The Effect of Cognitive Strategy Intervention on the Occupational Performance of Individuals with an Upper Limb Amputation Using a Prosthesis.

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BAppSc (OT)

A thesis submitted in fulfilment of the requirements for the degree of

Masters of Philosophy (Health)

Faculty of Science

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Charles Sturt University

Albury, Australia

August 2017

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Certificate of Authorship

Certificate of Authorship

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Acknowledgments

This work could not have been completed without the support and assistance of many, and I would like to acknowledge and thank the following people.

Dr Melissa Nott, my principal supervisor, and Dr Judy Ranka, my co-supervisor, for their supervision, support and wisdom in this research. They both provided me with countless hours of support and guidance in clinical and research matters for this thesis.

To the two participants of the study who gave up their time to be part of this study and were willing to discuss the impact the training had on them.

To Sarah Chesterman for conducting the intervention sessions with the participants and taking time out of her busy caseload to do so.

To Carolyn Fozzard, my manager, who provided me with the time and opportunity to pursue this research at Westmead Hospital.

To my amazing and loving wife, Carmen, and our three gorgeous children – Isaac, Lavinia and Simeon – who have supported me and helped me to persevere with this research study. Their patience and support has meant so much.

And, finally, to My Lord and Saviour, Jesus, for everything.

Professional Editorial Assistance

I would like to thank editor Brenton Thomas, from Fresh Eyes Australia, who provided editing assistance in accordance with the requirements of the university-endorsed *Guidelines for Editing of Research Theses,* which form part of the Australian Standards for Editing Practices.

Published Journal Paper

Sproats, M., Ranka, J., & Nott, M. (2013). Addressing cognitive load in upper limb prosthetic training using the perceive, recall, plan & perform (PRPP) intervention: A critical case study. *Australian Occupational Therapy Journal, 60*(Supp 1), 89.

Abstract

Occupational therapy is the primary profession that provides individuals who have an amputation of the upper limb with training in how to use a prosthesis in everyday activities. Rejection rates for prosthetics is high and cognitive load has been identified as a factor in this rejection. This thesis outlines a study investigating how cognitive load affects the occupational performance of individuals with an amputation of the upper limb.

Traditional intervention programs for prosthetic use have focused on rote learning and prosthetic control, and have not included cognitive strategy training. This research is an in-depth case study of two adult men with transhumeral amputations who use a prosthesis. A client-centred, goal-directed intervention approach was implemented based on the Perceive, Recall, Plan and Perform (PRPP) System of Task Analysis: Assessment and Intervention. Changes in occupational performance were measured using ecologically based assessments of functional performance. Occupational performance was measured through task mastery, cognitive strategy use and motor performance using the PRPP System of Task Analysis: Assessment and Intervention and the Upper Limb Performance Assessment (ULPA). Client-centred goals were evaluated using the Goal Attainment Scale and the psychological measures of the Depression, Anxiety and Stress Scale (DASS) and the General Self-efficacy Scale were also used.

The PRPP Intervention provides a framework for intervention that addresses cognitive load and encourages generalisation. The results from the research study indicate that the PRPP Intervention improved task mastery and cognitive strategy use, which resulted in increased prosthetic use for both participants. All areas of the participants' cognitive strategy had improved, but strategies in the Perform quadrant and the strategy of Flow were most critical. Client-centred goals were achieved and changes in the DASS and General Self-Efficacy were also noted.

The research findings of this study indicate that the PRPP Assessment and the ULPA are suitable assessments in determining the components of performance that impact on effective prosthetic use and for evaluating change following intervention.

Definition of Terms

Terms used throughout this study have been defined below. The terms appear in alphabetical order.

Cognitive Load: The information flow that needs to be handled by the amputee to use the prosthetic functions (Soede, 1982). Also referred to as mental load.

Cognitive Strategy Use: The information processing strategies that underpin occupational performance (Nott & Chapparo, 2012).

Information Processing: A self-organised cycle of collecting, processing and using information (Chapparo & Ranka, 2011).

Occupational Performance: The ability to perceive, recall, plan and perform needed and/or desired occupational roles, routines, tasks and sub-tasks for the purpose of self-maintenance, play/leisure, school/productivity, and/or rest in response to internal or external demands to the satisfaction of self and/or significant role partner (Ranka, 2005).

Performance Components

Biomechanical: The operation and interaction of and between physical structures of the body during task performance. This can include range of motion, muscle strength, grasp, muscular and cardiovascular endurance, circulation, elimination of body (Ranka & Chapparo, 1997).

Sensory-Motor: The operation and interaction of and between sensory input and motor responses of the body during task performance. This can include regulation of muscle tone during activity, generation of appropriate motor responses, coordination, and registration of sensory stimuli including pain (Ranka & Chapparo, 1997).

Cognition: Operation and interaction of, and between, mental processes used during task performance. This can include thinking, perceiving, recognising, remembering, judging, learning, knowing, attend and problem solving (Ranka & Chapparo, 1997).

Interpersonal: The continuing and changing interaction between a person and other during task performance that contributes to the development of the individual as a participant in society. This can include interaction among individuals in relationships such as marriages, families, communities and organisations both formal and informal (Ranka & Chapparo, 1997).

Intrapersonal: The operation and interaction of and between internal psychological processes used during task performance. This can include emotions, self-esteem, mood, affect, rationality and defence mechanisms (Ranka & Chapparo, 1997).

Prosthesis: An artificial body part, such as a limb. A prosthesis for the upper limb may be body powered, externally powered or a hybrid of the two.

Prosthetic Rejection: The decision to not use a prosthesis; may refer to complete non-use, or sparse use of the prosthesis.

Upper Limb Amputation: The loss of all or part of the arm and hand that may be the result of an accident or illness, or has resulted from a congenital cause (Spencer, 2003). Also referred to as upper extremity amputation.

Chapter 1
Introduction

1.1 Overview

This research was carried out to evaluate the impact of cognitive strategy intervention on the use of a prosthesis during everyday occupations by adults with an upper limb amputation. It emerged from the researcher's experience working with the adults who had an amputation and his frustration at the lack of clinical evidence or guidelines for structured prosthetic training programs that met the totality of the occupational performance needs of individuals seen.

People with upper limb amputations were noted to have difficulty using their limb to complete tasks, even if they were able to demonstrate competent control of the prosthesis. This was also reported by Datta and Ibbotson (1991). It was determined through the review of the literature that cognitive load may be a factor in prosthetic use (Bouwsema, van der Sluis, & Bongers, 2008; Soede, 1982; Spencer, 2003; Weeks, Wallace, & Anderson, 2003). A need was identified for research that would identify if cognitive load was an issue in prosthetic use and to provide a structured intervention program that targeted cognitive load and occupational performance. Unique to this research was the use of occupational performance-based outcome measures and a structured intervention program that targeted cognitive strategy use rather than repetitive motor-based training.

This introductory chapter describes the background and the need for the study, the significance of the problem, the research questions posed, the research design selected to answer these questions, and a description of the research scope. The chapter concludes with an overview of the structure of the thesis.

1.2 Background and Need for the Study

Amputation of the upper limb causes a significant impact on an individual, particularly in the physical, psychological and occupational performance domains (Schabowsky, Dromerick, Holley, Monroe, & Lum, 2008; Spencer, 2003). Occupational therapists play a major role in the rehabilitation of people with an upper limb amputation (Spencer, 2003). The rehabilitation provided can vary between individuals, but a core role of the occupational therapist is to provide training on the use of a prosthetic limb

(Smurr, Gulick, Yancosek, & Ganz, 2008). A prosthetic limb enables individuals with an amputation to engage in meaningful activities that may be too difficult to complete with their other limb (Spencer, 2003), and it provides the ability for those with an amputation to prevent injury to their intact limb (Jones & Davidson, 1999).

Despite the advantages of using an artificial limb, many individuals with an upper limb amputation choose to reject the use of a prosthesis. Davidson (2002) found in an Australian sample of 70 adults with an amputation of the upper limb, 56 per cent reported using their prosthesis “rarely” or “never”. Although prosthetic fit and design have been explored in relation to rejection factors (Biddiss, 2010; Biddiss, Beaton, & Chau, 2007; Biddiss & Chau, 2007a, 2007b; Davidson, 2002), there has been little exploration into how prosthetic training is provided.

Ostlie et al. (2012) state that in their study of 224 individuals with an amputation who were surveyed, only 104 respondents reported to have received adequate prosthetic training to meet their needs. Smurr et al. (2008) outline a protocol for providing training to individuals with an amputation of the upper limb that focuses on prosthetic use and describe characteristics of a successful training protocol. Although this protocol does provide some guidance, questions have arisen as to the adequacy of these protocols to address all areas of occupational performance given the high prosthetic rejection rates.

To the researcher’s knowledge, there is currently no research study that has explored a structured intervention program that considers cognition and occupational performance in the population of adults with an amputation of the upper limb. One program that does exist in other areas of occupational therapy is the Perceive, Recall, Plan & Perform (PRPP) System of Task Analysis: Assessment and Intervention. This system provides therapists with an appropriate assessment, intervention and evaluation tool to provide occupation-based training and was deemed appropriate to use with upper limb prosthetic users based on preliminary investigations (Sproats, Ranka, & Nott, 2013).

There is currently no literature that describes or evaluates a client-centred, occupation-focused intervention program that considers cognitive load as a factor when training adults with an amputation of the upper limb to use a prosthesis.

1.3 Significance of the Problem

The study may provide occupational therapists with an understanding of how cognitive load impacts on prosthetic use during occupational performance. The research describes and evaluates a novel application of an intervention that may provide a framework for developing intervention programs that address cognitive load, which will, in turn, lead to improved outcomes and improved prosthetic use.

The study may provide a basis for justifying increased occupational therapy input with adults who are learning to use a prosthesis. It will influence how training is provided when a prosthetic limb is being used.

1.4 Research Questions

The following four research questions were posed for this research study:

- What factors are associated with prosthesis rejection, and how do these influence the occupational role engagement of people with an upper limb amputation?
- What occupational performance and capacity component issues do adults with an upper limb amputation demonstrate when engaging in meaningful tasks with a prosthesis?
- What impact does the Perceive, Recall, Plan and Perform (PRPP) Intervention have on role engagement and occupational performance of adults with an upper limb amputation?
- What impact does the PRPP Intervention have on the individual component capacities of adults with an upper limb amputation when engaging in meaningful tasks with a prosthesis?

1.5 Scope of the Research

This study was a small pilot study designed to investigate the impact of a specific intervention on occupational performance. The study used assessments and an intervention that had not previously been investigated with the individuals with an amputation of the upper limb. This study was designed to replicate normal clinical practice and provided outpatient interventions of short durations over a short period of time. Clients were recruited from an existing amputee clinic and were seen in the usual outpatient clinic environment. The number of individuals with an amputation of the upper limb is generally small, and due to rejection rates, the number who use a prosthesis is even smaller. The study was designed mindful of this consideration, and was further modified due to the small recruitment numbers.

1.6 Design of the Research

This research adopted a mixed-methods, in-depth case study approach to explore the effectiveness of an occupational therapy intervention approach with adults who use an upper limb (UL) prosthesis. This research was originally designed as a pre/post cohort study with a proposed sample of 10. However, the recruitment of participants who met the inclusion criteria during the study period proved more difficult than anticipated.

Two (n = 2) participants were recruited. Complete prosthetic rejection is such a significant factor in this clinical population that many prospective participants did not meet the criteria to be included in this study. As a result, the study design was altered to one that was more appropriate for use with a smaller sample size.

1.7 Thesis Outline and Structure

This study follows the traditional format of a thesis. Chapter 2 provides details of the literature review that was undertaken and summarises the relevant research studies that provided a context for the subject of this research project. Chapter 3 outlines the research design and methods adopted for this study. In Chapter 4, the results chapter, the study findings are presented for each participant. In Chapter 5, the study findings and their implications for clinical practice, research and education are discussed.

Chapter 2
Literature Review

In this chapter, the relevant literature is explored to provide the context for the research and the selection of outcome measures. Key concepts and literature are also explored as well as the theoretical foundation of the study.

2.1 Upper Limbs

The upper limbs consist of multi-segmented, interconnected systems with highly specialised organs – the hands – located at the ends (M. Keenan, 2008). They comprise everything from the fingers up to and including the scapula-shoulder complex. The arms and hands enable one to use tools, stabilise and transport objects, and communicate through touch and gestures (Ranka & Chapparo, 2011b).

When there is a loss to all or part of one or both upper limbs, the capacity of a person to carry out day-to-day tasks and fulfil expectations of everyday roles is compromised to a greater or lesser degree. Although the terms "upper limb" and "upper extremity" are used interchangeably in the literature, for this study the term "upper limb" is used.

2.2 Upper Limb Amputation

The loss of all or part of the arm and hand may be the result of an accident, or an illness, or from a congenital cause. Upper limb amputation is a distinct diagnosis. It refers to the loss of any part of the arm from the wrist and above, including congenital limb deficiency. For the purpose of this study, congenital amputations will not be considered. Amputations are classified according to the part of the arm where the amputation has occurred as well as the length of the residual limb. They include wrist disarticulation, where the amputation has occurred at the level of the wrist; transradial amputation, where the amputation has occurred between the wrist and the elbow; elbow disarticulation, where the amputation has occurred at the level of the elbow; transhumeral amputation, where the amputation has occurred between the elbow and the shoulder; shoulder disarticulation, where the amputation has occurred at the level of the shoulder, leaving the top of the shoulder intact; and forequarter amputation, where the amputation has occurred through the shoulder, which means the top part of the shoulder has been removed as well as the limb. Figure 1 provides a diagrammatic representation of these types of amputation.

