caution and with qualitative information following the statistics in mind.

ORCID iD

Marte Ørud Lindstad http://orcid.org/0000-0003-1100-3381

REFERENCES

1 Andelic N, Soberg HL, Berntsen S, *et al*. Self-perceived health care needs and delivery of health care services 5 years after moderate-to-severe traumatic brain injury. *PM&R* 2014;6:1013–21.
2 Arntzen C, Hamran T. Rehabiliteringsforløp Etter Hjerneslag [recovery trajectory after stroke]. *Geriatrisk Sykepleie* 2015;3:24–34.
3 Gardner RC, Dams-O'Connor K, Morrissey MR, *et al*. Geriatric traumatic brain injury: epidemiology, outcomes, knowledge gaps, and future directions. *J Neurotrauma* 2018;35:889–906.
4 Chen R-L, Balami JS, Esiri MM, *et al*. Ischemic stroke in the elderly: an overview of evidence. *Nat Rev Neurol* 2010;6:256–65.
5 Norrving B, Barrick J, Davalos A, *et al*. Action plan for stroke in Europe 2018–2030. *Eur Stroke J* 2018;3:309–36.
6 Norwegian Ministry of Health and Care Services. *Opptrappingsplan for habilitering og rehabilitering 2017-2019 [Escalation plan for habilitation and rehabilitation 2017-2019]*. Oslo: Norwegian Ministry of Health and Care Services, 2016.
7 Meld. St. 26 (2014-2015). *Fremtidens primærhelsetjeneste - nærhet og helhet [The primary health and care services of tomorrow - localised and integrated]*. Oslo: Norwegian Ministry of Health and Care Services, 2014.
8 Meld. St. 15 (2017–2018). *Leve hele livet — En kvalitetsreform for eldre [A full life - all your life. A quality reform for older persons*. Oslo: Norwegian Ministry of Health and Care Services, 2018.
9 Arntzen C, Sveen U, Hagby C, *et al*. Community-based occupational therapy in Norway: content, dilemmas, and priorities. *Scand J Occup Ther* 2019;26:371–81.
10 Gramstad A, Nilsen R. Prioriterte Områder for Forskning Blant Kommuneergoterapeuter I Norge. [Prioritized topics for research amongst Norwegian occupational Thrapists]. *Ergoterapeuten* 2017;3:36–45.
11 Stigen L, Bjørk E, Lund A. The conflicted practice: municipal occupational therapists' experiences with assessment of clients with cognitive impairments. *Scand J Occup Ther* 2019;26:261–72.
12 Stigen L, Bjørk E, Lund A. Occupational therapy interventions for persons with cognitive impairments living in the community. *Occup Ther Health Care* 2022:1–20.
13 Downing M, Bragge P, Ponsford J. Cognitive rehabilitation following traumatic brain injury: a survey of current practice in Australia. *Brain Impairment* 2019;20:24–36.
14 Koh C-L, Hoffmann T, Bennett S, *et al*. Management of patients with cognitive impairment after stroke: a survey of Australian occupational therapists. *Aust Occup Ther J* 2009;56:324–31.
15 Korner-Bitensky N, Barrett-Bernstein S, Bibas G, *et al*. National survey of Canadian occupational therapists' assessment and treatment of cognitive impairment post-stroke. *Aust Occup Ther J* 2011;58:241–50.
16 Holmqvist K, Ivarsson AB, Holmefur M. Occupational therapist practice patterns in relation to clients with cognitive impairment following acquired brain injury. *Brain Inj* 2014;28:1365–73.
17 Chapparo C, Ranka J. The perceive: recall: plan: perform (PRPP) system of task analysis 2014. Available: http://www.occupational