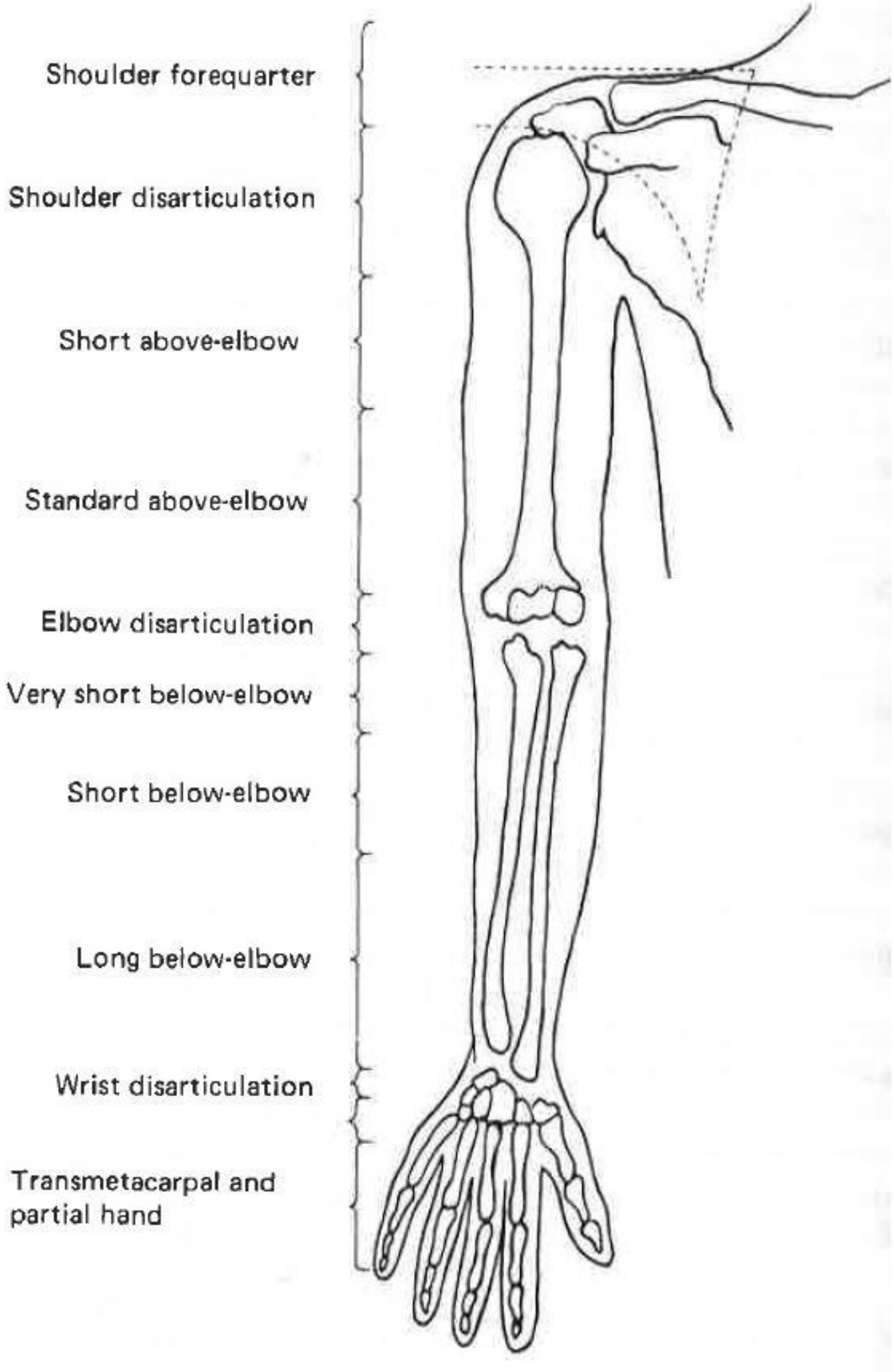

Figure 1. Amputation level. Reprinted from “Upper extremity musculoskeletal impairments,” by E. Spencer (2003, p. 799) in E. Crepeau, E. Cohn & B. Boyt Schell (Eds.), Willard and Spackman’s occupational therapy (10th ed.). Philadelphia, PA: Lippincott Williams & Wilkins. Copyright 2003 by Lippincott Williams & Wilkins.

The typical cause of upper limb amputation is reported to be trauma. Smurr, Gulick, Yancosek, and Ganz (2008) state that in the United States over 90 per cent of amputations are the result of trauma. Traumatic injuries include direct severance of a part of the upper limb, or amputation carried out secondary to crush injuries, avulsions or other forms of trauma, where medical complications or a decreased vascular supply compromise the viability of the injured part. The majority of traumatic amputations are the result of motor vehicle or industrial accidents (Jones & Davidson, 1995).

In Australia, it is difficult to estimate the number of individuals with an amputation of the upper limb. Australian census data collected in 2011 only identified the number of individuals who had an amputation (Australian Burea of Statistics, 2017). The data collected grouped both upper and lower limb amputations together. The definition of amputation in the census also included amputation of single digits (fingers or toes). No further data was collected to determine how many of these individuals could be defined as having an amputation of the upper limb at, or above, the level of a wrist disarticulation.

Regardless of the cause, the consequences of having an amputation is catastrophic for both the individual and his or her family (Davidson, 2004). An amputation "causes a deficit in both the musculoskeletal and neural systems, making previously effortless tasks more difficult" (Schabowsky, Dromerick, Holley, Monroe, and Lum (2008, pp. 589–590). Loss of all or part of an upper limb potentially impacts on all areas of daily living, especially in undertaking those tasks that require the use of both limbs to complete. For example, the simple task of cutting a tomato to make a sandwich becomes difficult as there is no way to stabilise the tomato to cut it. Pouring a glass of water can also be difficult as the other hand is not able to stabilise the cup to stop the water from spilling.

The primary method used to overcome the functional limitations that result from an amputation, and thereby enable a person to return to a productive life, is the prescription of an artificial, or prosthetic, limb, with the appropriate training in its use also being provided (Smurr et al., 2008). Occupational therapists play an important role in upper limb prosthetic training.

2.3 Occupational Therapy

Occupational therapy is the therapeutic use of occupations to assist individuals with injury or illness to improve their skills and functional performance. Occupational therapists believe that "appropriate engagement in relevant occupations has the potential to structure, shape and transform the lives of individuals, groups and communities" (O'Toole, DeCicco, Hong, & Dennis, 2011, p. 4). Everyday tasks, such as cooking and eating, are used in therapy intervention sessions to provide both a therapeutic effect, with the goal of increasing an individual's capacity to perform those tasks as well as providing practice of skills that other tasks may utilise.

Occupational therapy services are integral to enabling clients with an upper extremity amputation to return to daily activities (Spencer, 2003). Occupational therapists are involved in all aspects of the rehabilitation of clients with an upper limb amputation, including stump management, pre-prosthetic training, prosthetic training and reintegration into productive roles (Smurr et al., 2008; Spencer, 2003).

Occupational therapy intervention aims to enhance a client's occupational performance; that is, the performance of everyday tasks and routines in real-world contexts to a level that is effective and satisfying (Chapparo & Ranka, 2011).

2.3.1 Conceptual framework: Occupational performance. The conceptual framework for this study is the Occupational Performance Model (Australia) [OPM(A)]. Ranka and Chapparo (2011a) developed this model (see Figure 2) to provide a theoretical framework for determining the factors that will impact on an individual's ability to participate in the activities of their daily life.

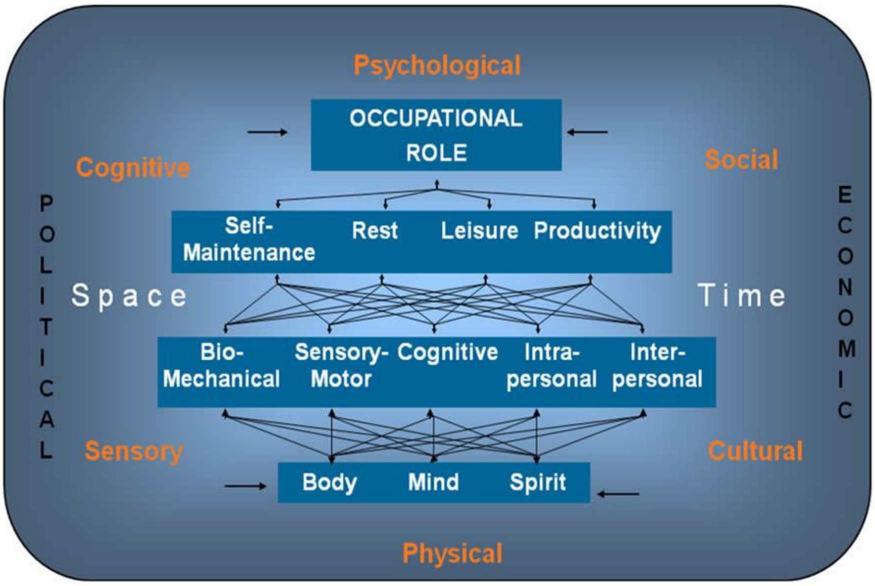

Figure 2. OPM(A) illustration. Adapted from "Draft Illustration of the 2011 Illustration of the Occupational Performance Model (Australia)" by J. Ranka and C. Chapparo, 2011. Copyright 2014 by Occupational Performance Model (Australia).

Occupation performance is defined as "the ability to perceive, recall, plan and perform needed and/or desired occupational roles, routines, tasks and sub-tasks for the purpose of self-maintenance, play/leisure, school/productivity, and/or rest in response to internal or external demands to the satisfaction of self and/or significant role partner" (Ranka, 2005, p. 3).

Roles are the large groups of routines and tasks that go together to form what an individual needs to do to achieve satisfaction in life. The role of a "mother" may include a large range of tasks, such as cooking, cleaning, driving, playing and providing emotional support. Also included in these roles are activities that are required to maintain oneself, such as showering/washing, dressing, eating and sleeping. These different areas can be classified using the OPM(A) as occupational performance areas.

Occupational performance areas are classified in the model as Self-Maintenance, Rest, Leisure and Productivity. The ability to participate in these occupational performance areas requires the use of component skills. These components of occupational performance are classified as Biomechanical, Sensory-Motor, Cognitive, Intrapersonal (psychological, emotional) and Inter-personal (social) components. The ability of someone to engage in their occupational roles relies on having the appropriate capacity to use these components during task performance. Occupational therapists, therefore, first seek to understand the occupational roles of an individual, the occupational performance areas that are required to complete that role and then the component capacities required to perform the tasks and routines in relevant and real-world contexts where performance typically occurs.

The OPM(A) can be used to understand the impact of an amputation of an upper limb on the ability of a person to engage in occupations, as component capacities are affected by the injury and therefore the ability to engage in relevant occupations. For example, a mother with the loss of an upper limb may find it difficult to dress independently, stump pain may be affecting her ability to sleep, she may not have the time to engage in the fun activities that she would normally do with her children, and she may no longer be able to cook for her family. These factors impact on her ability to identify as a mother and find meaning and satisfaction in her role. Intervention, therefore, requires an approach that considers the complexity of occupational performance.

Intervention is targeted at developing the component capacities of the individual so that they can engage and achieve satisfaction in their occupational performance areas and occupational role. To develop the component capacities, occupational therapists use the areas of occupational performance to identify specific tasks that are required to be completed. Occupational therapist use occupations not only as the goal of therapy but also as the means to providing that therapy (Gray, 1998).

2.4 Prosthetic Training Programs

Traditionally occupational therapists do not prescribe or fabricate prostheses, however occupational therapy services for clients with an upper limb amputation are extensive and involve building capacity, modifying tasks, adapting equipment and altering the context, as well as supervising the practice of task performance in simulated and real-world contexts (Celikyol, 1995; D. Keenan, 2011; Mosby, 2012; Rock & Atkins, 1996; Spencer, 2003).

There are three major components to most programs (Smurr et al., 2008; Spencer, 2003). These are (1) pre-prosthetic training, which includes upper limb and trunk strengthening and management of the residual limb; (2) one-handed training, with an emphasis on enabling performance of activities of daily living; and (3) prosthetic training, which includes both instruction in the operation and control of the prosthesis, and training in how to use the prosthesis to perform activities of daily living (Smurr et al., 2008; Spencer, 2003).

2.4.1 Biomechanical and sensory-motor capacity building and use. Prosthetic-training programs focus on developing the biomechanical and sensory-motor strategies needed to control the terminal device (Biddiss, 2010; Smurr et al., 2008; Spencer, 2003). Spencer (2003) emphasises the need to build the biomechanical skill of individuals with an amputation through initially the pre-prosthetic stage of strengthening and then through the focus on using a prosthesis for grasping activities.

Smurr et al. (2008) explore the need to complete training focused on the control of a prosthesis prior to conducting ADL training. In both of these instances, there is very little detail on how to provide this training. Smurr et al. (2008) indicate that prosthetic control begins by teaching each of the individual components of the prosthesis to the user. This is followed by training in the manipulation of objects of various shapes, textures, density and weight to practise control of the device. The rote learning of these skills needs to be balanced with the use of the prosthesis in daily activity.

Datta and Ibbotson (1991) reported that after 55 of their patients with an upper limb amputation, including individuals with a congenital deficiency, completed a questionnaire, a majority of the patients, despite demonstrating proficient use of their prosthesis in a clinical environment, did not report such proficiency when in their home environment. In a further survey of 62 individuals with an amputation of the upper limb, Datta, Selvarajah, and Davey (2004) found that the majority of patients used their prosthesis for cosmetic purposes only, with just 15% using their prosthesis for work tasks. Of these participants, 63% reported to only have a cosmetic prosthesis, these participants also reported having a proximal level of amputation, which may impact upon wearing and control. These studies indicate that the ability to control a prosthesis does not translate into its use in a functional setting. Smurr et al. (2008) suggest using verbal, tactile and visual cues to enhance training in prosthetic control, and utilising a task list to provide structure for training sessions to increase the functional use of a prosthesis.

2.4.2 Cognitive capacity building and use. Soede (1982) emphasises that cognitive capacity should also be considered as a factor in the ability to use a prosthesis. He describes in his study a group of able-bodied individuals who were using a prosthetic simulator to practise reaching and grasping tasks whilst also completing a dual task of responding to an auditory stimulus. Soede (1982) found that as more components were added to the prosthesis, the ability to complete the secondary task and maintain performance reduced, which thereby indicated that cognitive load was a factor in prosthetic use.

"Mental load", a term used by Soede (1982), was defined as "the information flow that needs to be handled by the amputee to use the prosthesis functions" (p. 185). Chapparo and Ranka (2011) use information processing as the explanatory model of cognition in the Perceive, Recall, Plan & Perform System of Task Analysis: Assessment and Intervention. Information processing is defined as "a self-organised cycle of collecting, processing and using information" (Chapparo & Ranka, 2011, p. 148).

For the purpose of this research, the term "cognitive load" will be used. Spencer (2003) states that there is a cognitive challenge in functioning with or without a prosthetic limb as new patterns of motor control and changes to functional ability are adjusted to. Weeks, Wallace, and Anderson (2003) and Bouwsema, van der Sluis, and Bongers (2008) all explored block versus variable practice in their studies with able-bodied participants using a prosthetic simulator, with contextual interference underlying the premises of their work. Contextual interference refers to the idea that learning a task can be enhanced when randomisation of training is introduced (Weeks et al., 2003). The idea is that a slight increase in complexity causes more cognitive effort to be applied to completing the task, which enhances learning. Cognition is a factor in these studies; however, no prosthetic training programs appear to incorporate these dimensions in their protocol.

2.4.3 Intrapersonal and interpersonal capacity building and use. Interpersonal and intrapersonal capacities also impact on the ability of an individual to engage in the tasks that are needed to fulfil their occupational roles. Spencer (2003) reports that feelings of guilt, shame, depression, anger or impatience are often exhibited by adults with an amputation of the upper limb, which may impact on their capacity to find meaning in life and value in the contributions they make to their communities. These capacities of the individual, therefore, contribute to the overall ability of an individual to engage in occupations. Conversely, the inability to engage in occupations due to impairments has an impact on self-esteem, confidence and motivation (Ranka & Chapparo, 2011b). Depression, anxiety and stress are common psychological disorders experienced by adults with an amputation of the upper limb and are thought to impact on rehabilitation, sustained prosthesis use and quality of life (Desmond, 2007). Considering these factors when treating adults with an amputation of the upper limb is important because a large proportion of adults are in their current situation as a result of traumatic circumstances. Ligthelm and Wright (2014) indicate that individuals with an amputation of the upper limb often need ongoing support as issues related to the loss of a limb are rarely resolved immediately.

2.4.4 Functional skill training. Literature supporting methods of instruction in how to use the prosthesis to carry out everyday tasks and routines are few and are designed by individual therapists based on expert opinion and experience (Smurr et al., 2008). The literature is limited in the guidance it provides to therapists on how to assist clients in integrating their prosthesis into everyday life.

Celikyol (1995) and D. Keenan (2011) advise therapists to use problem-solving with the client to enable the generalisation of skills and abilities outside of the therapy context. Rock and Atkins (1996) direct therapists to use repetition of practice to assist clients to reach the greatest speed and skill. Weeks et al. (2003) and Bouwsema et al. (2008) all explored the idea of block versus variable practice to enhance prosthetic control in their studies, and although Bouwsema et al. (2008) report using functional-based movements in their work, neither study indicates that real-world activities that were meaningful to the participants were used.

Smurr et al. (2008) indicate that functional training with a prosthesis is difficult and that the time and difficulty of training will vary between individuals. Advanced prosthetic training, as described by Smurr et al. (2008), contains five core characteristics. First, training needs to be individualised for the client based on their vocational and avocational goals. Second, it involves the interaction of the prosthesis with a tool such as a hammer or cooking utensil. Third, the tasks should be multi-stepped and complex. Fourth, the choice to involve the prosthesis should be made by the participant, and, finally, the fifth characteristic is that the outcome of the training should be meaningful. For example, this training might include activities such as the building of a wooden structure, or the cooking of a meal for a family gathering.

The literature indicates that functional use of a prosthesis is important; however, no studies to date have provided a model for how to develop, design and implement a comprehensive program. Ostlie et al. (2012) state that in their study of 224 surveyed individuals with an amputation, only 104 respondents reported that they had received adequate prosthetic training to meet their needs. Chapparo, Ranka, and Nott (2017) also indicate that the multifaceted dimensions of context are critical elements in the successful participation in an intervention program, and that tasks selected for training need to be meaningful and relevant.

2.5 Prosthetic Use

Current research with adults with an amputation of the upper limb has focused on prosthetic skills and prosthetic use, which has been measured by the length of time that the prosthesis has been used. As the goal of occupational therapy is engagement in occupations, there is a gap in the knowledge base when considering the role of occupational therapy with adults with upper limb amputation. As a result, there has been little research into how to integrate the occupational performance needs of adults with the approach of prosthetic training.

Datta and Ibbotson (1991) indicate that the performance of a prosthesis in the clinical environment did not translate into functional use in the household. Rejection rates are high and client satisfaction with a prosthesis is generally low. Much research has been completed in this area in relation to prosthetic design and fit, but little into training methods (Biddiss, 2010; Biddiss, Beaton, & Chau, 2007; Biddiss & Chau, 2007a, 2007b; Davidson, 2002).

2.5.1 Prosthetic satisfaction. Davidson (2002) conducted a survey that reviewed prosthetic use in relation to patient satisfaction with the prosthesis and perceived functional ability. She found a moderate link between satisfaction with the prosthesis and its use, but no significant link between functional ability and the amount of prosthetic use as measured by time worn. This finding suggests that measuring prosthetic use in terms of length of time worn is not a true measure of successful prosthetic use, and that measures of occupational performance may provide more relevant information.

This notion has been reiterated by Biddiss (2010), who states that full-time prosthetic use should not be the only consideration in determining quality of life but that part-time or sporadic use should be regarded as successful. The main factors that have been reported in studies to influence prosthetic satisfaction are comfort, function and control (Biddiss & Chau, 2007a; McFarland, Winkler, Heinemann, Jones, & Esquenazi, 2010;

Ostlie et al., 2012); however, Ostlie et al. (2012) also found that training had an impact on how satisfied an individual was with the function of their prosthesis.

Pezzin, Dillingham, MacKenzie, Ephraim, and Rossbach (2004) found that comfort was the major consideration in satisfaction with a prosthesis, although their survey group consisted of both individuals with upper limb and lower limb amputations. The prosthesis rejection rate for their study was 5.5 per cent and prosthesis use was reported as being 71 hours per week for both groups. As only 10 per cent of those surveyed were reported to have an amputation of the upper limb, the influence of the lower limb amputee participants, who generally have higher prosthetic use patterns, would have had a significant bearing on the results.

2.5.2 Prosthetic rejection. Although the potential for improved functional outcomes using a prosthesis is high, many people do not accept its use. In an Australian study of 70 adults with an amputation of the upper limb who completed a questionnaire on prosthetic use, Davidson (2002) found that 56 per cent of participants reported using their prosthesis “rarely” or “never”.

Raichle et al. (2008) investigated factors influencing prosthetic use in a United States sample of 752 individuals with an amputation of the upper limb of which 295 were mailed a questionnaire, and 107 responded. These authors asked patients to measure prosthetic use in terms of days per month and hours per day. They found that upper limb prosthetic use was linked to the level of amputation. Respondents who had a transradial amputation reported higher prosthetic use in terms of days per month; however, participants with a transhumeral amputation reported more prosthetic use in terms of hours per day. This suggests that individuals with a higher-level amputation (transhumeral amputation) do not use their prosthesis regularly, but when they do, they wear it for a longer period than those with a transradial amputation. The study did not investigate why this occurred; however, anecdotally, clients with a transhumeral amputation will often wear a prosthesis for cosmetic reasons, and so may wear a prosthesis all day or for the length of a social event.

The evidence suggests a low level of functional use of a prosthesis for those with a transhumeral amputation, which is supported by Davidson (2002), who also found that prosthetic users with higher-level amputations not only used a prosthesis less frequently but also used the function of “grasping” on fewer occasions. This is not surprising when one considers that the prosthetic designs required for higher-level amputations are inherently more complex and therefore more difficult to use.

The reasons for prosthetic rejection and poor use are complex and few studies have examined these factors in detail. Most research reported has focused on surgical techniques, pain and prosthetic design (Schabowsky et al., 2008). In an early study, Soede (1982) proposes that a client's perception of the value of the prosthesis influenced their acceptance of it. His model contains three factors: perceived gain in function; perceived functionality (ease of operation); and perceived mental control load. This model provides a basis for reviewing how the capacity of a client to process information affects their acceptance, and therefore their use, of a prosthesis (Bouwsema et al., 2008; Weeks et al., 2003).

Spencer (2003) and Smurr et al. (2008) acknowledge that the artificial nature of a prosthesis may cause increased frustration as clients begin to use it to perform real-world tasks. There is little guidance available to therapists on how best to help clients overcome this difficulty and frustration. This is evident from the high prosthetic rejection rate (Davidson, 2002; Raichle et al., 2008). This rate of rejection has a significant impact on the cost of providing services to individuals with an amputation of the upper limb.

First, there is the significant cost and time involved in the fabrication of a prosthetic limb. In Australia, for public patients, the costs are usually covered by artificial limb services. In the state of New South Wales, this service is part of the EnableNSW program. EnableNSW, previously known as PADP (Personal Aids for Disabled People), is a government-funded program that provides people with a disability with equipment that will enable them to live functionally in the community. The artificial limb scheme provides prostheses at no cost to the client.

Second, there is the cost and time spent in therapy. The costs involved in this stage of rehabilitation are twofold. There is the cost of time spent training the client in how to operate the prosthesis and how to complete tasks that they would find useful. If the client then rejects the prosthesis, there is the cost of the additional training required to assist the client to complete those tasks in another way. In those cases of rejection, the therapy time is potentially doubled for training clients in prosthetic use and one-handed techniques.

2.6 Outcome Measurement in Prosthetic Use

Current literature on outcome measures to use with adults with an amputation of the upper limb focuses on prosthetic control or the length of time of wearing a prosthesis. Outcome measures that look at prosthetic use for functional-based tasks have a set list of tasks that needs to be completed. In the literature search conducted for this study, no evidence was found of outcomes that had been measured in terms of person-centred achievement in using a prosthesis.

In a systematic review on outcome measures for use with individuals with an amputation of the upper limb, Resnik, Borgia, Silver, and Cancio (2017) suggest that the Activities Measure for Upper Limb Amputees (AM–ULA) is a suitable functional assessment. The AM–ULA evaluates 18 household and self-care activities that are assessed using the criteria of task completion, speed, movement quality, skilfulness of prosthetic use, and independence (Resnik et al., 2013). The AM–ULA was developed for use with an innovative new prosthetic arm from DEKA. The tasks that are assessed are completed exclusively using the prosthetic limb, with the therapist providing instructions on how to complete the task. Scoring is calculated by determining the lowest score on any item and assigning that as the score for that section. Therefore, if a single task is unable to be completed, the ability of the client to complete other tasks are not taken into consideration.

Resnik et al. (2017) also suggest that the Box and Block Test (Mathiowetz, Volland, Kashman, & Weber, 1985) was a suitable measure of performance. It is a measure of manual dexterity, where blocks are moved from one side of a box, over a barrier to the other side of the box for 60 seconds (Resnik et al., 2017). Scoring is based on the number of blocks that have been moved in the 60-second period. It is unclear how effective this assessment is at determining the ability of the individual to perform activities of daily living.

2.6.1 **Client-centred, occupation-based assessment and intervention.** The assessments outlined so far have been focused on motor activity and prosthetic use under set conditions. Intervention programs detailed in the literature have focused on massed practice and the encouragement of problem-solving without having provided a structured approach to developing a program that addresses these issues. Cognitive load has been highlighted as an issue that affects prosthetic use, but it has not been addressed in the assessments or intervention

programs presented from the literature review.

2.6.1.1 *The Perceive, Recall, Plan & Perform (PRPP) System of Task Analysis: Assessment.*

The Perceive, Recall, Plan and Perform (PRPP) System of Task Analysis: Assessment and Intervention measures occupational performance through a two-staged, criterion-referenced approach. It is a client-centred assessment that can be used to assess any task performed in relevant contexts. Although the PRPP Assessment has not been used with adults with an amputation of the upper limb, it shows promise for use in this research.

The conceptual foundation of the PRPP System of Task Analysis: Assessment and Intervention is in information processing, which provides the basis for understanding how cognitive capacity is utilised during task performance. In information-processing theory, information is received via the senses (Perceive), after which it is stored within the memory (Recall). Information is then organised using strategies for problem-solving and decision-making (Plan), after which a response is generated (Perform) (Chapparo & Ranka, 2011). In the PRPP System of Task Analysis: Assessment and Intervention, these behaviours are called descriptors. The descriptors are divided into sub-categories of information-processing strategies that are then grouped into four quadrants based on information processing. The four quadrants are Perceive (sensory/perception), Recall (memory), Plan (planning and evaluating) and Perform (performance monitoring) (Nott, Chapparo, & Heard, 2009). The PRPP Stage Two: Cognitive Strategy Use conceptual model is detailed in Figure 3.

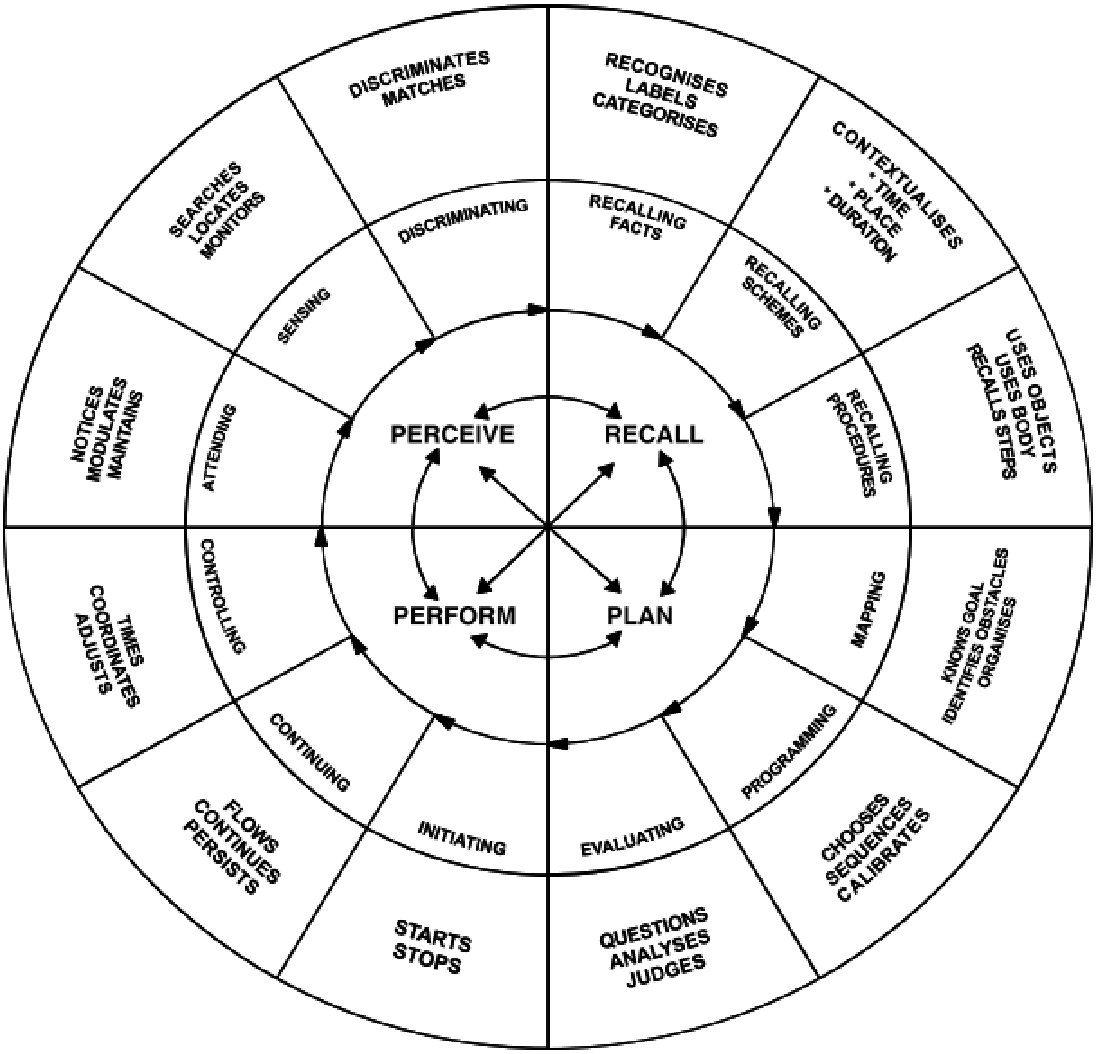

Figure 3. The PRPP System of Task Analysis Stage Two: Cognitive Strategy Use conceptual model. Reprinted from "The perceive, recall, plan & perform (PRPP) system of task analysis and intervention," by C. Chapparo, J. Ranka and M. Nott, (2017, p. 248) in M. Curtin, M. Egan & J. Adams (Eds), Occupational Therapy for people experiencing illness, injury or impairment (7th ed.). Edinburgh, Elsevier. Copyright 2017 by Elsevier.