performance.com/the-perceive-recall-plan-perform-prpp-system-of-task-analysis/ [Accessed 14 Dec 2022].
18 Chapparo C, Ranka JL, Nott MT. Perceive, recall, plan and perform (PRPP) system of task analysis and intervention. In: Curtin M, Egan M, Adams J, eds. *Occupational therapy for people experiencing illness, injury or impairment: Promoting occupation and participation*. 7 ed. Edinburgh: Elsevier, 2017: 243–57.
19 Nott MT, Chapparo C, Heard R. Effective occupational therapy intervention with adults demonstrating agitation during post-traumatic amnesia. *Brain Inj* 2008;22:669–83.
20 Wiig O, Rørstad K, Børing P. *Healthcare21. research and innovation related to municipal health and care services. NIFU-report 32*. Oslo: Nordic Institute for Studies innovation, research and education, Norwegian Ministry of Health and Care Services, 2016. Available: https://www.helseomsorg21.no/contentassets/18705eb8469f4d72a82f1a95e7bc8a56/nifurapport2016-32.pdf
21 Tate RL, Perdices M. Single-case experimental designs for clinical research and Neurorehabilitation settings. In: *Planning, conduct, analysis and reporting*. Abingdon, Oxon ; New York, NY : Routledge, 2018. | Series: Neuropsychological rehabilitation: a modular handbook: Routledge, 2019.
22 Lindstad MØ, Obstfelder AU, Sveen U, *et al*. Effectiveness of the perceive, recall, plan and perform intervention for persons with brain injury in community-based rehabilitation: protocol for a single-case experimental design with multiple Baselines. *BMJ Open* 2022;12:e060206.
23 Skivington K, Matthews L, Simpson SA, *et al*. A new framework for developing and evaluating complex interventions: update of medical research council guidance. *BMJ* 2021;374:n2061.
24 Tate RL, Perdices M, Rosenkoetter U, *et al*. Revision of a method quality rating scale for single-case experimental designs and N-of-1 trials: the 15-item risk of bias in N-of-1 trials (RoBiNT) scale. *Neuropsychol Rehabil* 2013;23:619–38.
25 Norwegian Association for Stroke Survivors. Main board 2021. Available: https://slagrammede.org/hovedstyret/ [Accessed 21 Aug 2021].
26 Huitt W. The information processing approach to cognition. *Educational Psychology Interactive* 2003;3:53.
27 Kleim JA, Jones TA. Principles of experience-dependent neural plasticity: implications for rehabilitation after brain damage. *J Speech Lang Hear Res* 2008;51:S225–39.
28 Petersen L. Treating and preventing social-behavioural problems in school. *Pastoral Care in Education* 1995;13:17–22.
29 Tailby R, Haslam C. An investigation of Errorless learning in memory-impaired patients: improving the technique and clarifying theory. *Neuropsychologia* 2003;41:1230–40.
30 Mathiowetz V, Haugen JB. Motor behavior research: implications for therapeutic approaches to central nervous system dysfunction. *Am J Occup Ther* 1994;48:733–45.
31 Chapparo C, Ranka J. *The PRPP intervention course manual*. 2018.
32 Ranka J. Description of the PRPP intervention. Occupational performance model (Asutralia). 2014. Available: www.occupati onalperformance.com/interventions/cognitive-strategies/prpp-intervention/
33 Ranka J, Chapparo C. *The PRPP assessment course manual*. 2015.
34 Chapparo C. Section 2: stage one analysis. In: *The PRPP assessment course manual*. 2023.
35 Kiresuk TJ, Smith A, Cardillo JE. *Goal attainment scaling: applications, theory, and measurement*. New York: Psychology Press, 1994.
36 Collin C, Wade DT, Davies S, *et al*. The Barthel ADL index: a reliability study. *Int Disabil Stud* 1988;10:61–3.
37 Mahoney FI, Barthel DW. Functional evaluation: the Barthel index: a simple index of independence useful in scoring improvement in the rehabilitation of the chronically ill. *Md State Med J* 1965;14:61–5.
38 Lane JD, Gast DL. Visual analysis in single case experimental design studies: brief review and guidelines. *Neuropsychol Rehabil* 2014;24:445–63.
39 Cicerone KD, Goldin Y, Ganci K, *et al*. Evidence-based cognitive rehabilitation: systematic review of the literature from 2009 through 2014. *Arch Phys Med Rehabil* 2019;100:1515–33.
40 Kratochwill TR, Hitchcock J, Horner R. Single-case designs technical documentation.What works clearinghouse Website. 2010. Available: https://ies.ed.gov/ncee/search/?q=kratochwill [Accessed 22 Dec 2022].
41 Ledford JR, Gast DL. Measuring procedural fidelity in behavioural research. *Neuropsychol Rehabil* 2014;24:332–48.
42 Kratochwill TR, Hitchcock JH, Horner RH, *et al*. Single-case intervention research design standards. *Remedial and Special Education* 2013;34:26–38.
43 Chapparo C, Ranka J. *The Perceive, Recall, Plan and Perform System assessment course manual*. 2014.