The arrows in the centre of the circle represent the flow of information as tasks are completed. As tasks become more routine and habitual, reliance on the entire system is reduced. This enables cognitive resources to be allocated appropriately to new and novel tasks, whilst other more routine tasks can be done without conscious engagement.

As explored by Soede (1982), there is an increased requirement for conscious engagement when using a prosthesis, and this increased requirement may be a factor in prosthetic non-use and rejection. The PRPP Assessment has not been used with people living with the challenges posed by an amputation, but it does provide the opportunity to evaluate occupational performance outcomes. It provides an ecological assessment, where the evaluation of the performance of a relevant task and occupation is conducted and rated against the requirements of the task within its context, rather than limiting the evaluation of performance to a set standard of tasks and comparisons made with the performance of others (Chapparo & Ranka, 2011).

2.6.1.2 The Upper Limb Performance Assessment (ULPA). The ULPA is a client-centred, task-based, criterion-referenced assessment of upper limb contributions to task performance (Ranka & Chapparo, 2011b). Although it, too, has never been used with adults with an amputation of the upper limb, the ULPA is able to measure arm and hand use during occupational performance and the motor limitations that are affecting performance (Ranka & Chapparo, 2011b).

For adults with an amputation of the upper limb, the assessment provides an opportunity to review how the prosthesis is operated in the context of a task, and movements that are not directly related to the operation of the prosthesis can also be evaluated. The ULPA provides opportunities for therapists to determine how to provide intervention to target the specific movements that are difficult for the individual to perform, or provide modifications to tasks when the movements required are beyond the scope of an individual's abilities.

2.7 Addressing Cognitive Load in Prosthetic Training

Earlier sections of this literature review have described the components of upper limb prosthetic training programs. Although the cognitive load associated with prosthetic use has been identified as a potential factor in prosthetic rejection rates, no training programs appear to have been developed to provide guidance in how to address this issue.

The Perceive, Recall, Plan & Perform System of Task Analysis has both assessment and intervention components. It is a dynamic system. The assessment aspect identifies the degree of task performance mastery demonstrated and the cognitive strategies required for effective task performance. Dynamic assessments enable a therapist during a session to modify the performance of clients using their prosthesis and tailor interventions that specifically target the performance as it occurs (Carlson & Wiedl, 1992; Polatajko, Mansich, & Martini, 2000). The PRPP Intervention simultaneously targets task and cognitive strategy training during the performance of everyday tasks (Chapparo &

Ranka, 2007, 2011; Chapparo et al., 2017). The PRPP Intervention was deemed suitable for use in this research and literature and its effectiveness is presented in the next section.

2.7.1 The Perceive, Recall, Plan & Perform (PRPP) System of Task Analysis: Intervention.

The PRPP System of Task Analysis: Intervention has not been used in with adults with an amputation of the upper limb. It has been used in the traumatic brain injury (Nott & Chapparo, 2012) and aged populations (Steultjens, Voigt-Radloff, Leonhart, & Graff, 2012) to assess performance in the context of cognitive limitations.

The intervention focuses on a "Stop/Attend, Sense, Think, Do" sequence of information processing strategies. Clients are taught to apply these strategies to the task performance through structured and targeted prompts (Chapparo et al., 2017). The intervention occurs in the context of task-specific training. Hubbard, Parsons, Neilson, and Carey (2009) suggest that task-specific training should be used as it provides appropriate context and allows for feedback from the performance of the task. Smurr et al. (2008) also indicate in their overview of an intervention program for adults with an amputation of the upper limb that there are five important characteristics of an intervention program.

The PRPP Intervention provides opportunities to address all five characteristics. The first characteristic is that the intervention is individualised for each client as any particular difficulties with the application of cognitive strategies are targeted at an individual level. For the second characteristic, the training takes place in the context of everyday activities, and so the use of tools and interactions with different objects occur. The third characteristic is that the training includes multi-stepped tasks, which can be achieved through the completion of occupational tasks. The fourth characteristic is allowing the client to choose if and when to use the prosthesis, which is encouraged through the use of information processing and the "think" prompts. The final characteristic is that the outcome should have meaning to the client, which is achieved through targeting tasks that are relevant and important to the client.

In this way, the PRPP Intervention meets the needs of the population by targeting the tasks that are relevant and important to the individual, and then providing a systemic approach to developing the most appropriate prompting sequence.

2.8 Summary

This literature review has revealed the gaps in the current knowledge base in the assessment of occupational performance and the interventions provided to adults with an amputation of the upper limb. Rejection and non-use rates are high in this population. Few person-centred assessments exist that have the capacity to measure occupational performance outcomes. Two have been identified in this study: the PRPP Assessment and the ULPA. Cognitive load is seen as a need in prosthetic training programs but no such programs to date appear to have addressed this issue of cognitive load. The PRPP Intervention is an approach that focuses on cognitive strategies used during occupational performance.

In the next chapter, the methodology that was selected to address cognitive load in prosthetic training and evaluate occupational performance outcomes with adults with an amputation of the upper limb is discussed.

Chapter 3
Methods

3.1 Introduction and Purpose

The purpose of this chapter is to summarise the research design and methods adopted in this research, and the adaption of the study design to address the questions appropriately within the constraints of the clinical environment. Interview and standardised assessment techniques were integrated to draw upon the complementary strengths of each methodological approach (Ivankova, Creswell, & Stick, 2006; Morgan, 1998) in order to answer the following specific research questions:

What factors are associated with prosthesis rejection and how do these influence the occupational role engagement of people with an upper limb amputation?

What occupational performance and capacity component issues do adults with an upper limb amputation demonstrate when engaging in meaningful tasks with a prosthesis?

What impact does the Perceive, Recall, Plan and Perform (PRPP) Intervention have on role engagement and occupational performance of adults with an upper limb amputation?

What impact does the PRPP Intervention have on the individual component capacities of adults with an upper limb amputation when engaging in meaningful tasks with a prosthesis?

3.2 Ethics Approval Procedures

This study was approved by the relevant institutional Human Research and Ethics Committee (HREC/14/WMEAD/377) (see Appendix A) and (CSU/2015/268) (see Appendix B). All participants provided their consent to participate in this study, including for data collection and dissemination, and the video recording of all assessment and treatment sessions.

3.3 Research Design

This research adopted a mixed-methods, in-depth case study approach to explore the effectiveness of an occupational therapy intervention approach with adults who use an upper limb (UL) prosthesis. Individual participants were evaluated prior to occupational therapy intervention to gain information regarding their baseline level of performance with a prosthesis. Occupational therapy intervention was provided over a six-week period. The intervention provided was based on the Perceive, Recall, Plan and Perform (PRPP) System of Task Analysis: Assessment and Intervention. The aim of the intervention was to develop cognitive strategies for effective use of a prosthesis during everyday functional tasks. Post-intervention assessment measured the impact of this occupational therapy intervention on everyday performance. Follow-up assessment was conducted to determine if changes in occupational performance had been maintained after the intervention period had concluded.

A case study is an empirical inquiry that investigates a contemporary phenomenon within its real-life context (Yin, 2002). Case-study methodology is suitable to be used in a number of situations. It is particularly appropriate for situations where little is known about a new phenomenon; or when studying problems of professional practice significance; or in research, where a number of human factors are impacting the results (Salminen, Harra, & Lautamo, 2006). A case-study approach was used as it provides an opportunity to evaluate the therapy provided to this population in the context of the real-life goals of the individuals. In this population group there is very little information available about intervention methods, and given that the rejection rate of prosthetics is high, determining the individual factors for this population is important (Salminen et al., 2006).

3.4 Study Participants

Potential participants for the study were identified through the Rehabilitation Medicine Amputee Clinic at Westmead Hospital, Sydney, Australia. The client database (total number of client = 30) was reviewed after receiving ethics approval for the study. All clients on the database were screened against the following inclusion and exclusion criteria:

3.4.1 Inclusion criteria. Participants were included in the research based on the following criteria:

Upper limb amputee – defined as an amputation above or equal to a wrist disarticulation.

Age over 18 years old.

Occupational goals related to improving functional capacity to use a prosthesis in everyday tasks.

Previously (or currently) using a prosthesis with an active terminal device, for a period of at least six months, and finding limitations with its use.

3.4.2 Exclusion criteria. Participants who met the following exclusion criteria were excluded from the study:

Congenital limb loss.

Had never used a prosthesis.

3.5 Recruitment

Clients of the Rehabilitation Medicine Amputee Clinic database identified as likely to meet the above criteria were initially contacted via telephone informing them of the study and requesting permission to mail an information package to them. Clients were then sent a written information package that included a detailed description of the study procedure. Additionally, clients attending the Rehabilitation Medicine Amputee Clinic who met the criteria were invited to participant in the study. Clients attending the clinic in person were given an option to participate in the study and were informed that declining participation in the study would not affect their ability to access services available through the Rehabilitation Medicine Department at Westmead Hospital.

Fifteen potential participants were contacted through either their attendance at the clinic or via telephone and were invited to be part of the study. Figure 4 outlines the recruitment process.

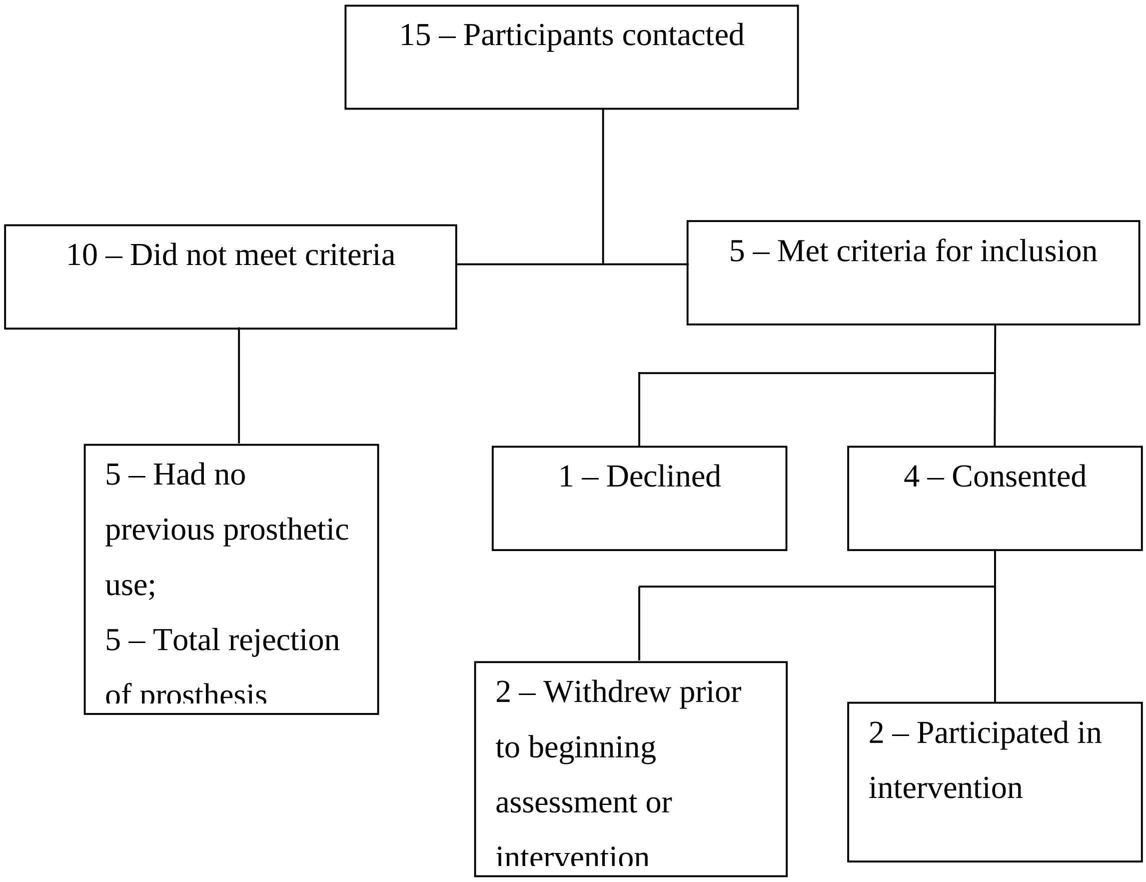

Figure 4. Flow chart of participant recruitment.

This research was originally designed as a pre-post cohort study with a proposed sample of 10. However, the recruitment of participants proved more difficult than anticipated. Two (n = 2) participants were recruited during the study period. Complete prosthetic rejection is such a significant factor in this clinical population that many potential participants did not meet the criteria to be a part of this study. As a result, the study design was altered to one that was more appropriate for use with a smaller sample size.

3.6 Instrumentation and Outcome Measures

In order to explore the impact of occupational therapy intervention on occupational role engagement, occupational performance, individual component capacities and prosthesis rejection, a wide range of data was collected (Table 1).

Table 1
Data Collection

Occupational Therapy Domain	Outcome Measure.
Occupational role engagement	Initial and post intervention interviews
	Goal Attainment Scale
Occupational performance	Perceive, Recall, Plan and Perform (PRPP) System of Task Analysis – Stage One
	Upper Limb Performance Assessment (ULPA) – Task Performance Mastery (TPM)
Individual component capacities	
• Cognitive Capacities	PRPP System of Task Analysis– Stage Two
• Biomechanical and sensor motor capacities	ULPA Comparative Analysis of Performance – Motor (CAP-M)
• Intrapersonal Capacities	Depression, Anxiety and Stress Scale (DASS).
	Generalised Self-efficacy Scale.
Prosthesis rejection	Initial and post intervention interviews.

A number of different instruments were used to gather data to address the research questions. Instruments were selected to ensure that all levels of occupational engagement, performance and component capacities were evaluated.

3.6.1 In-depth interviews. Interviews were conducted prior to commencing the intervention and also at the end of the intervention period. The factors influencing prosthetic use were explored through an interview based on the model proposed by Soede (1982) as well as the Occupational Performance Model Australia (Ranka & Chapparo, 1997).

Perceived cognitive load was also explored through the interviews conducted in this study. The interview process used a combination of closed and open questions to elicit the most meaningful information. This enabled the investigator to gain insight into reasons for prosthetic disuse and rejection and seek clarification from each individual. It also assisted in the development of goals and treatment plans that were to be individualised for each participant. The pre-interview questions are detailed in Appendix C and the post-interview questions are detailed in Appendix D.

3.6.2 Goal Attainment Scale. The Goal Attainment Scale (GAS) is an outcome measure instrument that has been suggested as appropriate to use with individuals with an amputation of the upper limb (Wright, 2006).

The GAS is used to measure the successfulness of interventions, based on the client's satisfactory attainment of each goal.

It enables the client to give a score on how well they believed their goal had been met based on their expectations and the current performance of that goal (Turner-Stokes, 2009; Turner-Stokes & Williams, 2010).

The GAS was used with participants in the study to set general goals that they would like to achieve. Once this had been done, the therapist then worked with the participant to determine how that task was currently being completed, how important that goal was, and how difficult the client thought it may have been to achieve.

The current performance level is set as the –1 goal attainment. The participant, in collaboration with the therapist, determines different levels of goal attainment starting at that baseline and working up from a 0 level goal attainment to a +2 goal attainment, which is expected to be well above expected outcomes. The participant also sets a level below the current level of performance at a –2 level. An example flowchart of the process is presented in Figure 5 (Bovend'Eerdt, Botell, & Wade, 2009).

The goals were developed to also meet the SMART criteria. SMART is methodology of goal setting that ensures that goals are specific, measurable, achievable, realistic/relevant and timed. For the purpose of this study, the time to achieve the goal was the intervention period of four weeks. The GAS assisted with determining the perceived success of the intervention on the participant's ability to perform the tasks that they had identified as being important. This was seen as an important aspect of the Goal Attainment Scale, where goals and achievement were set by the participant.

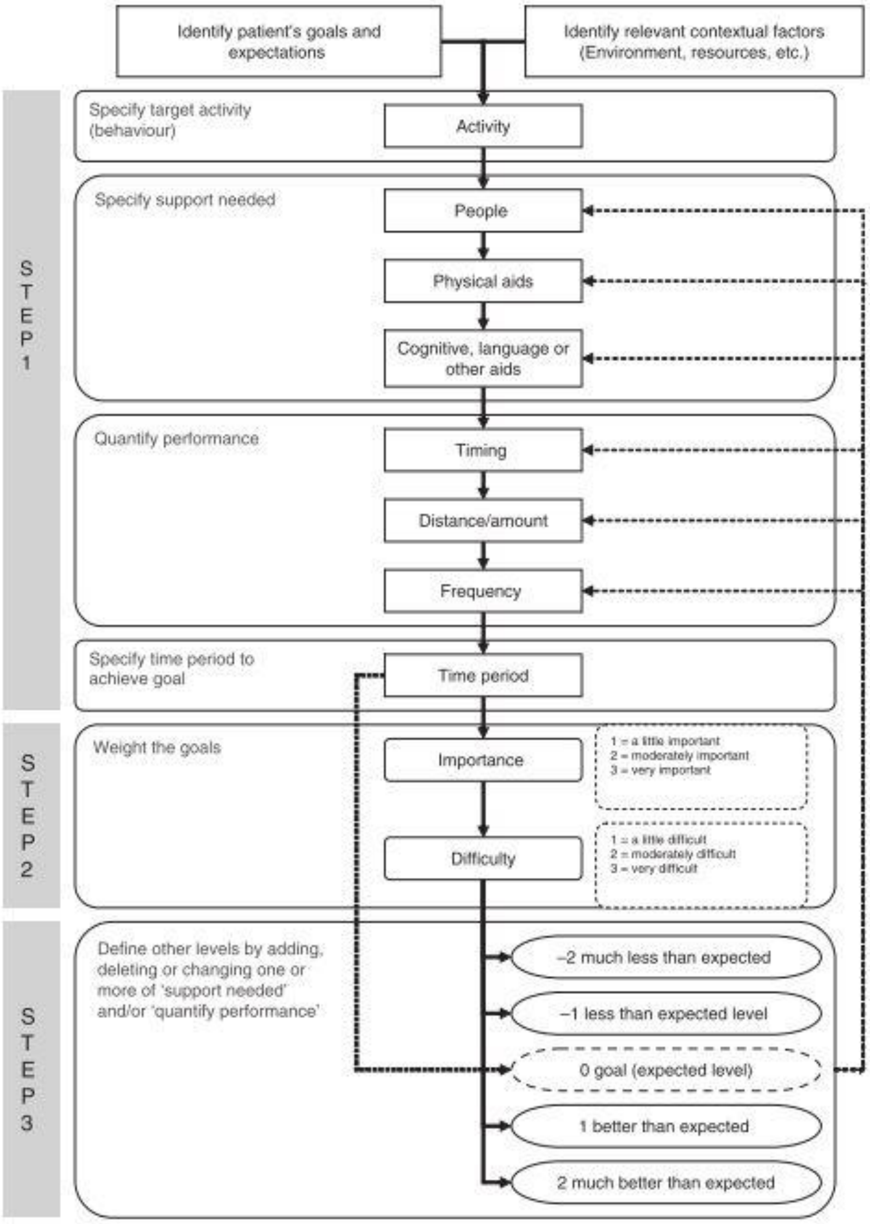

Figure 5. Goal-setting flowchart. .Reprinted from "Writing SMART rehabilitation goals and achieving goal attainment scaling: A practical guide," by T. J. Bovend'Eerdt, R. E. Botell, and D. T. Wade, 2009, *Clinical Rehabilitation, 23*(4), p. 355. Copyright by Sage Publications

3.6.3 Perceive, Recall, Plan & Perform Assessment. The PRPP System of Task Analysis: Assessment and Intervention was developed by Chapparo and Ranka (2007) as an integrated, dynamic system of assessment and intervention. The assessment component is used to determine the cognitive strategies that the participant is using during the completion of functional/occupational tasks. The assessment involves direct observation of the participant and is a dynamic assessment, informing intervention throughout the treatment period. PRPP Assessment Stage One: Performance Mastery analysis was used to determine the mastery of specific tasks identified as goals by each individual participant. The expected performance of a task is the criteria that the assessment is conducted against, and so participants in the study were expected to complete tasks to the expected mastery level to be successful. After the task had been broken down into these steps, errors that had been made by the participants were coded.

Errors that have been made during the PRPP Assessment Stage One: Performance Mastery are defined as errors of accuracy, omission, repetition or timing. Errors of *accuracy* occur when the step of a task is attempted but the performance of that step has not been completed appropriately. Errors of *omission* occur when a required step is not completed. Errors of *repetition* occur when a step in the task is completed again when it is not required. Errors of *timing* occur when a step is either done for too long a period, not long enough, or at the wrong time. Once all of the errors are recorded, an overall task mastery score is calculated, which is the total number of steps completed with no task errors out of the total number of possible steps (Chapparo & Ranka, 2007, 2011).

PRPP Assessment Stage Two: Cognitive Strategy Use analysis was used to determine the cognitive strategy errors performed by the participants. In this stage of the assessment, the therapist scores the performance of the participants against 34 cognitive strategies. These strategies are referred to as descriptors. The descriptors are detailed in the outer layer of the PRPP Assessment Stage Two model (see Figure 3 in Chapter 2) (Chapparo & Ranka, 2007). The descriptors are assessed during task performance in reference to requirements of the task, and hence this stage of the assessment is also criterion referenced. Each descriptor is assessed and scored on the following criteria: 3 = effective strategy for task performance; 2 = questionable use during task performance; and 1 = not effective for task performance (Chapparo & Ranka, 2007, 2011). Figure 6 is an example of a scoring sheet (Chapparo & Ranka, 2007).

THE PRPP SYSTEM SCORING SHEET

Client Name: GAVIN	Date:	Task: DRINKING FROM A CUP

3(--) = Performance of this descriptor meets criterion expectations; reasonable time, without assistance; without prompts

2(?) = Performance of this descriptor meets criterion expectations but indicates concern due to timing or prompts needed

1(X) = Performance of this descriptor does not meet criterion expectations; inhibits performance

STAGE ONE ANALYSIS: CRITERION %_______________.

STEPS	**ERRORS** Acc	Rep	Om	Ti
1. Roll to side				
2. Sit on edge of bed				
3.Locate cup				
4. Reach to cup				
5. Lift to mouth				
6. Drink from cup				
7. Give cup to OT				

PERCENTAGE SCORE:__________________________.

STAGE TWO ANALYSIS RATING

		1(X)	2(?)	3(--)
PERCEIVE	**ATTENDING**			
	Notices	1	2	3
	Modulates	1	2	3
	Maintains	1	2	3
	SENSING			
	Searches	1	2	3
	Locates	1	2	3
	Monitors	1	2	3
	DISCRIMINATING			
	Discriminates	1	2	3
	Matches	1	2	3
RECALL	**RECALLING FACTS**			
	Recognises	1	2	3
	Labels	1	2	3
	Categorises	1	2	3
	/ SCHEMES			
	Contextualises to time	1	2	3
	/ place	1	2	3
	/ duration	1	2	3
	/ PROCEDURES			
	Uses objects	1	2	3
	Uses body	1	2	3
	Recall steps	1	2	3
PLAN	**MAPPING**			
	Knows goal	1	2	3
	Identifies obstacles	1	2	3
	Organises	1	2	3
	PROGRAMMING			
	Chooses	1	2	3
	Sequences	1	2	3
	Calibrates	1	2	3
	EVALUATING			
	Questions	1	2	3
	Analyses	1	2	3
	Judges	1	2	3
PERFORM	**INITIATING**			
	Starts	1	2	3
	Stops	1	2	3
	CONTINUING			
	Flows	1	2	3
	Continues	1	2	3
	Persists	1	2	3
	CONTROLLING			
	Times	1	2	3
	Coordinates	1	2	3
	Adjusts	1	2	3

Figure 6. PRPP *A*ssessment score sheet example. Reprinted from "The PRPP System: Intervention," by C. Chapparo and J. Ranka, 2007. Copyright 2007 by the University of Sydney.

The psychometric properties of this assessment have been evaluated in several adult populations. Using correlation analysis and measures of agreement, the PRPP Assessment has been shown to have a moderate level of interrater reliability (for trained therapists) and high test/retest reliability (Nott, Chapparo, & Heard, 2009). Validity of the PRPP Stage Two: Cognitive Strategy Use has been evaluated using Rasch analysis.

This was explored through fitting test items, raters and patients into the Rasch model. Construct validity was supported through the generation of a cognitive strategy hierarchy that was support by the theoretical models of the information processing on which the PRPP System of Task Analysis: Assessment & Intervention is based (Nott & Chapparo, 2012).

3.6.4 Upper Limb Performance Assessment. The Upper Limb Performance Assessment (ULPA) is a criterion-based assessment that is used to assess the performance of an individual's upper limb during functional tasks. The assessment consists of two parts: Part One evaluates task performance mastery (TPM) and is used to analyse the arm and hand contributions to task performance. It is based on task analysis methodology that is similar to Stage One of the PRPP Assessment, with the exception that the steps consist of the reach, grasp and release steps of task performance. The error classification consists of similar types to those used on the PRPP Assessment with the exception of omission. In the ULPA, omission is named *unable*/*omission*, whereby a step is physically unable to be carried out or intentionally left out. The remaining errors are *accuracy*, whereby an arm and hand use step is attempted but performed incorrectly; errors of *repetition*, whereby a step is repeated unnecessarily; and errors of *timing*, whereby a step is done for too long or not long enough.

Part Two: Comparative Analysis of Performance – Motor (CAP–M) uses a comparative analysis method, whereby the positive and negative symptoms of the upper limb use that are affecting task performance are identified (Ranka & Chapparo, 2011). The CAP–M is completed by determining what the expected movements of the upper limb are for a step, multiple steps or the whole task if it is to be completed successfully. In this study, the actions needed for effective prosthetic use to accomplish identified tasks were listed as expected actions.

The person being assessed is then observed during task performance and the actual movements used are recorded. A comparison of the movements used and those expected for successful task performance produces a list of missing/desired movements, a list of excessive and unwanted movements, and a notation of timing errors. This assessment was used to determine how motor control of the prosthesis and body were affecting task performance.

An example of the ULPA is detailed in Figure 7.

TASK PERFORMANCE MASTERY (TPM)						COMPARATIVE ANALYSIS OF PERFORMANCE – MOTOR (CAP-M)				
STEPS	Om	Acc	Rep	Tim		STEP: Cut capsicum with a knife (post-intervention – Stuart)				
Orient body towards bench		X				Expected	Observed	Excessive	Missing	Timing
Reach towards tomato						*Shoulder:* Flexion, internal rotation. *Elbow:* Flexion *Wrist unit:* Rotation using right UL *Terminal Device (open):* Right and left should adduction and flexion *Terminal Device (close):* Return right shoulder to neutral *Neck:* Flexion *Torso:* Flexion	*Shoulder:* Flexion, internal rotation *Elbow:* Flexion *Wrist Unit:* Rotation into position using R UL *Terminal Device (open):* Right and left shoulder adduction and flexion *Terminal Device (Close):* Return right shoulder to neutral *Neck:* Flexion *Torso:* Flexion	*Neck:* Flexion *Torso:* Flexion		
Pre-position prosthesis wrist unit										
Open terminal device										
Close Terminal Device										
Stabilise capsicum										
Open terminal device to release capsicum										
Re-align										

Figure 7. ULPA assessment score sheet example.

3.6.5 Depression, Anxiety and Stress Scale. The Depression, Anxiety and Stress Scale (DASS) is a 21-item self-reporting instrument designed to measure the three related negative emotional states of depression, anxiety and tension/stress. It is designed to assess the severity of the core symptoms of each emotional state. The instrument is not designed as a diagnostic tool, but to assist clinicians to understand the dimensions of the emotional states of depression, anxiety and stress (Antony, Bieling, Cox, Enns, & Swinson, 1998). The DASS is a self-reporting measure, where a set of 21 questions is responded to with reference to the last week and how often the statement applied. It has a four-point scale from 0 – "did not apply" to 3 – "applied to me very much, or most of the time". A matrix is then used to assign each of the responses to depression, anxiety or stress. The score is then doubled for the DASS 21. It provides a specific score for each subsection. It has been demonstrated that it has good construct validity, indicating a consistent fit with general psychological stress as well as with the specific factors of depression, anxiety and stress considered independently of each other (Henry & Crawford, 2005). There is also normative data for the Australian population (Crawford, Cayley, Lovibond, Wilson, & Hartley, 2011).

3.6.6 General Self-efficacy Scale. The General Self-efficacy Scale was developed to measure perceived self-efficacy. This scale can be used to predict coping and adaption after stressful events. Its constructs also reflect optimistic self-belief, which is the belief that one can perform a novel or difficult task, or cope with adversity (Bosscher & Smit, 1998). There is evidence in chronic disease populations that this is an important factor in the ability to cope with chronic disease long term and adjust to everyday life (Bentsen, Wentzel-Larsen, Henriksen, Rokne, & Wahl, 2010; Bonsaksen, Lerdal, & Fagermoen, 2012). Factor analysis of the general self-efficacy scale demonstrates that it is a good fit for a higher-order model, indicating that the scale should be seen as a uni-dimensional broad construct, which is its intended purpose (Bosscher & Smit, 1998). This idea of self-belief may be an important factor in successful prosthetic use, and it is possible that successful prosthetic use may, in turn, affect perceived self-efficacy.

3.7 Data Collection – Procedures

After clients consented to participate in the study, an initial assessment was conducted at Westmead Hospital's Occupational Therapy Department. The assessment consisted of an interview, where demographic information, as well as information related to their current use of a prosthesis, was collected. This assessment session also included the setting of three occupation-focused goals. The Goal Attainment Scale was used in collaboration with the participant to set goals and categorise behavioural descriptions of under- and over-achievement of goals. The Depression, Anxiety and Stress Scale and the General Self-efficacy Scale were also administered in the session. The participant was then provided with an opportunity to complete a task related to the goals they had set. If further resources were required to appropriately complete this task (such as purchasing fresh-food items for a cooking task), the task performance component of the session was scheduled at another time. The task performance was videotaped to enable post-hoc analysis of the task performance to be undertaken and provide the treating therapist with an opportunity to review the participant's performance to formulate a treatment plan. The video footage was also analysed to measure the level of cognitive strategy application using the PRPP Assessment as well as biomechanical performance using the ULPA.

Following this initial assessment session/s, four subsequent intervention sessions were scheduled approximately one week apart. The intervention sessions were completed by an occupational therapist who has received training in the PRPP assessment (post-graduate 5-day workshop) and intervention (post-graduate 4-day workshop). These treatment sessions targeted retraining of two out of the three occupational tasks identified as participant goals. Each intervention session was also videotaped to provide the investigators with an opportunity to review the treatment administered and ensure its fidelity.

After these four sessions had been completed, a post-intervention assessment session was conducted. This session consisted of an evaluation of the two targeted GAS goal tasks: an interview, where changes in prosthetic use were captured; and an occupation-based assessment, where the PRPP Assessment and ULPA were completed on one of the tasks. The participant's current emotional state and self-efficacy were also measured using the DASS and General Self-efficacy Scale during this session.

At follow-up, occupation-based assessment was conducted on performance of tasks that previously had been videotaped. This assessment was used to determine if gains that had been made during the preceding therapy period could be maintained. An overview of the assessment procedure is detailed in Table 2.

Table 2
Assessment Procedure

Instrument	Initial assessment (week 0)	Intervention (week 1-3)	Post intervention assessment (week 4)	Three-month follow-up assessment
PRPP	X	X	X	X
Pre-interview	X			
Post-interview			X	
GAS	X		X	
ULPA	X	X	X	X
DASS	X		X	X
General self-efficacy scale	X		X	X

3.8 PRPP Intervention – Perceive, Recall, Plan & Perform (PRPP) System of Task Analysis: Assessment & Intervention

Intervention sessions were conducted in the occupational therapy outpatient clinic at Westmead Hospital. Participants were provided with four one-on-one treatment sessions, each of which was at least one hour's duration. These sessions focused on two of the goals formulated by the participants. Intervention was provided using the PRPP System of Task Analysis: Assessment & Intervention. The PRPP Intervention, developed by Chapparo and Ranka (2007), integrates cognitive strategy training with traditional neurocognitive intervention approaches such as systematic instruction, learning theory and information processing theory. As part of the PRPP Intervention, participants learn to apply a sequence of processing strategies that enable them to complete tasks. The strategies of “Stop, Attend/Sense, Think, Do” formed the basis of the therapist’s intervention. The PRPP Assessment Stage One: Performance Mastery is used to identify the cognitive strategies that have a negative impact on task performance. The therapist uses these cognitive strategies to formulate a prompting sequence that aligns with the “Stop/Attend, Sense, Think, Do” process. Cognitive strategies from the Perceive quadrant of Chapparo and Ranka’s conceptual model (see Figure 3 in Chapter 2) are targeted through “Sense/Attend” prompts. The “Think to Remember” prompts are used for cognitive strategies in the Recall quadrant. Cognitive strategies from the Plan quadrant are targeted through “Think to Work Out/Checkout” prompts. The Perform quadrant is targeted through “Do/Stop” prompts. The intervention is designed to facilitate multiple cognitive processes rather than target specific individual cognitive or information processing deficits.

The participants in the study learnt to apply these cognitive strategies to task performance by initially observing and modelling the therapist. The therapist’s role was to act as a cognitive mediator between the participants and the task. Over time, the therapist’s role was reduced as the participants internalised the strategies and applied them to all the tasks that they were required to do. This mediatory approach drew from research in occupational therapy with adults with acquired brain injury (Chapparo, Ranka, & Nott, 2017; Nott, Chapparo, & Heard, 2008).

The intervention also focused on “errorless” learning, and the participants were provided with prompts on a most-to-least hierarchy. Initially, the therapist may have started with a training arm to demonstrate the appropriate movements to the participants. A training arm is a prosthetic limb that has been constructed to enable a non-amputated individual to wear the limb and demonstrate the required movements of operation. As therapy continues, the amount of prompting is reduced until the individual can competently complete a required task independently.

Delivery of the intervention in the study was personalised to the cognitive strategy application behaviours most impacting on task performance as errors occurred. This is consistent with the dynamic quality of the PRPP System of Task Analysis.

3.9 Data Analysis – Procedures

All data was de-identified and analysed using Microsoft Excel. Demographic and injury-related information was extracted from the participant’s medical record or pre-intervention interview and entered into the Excel spreadsheet, including age, sex, education level, current work status and social living arrangements, level of amputation, time since injury, dominance, limb pain, phantom sensation and type of prosthesis.

Standardised GAS scores were calculated using the following equation from the method published by Turner-Stokes (2009):

$$T = 50 + \frac{10\sum(w_i x_i)}{\sqrt{\left((1-\rho)\sum w_i^2 + \rho\left(\sum w_i\right)2\right)}}$$

Where w_i = the weight assigned to the *i*th goal, x_i = the numerical value achieved (between +2 and -2), and ρ (rho) = the expected correlation of the goal scales (assumed to be 0.3).

Performance mastery scores (PRPP Assessment Stage One: Performance Mastery and ULPA: TPM) were calculated as a percentage of the task steps performed without error and were entered into the Excel spreadsheet. Differences from pre- to post-intervention were calculated for each participant. Individual error sub-types were summed for each participant on each task. Expected, Observed, Excessive and Missing actions were summed using the ULPA: CAP-M score sheets and summed scores were entered into the spreadsheet.

Individual PRPP sub-quadrant percentage scores were calculated based on each participant's scores on PRPP Assessment Stage Two: Cognitive Strategy Use. These were entered into the spreadsheet and plotted using the radar graph visual display, where the shaded area of the graph represents the total score on PRPP Assessment Stage Two: Cognitive Strategy Use.

3.10 Summary

This chapter has provided an overview of the methods implemented for this study. In the following chapter, the results of the intervention are discussed. The dynamic quality of the PRPP System of Task Analysis: Assessment and Intervention, whereby the specific intervention prompts used are selected based on the results of the PRPP Assessment – Stage Two Cognitive Strategy Use findings, meant that intervention was personalised for each participant. This is further elaborated on in the research findings that are presented in the next chapter.

Chapter 4
Results

In this chapter, the study findings will be presented for each of the participants, as well as in relation to each of the research questions. Qualitative and quantitative measures have been used to describe each participant's occupational performance prior to and following the PRPP Intervention.

4.1 Participant 01 – Stuart

At the time of the study "Stuart" (pseudonym) was a 71-year-old male who had sustained an amputation of his non-dominant left upper limb at a transradial level. The amputation had occurred 11 months prior to his participation in the study and was the result of an industrial accident involving a drop saw. It was reported that when his sleeve became caught in the machine, his hand was pulled towards the blade, which resulted in a surgical termination. Stuart had an intact stump and reported nil stump pain. He said that the phantom limb sensations occurred less than daily and did not have any impact on his daily life.

Stuart had been using his current, body-powered prosthesis with a 7LO terminal device in a quick-disconnect locking-wrist unit for the past nine months. He reported that he wore his prosthesis two to three days a week for around four hours each time.

Stuart lived with his wife and provided informal care to his grandchildren on a regular basis. His social situation had not changed since his injury and did not change during the study period. Stuart had previously worked as an electrician and had retired a number of years ago.

4.1.1 Prosthesis rejection and occupational role engagement.

Prior to engaging in PRPP Intervention, Stuart reported a moderate to significant impact of several prosthetic and personal factors that contributed to the minimal use of his prosthesis.

As detailed in Table 3, prosthetic factors such as weight and discomfort were significant contributors to prosthesis rejection, as were the personal factors of greater effort, concentration and difficulty of getting the prosthesis to function as desired. For this scale, 1 = no impact at all, 2 = little impact, 3 = moderate impact, 4 = significant impact, 5 = most significant impact.

Stuart reported that he generally tried to complete most of his everyday activities himself, that he was able to shower and dress himself independently, but required help with shoes and braces at times. His leisure activities involved predominantly passive pursuits such as reading, writing and watching movies. He reported that since his amputation he had not been able to engage in his preferred leisure activity of fishing. Stuart attended therapy with the explicit goal of gaining more confidence in completing cooking, handyman and gardening tasks.

Following PRPP Intervention, the impact of these same prosthetic and personal factors was self-reported by Stuart to have reduced to the level of “little impact” or “no impact at all”, with the exception of the impact of uncomfortable nature of the prosthesis and the concentration required to use the prosthesis (see Table 3, right-hand column). Concentration is still a factor that was rated, and therefore the role of cognitive load was still considered a factor by Stuart after the training period had been completed.

Table 3

Participant 1: Stuart – Pre- and Post-Prosthetic Rejection Factors

Rejection Factors	Pre	Post
Prosthetic factors		
The weight of the prosthesis is too heavy	4	2
The look or cosmetics of the prosthesis is not what I want	3	1
The prosthesis is uncomfortable or hot	5	3
The physical effort or force required to use the prosthesis	2	2
Difficulty getting the prosthesis on and off	2	1
Personal factors		
Difficulty using the prosthesis for what you want to do	4	1
The concentration required to use the prosthesis	4	3
The prosthesis is useful but not worth the effort	4	1
The prosthesis is not what I expected it to be	2	2
It is quicker or easier to complete tasks without the prosthesis	4	1

Occupational role engagement was evaluated using the GAS and was based on the goals identified by Stuart. The goals were set collaboratively between the researcher and Stuart (see Table 4). Each of these goals was rated as being either moderately important (2) or a little difficult (1). The baseline performance of Stuart was rated at –1, and he reported at the end of the treatment period that he had achieved better than expected (+1) for each of the goals. GAS-standardised scores were calculated, which indicated a GAS change of 26.7 points (baseline = 36.7; post-treatment = 63.3). The T score should be distributed around the value of 50 with a standard deviation of 10 indicating a higher than normal result (Krasny-Pacini, et al 2013). Cooking and carpentry were specifically trained as part of the PRPP Intervention, while gardening was intentionally not trained.

Table 4

Participant 1: Stuart – Goal-Setting Criteria Based on the Goal Attainment Scale (GAS)

Level of Attainment	Cooking	Handyman/Carpentry	Gardening
Much less than expected (–2)	Use the prosthesis 0% – 24% of the time when cooking.	Use the prosthesis 0% – 24% of the time when completing handyman tasks.	Use the prosthesis 0% – 24% of the time when gardening.
Less than expected (–1)	Use the prosthesis 25% – 49% of the time when cooking.	Use the prosthesis 25% – 49% of the time when completing handyman tasks.	Use the prosthesis 25% – 49% of the time when gardening.
Expected level (0)	Use the prosthesis 50% of the time when cooking.	Use the prosthesis 50% of the time when completing handyman tasks.	Use the prosthesis 50% of the time when gardening.
Better than expected (+1)	Use the prosthesis 51% – 74% of the time when cooking.	Use the prosthesis 51% – 74% of the time when completing handyman tasks.	Use the prosthesis 51% – 74% of the time when gardening.
Much better than expected (+2)	Use the prosthesis 75% – 100% of the time when cooking.	Use the prosthesis 75% – 100% of the time when completing handyman tasks.	Use the prosthesis 75% – 100% of the time when gardening.

4.1.2 Measuring the impact of PRPP Intervention on occupational performance: PRPP Assessment – Stage One. The PRPP Assessment is composed of two stages that are used to evaluate task mastery (Stage One) and cognitive strategy use (Stage Two). Stage One and Stage Two both form the assessment record and are presented together. PRPP Assessment Stage One: Performance Mastery is on the left-hand side of the charts in Figures 8 to 11 and is the focus of this section. It deals with occupational performance as measured through task mastery. Stage Two is explored in section 4.1.4.

4.1.2.1 Pre-intervention assessment. Stuart identified that assisting his wife with cooking tasks was an important occupation for him. Pre-intervention PRPP Assessment was conducted in the ADL kitchen, which involved cutting up a number of vegetables.

The task criterion was set at 100%. Stuart achieved a task mastery score of 40% for Stage One (number of error-free steps/total number of task steps). Further pre-intervention PRPP Assessment was conducted in the hospital-based therapy workshop, which involved constructing a wooden frame that could be used to create a jig. (A jig is a wooden template that is used to speed up the process of making other woodworking items.) Stuart achieved a task mastery score of 50%. His average Stage One score prior to assessment was 45%. The frequency of errors is indicated in Figure 8 and Figure 9.

The errors of accuracy were a result of Stuart not effectively using his prosthesis during the task. During the steps of the task that required Stuart to hold onto an ingredient and cut, he had difficulty positioning his terminal device in an appropriate orientation, and often needed to stop and adjust his body position. During other bilateral task steps when the use of the prosthesis would have assisted the task, Stuart did not use his prosthesis at all, which resulted in an inaccurate, unilateral performance of the task step. This was particularly evident during the carpentry task when Stuart did not use his prosthetic limb appropriately and was therefore unable to effectively stabilise the wood during different parts of the task. Stuart used a "planing stop" (a wooden strip on the tabletop that is used to stop wood sliding when using a plane) to steady the wood. The planing stop was ineffective at times, so when he attempted the step of stabilising the wood, his use of the prosthesis to stabilise the wood was ineffective, and therefore he had difficulty effectively performing this step.

4.1.2.2 Post-intervention and follow-up assessments. After the PRPP Intervention, Stuart was assessed again when he attempted to make a salad sandwich. This involved cutting up ingredients to place on his sandwich, which meant that the steps involved in this task were similar to those of the pre-intervention task of cutting up the vegetables, with the addition of further task steps to make the sandwich. His overall task mastery increased to a score of 89%. Accuracy errors were almost eliminated as indicated in Figure 10.

At his follow-up session (six weeks after completion of the PRPP Intervention), Stuart was assessed again using the PRPP Assessment Stage One: Performance Mastery to evaluate his level of skill maintenance. Stuart's task mastery score on this occasion was 87.5%, with one accuracy error and one timing error as indicated in Figure 11.

THE PRPP SYSTEM SCORING SHEET

Client Name: Stuart	Date:	Task: Cutting vegetables

3(--) = Performance of this descriptor meets criterion expectations; reasonable time, without assistance; without prom
2(?) = Performance of this descriptor meets criterion expectations but indicates concern due to timing or prompts needed
1(X) = Performance of this descriptor does not meet criterion expectations; inhibits performance

STAGE ONE ANALYSIS: CRITERION %________________.

STEPS	**ERRORS** Acc	Rep	Om	Ti
Find knife	X			
Cut capsicum	X			
Cut avocado				
Scoop out avocado				
Cut onion	X			

PERCENTAGE SCORE:_____ 2/5 = 40%

STAGE TWO ANALYSIS RATING

		1(X)	2(?)	3(--)
PERCEIVE	**ATTENDING**			
	Notices	1	2	③
	Modulates	1	2	③
	Maintains	1	2	③
	SENSING			
	Searches	1	2	③
	Locates	1	2	③
	Monitors	①	2	3
	DISCRIMINATING			
	Discriminates	1	2	③
	Matches	1	2	③
	Regulates	1	2	③
RECALL	**RECALLING FACTS**			
	Recognises	1	2	③
	Labels	1	2	③
	Categorises	1	2	③
	/ SCHEMES			
	Contextualises to time	1	2	③
	/ place	1	2	③
	/ duration	1	2	③
	/ PROCEDURES			
	Uses objects	1	2	③
	Uses body	①	2	3
	Recall steps	①	2	3
PLAN	**MAPPING**			
	Knows goal	1	2	③
	Identifies obstacles	①	2	3
	Organises	①	2	3
	PROGRAMMING			
	Chooses	①	2	3
	Sequences	1	2	③
	Calibrates	①	2	3
	EVALUATING			
	Questions	1	2	③
	Analyses	①	2	3
	Judges	①	2	3
PERFORM	**INITIATING**			
	Starts	1	2	③
	Stops	1	2	③
	CONTINUING			
	Flows	①	2	3
	Continues	1	2	③
	Persists	1	2	③
	CONTROLLING			
	Times	1	2	③
	Coordinates	1	2	③
	Adjusts	①	2	3

Figure 8. Participant 1: Stuart – pre-intervention PRPP Assessment of meal preparation task.

THE PRPP SYSTEM SCORING SHEET		
Client Name: Stuart	Date:	Task: Making a jig / frame

3(--) = Performance of this descriptor meets criterion expectations; reasonable time, without assistance; without prom
2(?) = Performance of this descriptor meets criterion expectations but indicates concern due to timing or prompts needed
1(X) = Performance of this descriptor does not meet criterion expectations; inhibits performance

STAGE ONE ANALYSIS: CRITERION %______________.

STEPS	ERRORS Acc	Rep	Om	Ti
Arrange Wood				X
Mark out pieces of wood				
Get drill				
Place bit in drill	X			
Drill guide and countersink holes	X			
select screws				
Use vice to hold wood				
Hold wood steady with prosthesis	X			
PERCENTAGE SCORE:_____	4/8 = 50%			

STAGE TWO ANALYSIS RATING

		1(X)	2(?)	3(--)
PERCEIVE	**ATTENDING**			
	Notices	1	2	(3)
	Modulates	1	2	(3)
	Maintains	1	2	(3)
	SENSING			
	Searches	1	2	(3)
	Locates	1	2	(3)
	Monitors	(1)	2	3
	DISCRIMINATING			
	Discriminates	1	2	(3)
	Matches	1	2	(3)
	Regulates	1	2	(3)
RECALL	**RECALLING FACTS**			
	Recognises	1	2	(3)
	Labels	1	2	(3)
	Categorises	1	2	(3)
	/ SCHEMES			
	Contextualises to time	1	(2)	3
	/ place	1	2	(3)
	/ duration	1	2	(3)
	/ PROCEDURES			
	Uses objects	1	2	(3)
	Uses body	(1)	2	3
	Recall steps	1	2	(3)
PLAN	**MAPPING**			
	Knows goal	1	2	(3)
	Identifies obstacles	(1)	2	3
	Organises	(1)	2	3
	PROGRAMMING			
	Chooses	(1)	2	3
	Sequences	1	2	(3)
	Calibrates	(1)	2	3
	EVALUATING			
	Questions	1	2	(3)
	Analyses	(1)	2	3
	Judges	(1)	2	3
PERFORM	**INITIATING**			
	Starts	1	2	(3)
	Stops	1	2	(3)
	CONTINUING			
	Flows	(1)	2	3
	Continues	1	2	(3)
	Persists	1	2	(3)
	CONTROLLING			
	Times	1	2	(3)
	Coordinates	1	2	(3)
	Adjusts	(1)	2	3

Figure 9. Participant 1: Stuart – pre-intervention PRPP Assessment of woodworking task.

THE PRPP SYSTEM SCORING SHEET

Client Name: Stuart | Date: | Task: Making sandwhich

3(--) = Performance of this descriptor meets criterion expectations; reasonable time, without assistance; without prom

2(?) = Performance of this descriptor meets criterion expectations but indicates concern due to timing or prompts needed

1(X) = Performance of this descriptor does not meet criterion expectations; inhibits performance

STAGE ONE ANALYSIS: CRITERION %______________

STEPS	ERRORS			
	Acc	**Rep**	**Om**	**Ti**
Open bread package	X			
Take out bread slices				
Butter bread				
Cut tomato				
Cut capsicum				
Cut lettuce				
Open cheese package				
Assemble ingredients				
Cut sandwich				

PERCENTAGE SCORE:_____ 8/9 = 89%

STAGE TWO ANALYSIS RATING

	Descriptor	1(X)	2(?)	3(--)
PERCEIVE	**ATTENDING**			
	Notices	1	2	③
	Modulates	1	2	③
	Maintains	1	2	③
	SENSING			
	Searches	1	2	③
	Locates	1	2	③
	Monitors	1	2	③
	DISCRIMINATING			
	Discriminates	1	2	③
	Matches	1	2	③
	Regulates	1	2	③
RECALL	**RECALLING FACTS**			
	Recognises	1	2	③
	Labels	1	2	③
	Categorises	1	2	③
	/ SCHEMES			
	Contextualises to time	1	2	③
	/ place	1	2	③
	/ duration	1	2	③
	/ PROCEDURES			
	Uses objects	1	2	③
	Uses body	1	②	3
	Recall steps	1	2	③
PLAN	**MAPPING**			
	Knows goal	1	2	③
	Identifies obstacles	1	2	③
	Organises	1	2	③
	PROGRAMMING			
	Chooses	1	2	③
	Sequences	1	2	③
	Calibrates	1	②	3
	EVALUATING			
	Questions	1	2	③
	Analyses	1	2	③
	Judges	1	2	③
PERFORM	**INITIATING**			
	Starts	1	2	③
	Stops	1	2	③
	CONTINUING			
	Flows	1	②	3
	Continues	1	2	③
	Persists	1	2	③
	CONTROLLING			
	Times	1	2	③
	Coordinates	1	2	③
	Adjusts	1	②	3

Figure 10. Participant 1: Stuart – post-intervention PRPP Assessment of cooking task.

THE PRPP SYSTEM SCORING SHEET

Client Name: Stuart	Date:	Task: Making pancakes

3(--) = Performance of this descriptor meets criterion expectations; reasonable time, without assistance; without prom

2(?) = Performance of this descriptor meets criterion expectations but indicates concern due to timing or prompts needed

1(X) = Performance of this descriptor does not meet criterion expectations; inhibits performance

STAGE ONE ANALYSIS: CRITERION %_______________

STEPS	ERRORS Acc	Rep	Om	Ti
Get flour				
Get eggs				
Get milk				
Get sugar				
Get measuring bowl				
Measure and add flour				X
Measure and add milk				
Crack and add egg				
Measure and add sugar				
Mix				
Get frypan				
Turn on stove	X			
Add pancake mixture				
Flip pancake				
Serve				

PERCENTAGE SCORE:_____ 13/15 = 87%

STAGE TWO ANALYSIS RATING

		1(X)	2(?)	3(--)
PERCEIVE	**ATTENDING**			
	Notices	1	2	③
	Modulates	1	2	③
	Maintains	1	2	③
	SENSING			
	Searches	1	②	3
	Locates	1	2	③
	Monitors	1	2	③
	DISCRIMINATING			
	Discriminates	1	2	③
	Matches	1	2	③
	Regulates	1	2	③
RECALL	**RECALLING FACTS**			
	Recognises	1	2	③
	Labels	1	2	③
	Categorises	1	2	③
	/ SCHEMES			
	Contextualises to time	1	2	③
	/ place	1	2	③
	/ duration	1	2	③
	/ PROCEDURES			
	Uses objects	1	2	③
	Uses body	1	②	3
	Recall steps	1	②	3
PLAN	**MAPPING**			
	Knows goal	1	2	③
	Identifies obstacles	1	2	③
	Organises	1	2	③
	PROGRAMMING			
	Chooses	1	2	③
	Sequences	1	2	③
	Calibrates	1	2	③
	EVALUATING			
	Questions	1	2	③
	Analyses	1	2	③
	Judges	1	2	③
PERFORM	**INITIATING**			
	Starts	1	2	③
	Stops	1	2	③
	CONTINUING			
	Flows	1	②	3
	Continues	1	2	③
	Persists	1	2	③
	CONTROLLING			
	Times	1	2	③
	Coordinates	1	2	③
	Adjusts	1	2	③

Figure 11. Participant 1: Stuart – follow-up PRPP Assessment of cooking task.

4.1.3 Measuring the impact of PRPP Intervention on cognitive strategy application – PRPP Assessment Stage Two: Cognitive Strategy Use.

Stuart's ability to apply cognitive strategies for effective task performance was analysed using PRPP Assessment Stage Two: Cognitive Strategy Use for each of the tasks that he completed for his pre-intervention and post-intervention and follow-up assessments. The results of these assessments are detailed in Figures 8 to 11.

4.1.3.1 Pre-intervention assessment. Stuart achieved PRPP total scores of 83 and 84 for his two pre-intervention assessments. Individual quadrant scores are outlined in Figures 8 and 9 (right-hand column). This section will focus on the first pre-intervention assessment of cutting vegetables. During the pre-intervention assessment, cognitive strategies for Recalling Schemes (Recall quadrant), Programming and Evaluating (Plan quadrant) were noted as the primary areas of difficulty. The specific strategies within these sub-quadrants that were impacting on task performance were recalling the correct procedures for Using the Body (for this study the prosthesis was considered part of the body), as Stuart often did not remember when or how to integrate his prosthesis into the task. He also demonstrated difficulty with the planning aspects of Identifying Obstacles, Organising and Choosing.

These errors were evident when observing Stuart attempt to prepare some vegetables, whereby he did not anticipate the difficulty he would experience using his prosthesis without rotating it into the correct position first. As a result, he attempted aspects of the tasks without organising the environment and the task to make best use of his prosthesis. When he did attempt to rotate the terminal device into an appropriate position, he often adopted a trial-and-error approach, which meant that he had not analysed the most appropriate use of the prosthesis nor made good judgements. He often questioned his approach but did not adjust his actions accordingly. Consequently, his performance did not Flow through the task.

4.1.3.2 Designing PRPP Intervention. The results of the PRPP Assessment were then used to develop a plan for the PRPP Intervention sessions. The PRPP System of Task Analysis: Assessment & Intervention provides a framework that can be used to develop an intervention plan for targeting the specific cognitive strategies that are required to improve task performance. After the initial assessment was completed and the cognitive strategy errors evaluated, the general PRPP prompting sequence was applied: Stop, Attend/Sense; Think "remember"; Think "figure out"/"checkout"; Do. This prompting structure facilitated the use of specific cognitive strategies for each step of the sequence, thereby mirroring information processing. Cognitive strategies were also selected based on how they flowed together to form a coherent approach to a task.

The PRPP Intervention was focused on increasing prosthesis use for all tasks, so a prompting strategy was developed to target this action. For the initial intervention session, the treating therapist also wore a training arm so that they could demonstrate to Stuart how to use his prosthesis in different ways.

Using the Stop prompt to prevent an error occurring featured in most of Stuart's prompting sequences in some format, either as the verbal prompt "Stop" or the participant's name "Stuart". The Attend/Sense prompt targets cognitive strategy errors from the Perceive quadrant. For Stuart, the descriptor of Monitors was targeted and prompted Stuart to use his senses to consider where his prosthesis was. The Think to Remember prompt targets cognitive strategy errors from the Recall quadrant. The strategy of Uses Body was targeted to remind Stuart how to use his prosthesis as well as to consider how it could be used. The Think "figure out" or Think "checkout" prompts target cognitive strategy errors in the Plan quadrant. The strategies of Analyses and Judges were targeted. Questioning prompts were used to encourage Stuart to consider the different ways he could use his prosthesis and to work out which strategy would be the most effective. The Do prompt focuses on cognitive strategy errors from the Perform quadrant and may be as simple as the prompt to "do" or to "start". The observed difficulties with Flow were targeted by encouraging Stuart to also consider what step was coming next so that he understood that he should start the process again.

An example of a prompting sequence is as follows:

Stop, have a look at your prosthesis. Can you feel where it is? Can you think about how you could use it for this step? Go inside your head and think about a different way to do it. Okay? You can start when you are ready.

As this prompting sequence demonstrates, the specific steps of the task were not part of the prompt, so this full prompting sequence or part of it could be used during any task and at any point in a task. As Stuart increased his ability to use his prosthesis, this prompting sequence was changed and modified. Stuart became less and less reliant on the therapist providing the full prompting sequence. Therapist-prompting was also reduced once Stuart could internalise the effective use of the prompts and apply them himself. This encouraged the generalisation of the prompting sequence to other tasks. As noted in the previous results of the GAS, Stuart achieved mastery of specific tasks that were not targeted as part of this PRPP Intervention.

4.1.3.3 Post-intervention and follow-up assessments. Post-intervention, Stuart's PRPP total score increased from 83 to 101 and at the follow-up assessment remained stable at 101. As is indicated in Table 5 and Figure 16, the greatest gains in cognitive strategy application occurred in the Plan and Perform quadrants. It is interesting to note that the total PRPP score post-intervention and at the follow-up session was the same; however, the errors pattern was slightly different.

During both the post-intervention and follow-up assessments there was notable improvement in Stuart's ability to Analyse and Judge how to use the prosthesis, and although he made some errors in Using His Body, they had minimal impact on task performance. Flow continued to be an issue; however, the impact on overall task performance was reduced. It was also noted that during the more novel task of making pancakes, errors in Recall Steps occurred.

Table 5
Participant 1: Stuart – PRPP Stage Two Scoring

Cognitive Strategy	Pre-Intervention Score (Task 1)	Pre-Intervention Score (Task 2)	Post-Intervention Score	Follow-Up Score
Attending	9	9	9	9
Sensing	7	7	9	8
Discriminating	9	9	9	9
Perceive quadrant	25	25	27	26
Recalls facts	9	9	9	9
Recalls schemes	9	8	9	9
Recalls procedures	5	7	8	7
Recall quadrant	23	24	26	25
Mapping	5	5	9	9
Programming	5	6	8	9
Evaluating	5	5	9	9
Plan quadrant	15	16	26	27
Initiating	6	6	6	6
Continuing	7	7	8	8
Controlling	7	7	8	9
Perform quadrant	20	20	22	23
PRPP total score	83	85	101	101

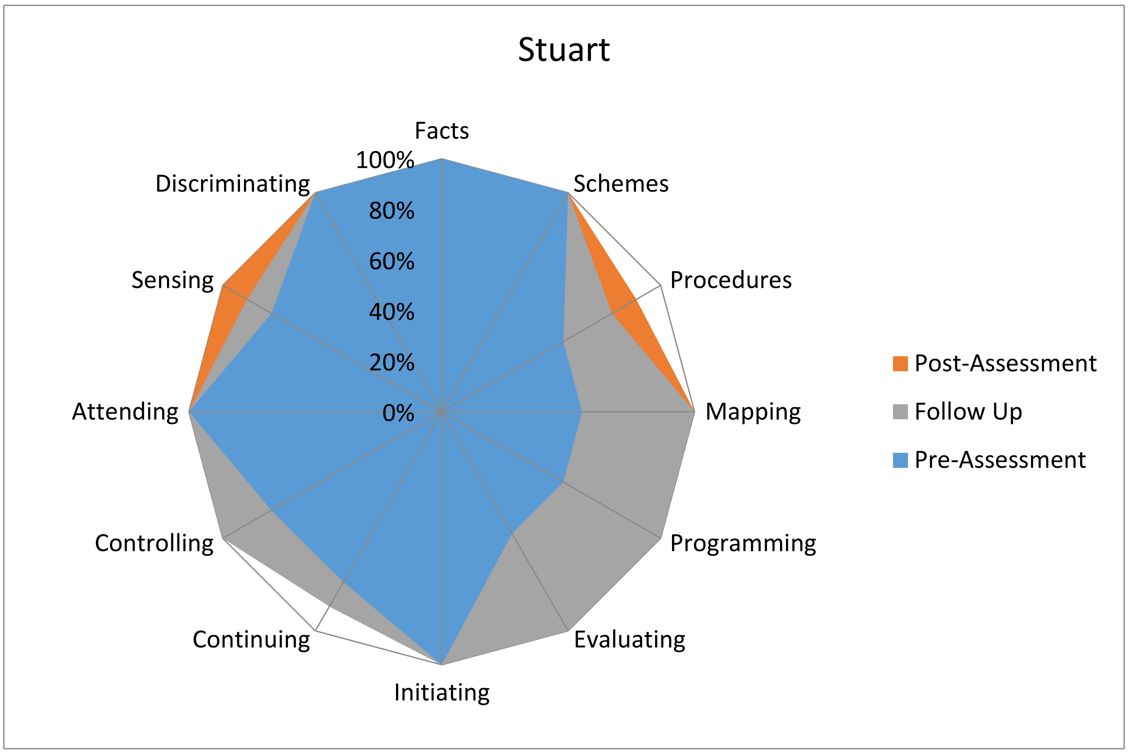

Figure 12. Participant 1: Stuart – PRPP Stage Two analysis.

4.1.3.3.1 Intrapersonal capacities. Stuart reported very low levels of anxiety and stress and exhibited no signs of a depressed mood. All scores both pre- and post-intervention were within the normal range on the DASS 21 (see Table 6). Stuart's sense of general self-efficacy increased following the PRPP Intervention (see Table 7). His initial score on the General Self-Efficacy Scale was 27/40, which increased to 35/40 following intervention. This compares favourably with the mean score (29/40) of a large population-based normative study published by the tool developers (Luszczynska, Gutiérrez- Doña, & Schwarzer, 2005).

Table 6
Participant 1: Stuart – DASS 21

DASS 21	Pre	Post
Depression	0	0
Anxiety	4	2
Stress	2	2

Table 7

Participant 1: Stuart – General Self-Efficacy Scale

General Self-Efficacy Scale	Pre	Post
I can always manage to solve difficult problems if I try hard enough.	3	3
If someone opposes me, I can find the means and ways to get what I want.	3	3
It is easy for me to stick to my aims and accomplish my goals.	3	4
I am confident that I could deal efficiently with unexpected events.	2	4
Thanks to my resourcefulness, I know how to handle unforeseen situations.	2	4
I can solve most problems if I invest the necessary effort.	3	3
I can remain calm when facing difficulties because I can rely on my coping strategies.	3	4
When I am confronted with a problem, I can usually find several solutions.	3	4
If I am in trouble, I can usually think of a solution.	3	3
I can usually handle whatever comes my way.	2	3
Total score	27	35

4.1.4 Measuring the impact of PRPP Intervention on biomechanical capacity: ULPA – Task Performance Mastery (TPM) and Comparative Analysis of Performance – Motor (CAP–M). Stuart's capacity to apply his biomechanical abilities to the task was evaluated using the ULPA, which included analysis of the movements required to operate the prosthesis and all other actions required for task performance. Operation of the terminal device and wrist unit were considered as a separate movements. This was done to differentiate movements required to operate the prosthesis from movement required to position the limb. The ULPA consists of two parts – Part One: Total Performance Mastery (TPM) is presented on the left-hand side of the ULPA score sheets; Part Two: Comparative Analysis of Performance – Motor (CAP–M) is presented on the right-hand side of the ULPA score sheets. As outlined in section 3.6.4, the TPM evaluates performance errors across all task steps, while the CAP–M focuses on the most problematic step of the task.

4.1.4.1 Pre-intervention assessment. For the pre-intervention assessment, the task of cutting a capsicum was selected. This task was selected as cutting was a step common to a number of different cooking tasks. During this task, Stuart initially did not use his prosthesis. On his second attempt, he did include the use of his prosthesis but still demonstrated errors. The task was therefore analysed twice to establish the difference in performance between non-prosthetic and prosthetic use. These two separate assessments are detailed in

Figure 13 and Figure 14. During Stuart's pre-assessment, when he did not use his prosthesis, several "omission" errors were recorded in the TPM section of the ULPA sheet (see Figure 12 – left-hand section). This resulted in a TPM score of 0% as errors were recorded on all task steps. Stuart then attempted to use his prosthesis for the task. The results of this assessment are detailed in Figure 14. The TPM score for this task was 62.5%. The errors shifted from errors of omission to errors of accuracy. Stuart opened and closed the terminal device correctly; however, he had difficulty working out the most appropriate position of the terminal device and did not accurately pre-position the terminal device.

The CAP–M analysis highlighted the excessive movements that Stuart demonstrated when attempting to get into a position to cut with one hand (see Figure 13). The observed excessive movements included not only external rotation of the shoulder but also excessive shoulder elevation and neck and torso flexion. Using the CAP–M to evaluate prosthetic use in this same step (see Figure 14) highlighted that Stuart could perform the appropriate movements to use the terminal device but still exhibited excessive movements of shoulder elevation and neck flexion.

4.1.4.2 Post-intervention assessment. After the PRPP Intervention, Stuart completed a very similar task to the initial assessment that involved making the sandwich. The task that was selected for analysis using the ULPA also involved cutting, and again a capsicum was used. The results of this assessment are detailed in Figure 15. Overall, Stuart improved his cutting ability, increasing his TPM score from 62.5% to 87.5%, with only one error in orientating his body towards the bench incorrectly. This error translated into the CAP–M through the motor action of Stuart's neck and torso. Although he had his prosthesis and arm in a good position, he leaned forward over the bench to get a better view of what he was doing.

4.1.4.3 Follow-up assessment. During the follow up assessment, Stuart was asked to complete a more novel task for him, which was to make pancakes. The step that was selected for analysis using the ULPA Part Two: CAP–M was flipping the pancake. The results of this assessment are detailed in Figure 16. Stuart achieved a TPM score of only 12.5% as he did not use his prosthesis for this task. When reviewing the CAP–M, Stuart had mainly missing movements.

When compared to the CAP–M during the pre-assessment (see Figure 13), there was a reduced number of excessive movements. Stuart did not demonstrate any of the shoulder elevation that was evident during the initial assessment. It was also noted that although Stuart did not use his prosthesis, it was not sitting out to the side of his body (shoulder external rotation) but was just by his side and it appeared to be an active choice by Stuart not to use the prosthesis for that step as he had used it during other steps in the task effectively.

<table>
<tr><td colspan="6">TASK PERFORMANCE MASTERY (TPM)</td><td colspan="5">COMPARATIVE ANALYSIS OF PERFORMANCE – MOTOR (CAP-M)</td></tr>
<tr><td>STEPS</td><td>Om</td><td>Acc</td><td>Rep</td><td>Tim</td><td></td><td colspan="5">STEP: Cut Capsicum with a knife (Pre-assessment - Not using arm) - Stuart</td></tr>
<tr><td>Orient body towards bench</td><td></td><td>X</td><td></td><td></td><td></td><td>Expected</td><td>Observed</td><td>Excessive</td><td>Missing</td><td>Timing</td></tr>
<tr><td>Reach towards Capsicum</td><td>X</td><td></td><td></td><td></td><td></td><td rowspan="11">Shoulder: Flexion, internal rotation.

Elbow: Flexion
Wrist unit: Rotation using right UL
Terminal Device (open): Right and left should adduction and flexion
Terminal Device (close): Return right shoulder to neutral
Neck: Flexion
Torso: Flexion</td><td rowspan="11">Shoulder: Elevation, external rotation
Elbow: Extension
Wrist Unit:

Terminal Device (open):

Terminal Device (Close):

Neck: Flexion
Torso: Flexion</td><td rowspan="11">Shoulder: Elevation, external rotation

Elbow: Extension

Neck: Flexion
Torso: Flexion</td><td rowspan="11">Shoulder: Flexion, Internal rotation

Elbow: Flexion
Wrist Unit: Rotation using R UL
Terminal Device (open): Right and left should adduction and flexion
Terminal Device (close): Return right shoulder to neutral</td><td rowspan="11"></td></tr>
<tr><td>Pre-position prosthesis wrist unit</td><td>X</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Open terminal device</td><td>X</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Close Terminal Device</td><td>X</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Stabilise capsicum</td><td>X</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Open terminal device to release capsicum</td><td>X</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Re-align</td><td>X</td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>TPM: 0/8 = 0%</td><td></td><td></td><td></td><td></td><td></td><td>9</td><td>5</td><td>5</td><td>7</td><td></td></tr>
</table>

Figure 13. Participant 1: Stuart – ULPA pre-intervention assessment of cutting a capsicum (no prosthetic use).

TASK PERFORMANCE MASTERY (TPM)					
STEPS	Om	Acc	Rep	Tim	
Orient body towards bench		X			
Reach towards Capsicum					
Pre-position prosthesis wrist unit		X		X	
Open terminal device					
Close Terminal Device					
Stabilise capsicum		X			
Open terminal device to release capsicum					
Re-align					
TPM: 5/8 = 62.5%					

COMPARATIVE ANALYSIS OF PERFORMANCE – MOTOR (CAP-M)				
STEP: Cut capsicum with a knife (pre-assessment – Prosthetic use – Stuart)				
Expected	Observed	Excessive	Missing	Timing
Shoulder: Flexion, internal rotation. *Elbow:* Flexion *Wrist unit:* Rotation using right UL *Terminal Device (open):* Right and left should adduction and flexion *Terminal Device (close):* Return right shoulder to neutral *Neck:* Flexion *Torso:* Flexion	*Shoulder:* Elevation, Flexion, internal rotation *Elbow:* Flexion *Wrist Unit:* Rotation into position using R UL *Terminal Device (open):* Right and left shoulder adduction and flexion *Terminal Device (Close):* Return right shoulder to neutral *Neck:* Flexion *Torso:* Flexion	*Shoulder:* Elevation *Neck:* Flexion *Torso:* Flexion		*Wrist Unit:* Rotation into position using R UL
9	*10*	*3*		*1*

Figure 14. Participant 1: Stuart – ULPA pre-intervention assessment of cutting a capsicum (prosthetic use).

TASK PERFORMANCE MASTERY (TPM)					
STEPS	Om	Acc	Rep	Tim	
Orient body towards bench		X			
Reach towards Capsicum					
Pre-position prosthesis wrist unit					
Open terminal device					
Close Terminal Device					
Stabilise capsicum					
Open terminal device to release capsicum					
Re-align					

COMPARATIVE ANALYSIS OF PERFORMANCE – MOTOR (CAP-M)				
STEP: Cut capsicum with a knife (post-intervention – Stuart)				
Expected	Observed	Excessive	Missing	Timing
Shoulder: Flexion, internal rotation. *Elbow:* Flexion *Wrist unit:* Rotation using right UL *Terminal Device (open):* Right and left should adduction and flexion *Terminal Device (close):* Return right shoulder to neutral *Neck:* Flexion *Torso:* Flexion	*Shoulder:* Flexion, internal rotation *Elbow:* Flexion *Wrist Unit:* Rotation into position using R UL *Terminal Device (open):* Right and left shoulder adduction and flexion *Terminal Device (Close):* Return right shoulder to neutral *Neck:* Flexion *Torso:* Flexion	*Neck:* Flexion *Torso:* Flexion		

Figure 15. Participant 1: Stuart – ULPA post-intervention assessment of cutting a capsicum.

<table>
<tr><td colspan="6">TASK PERFORMANCE MASTERY (TPM)</td><td colspan="5">COMPARATIVE ANALYSIS OF PERFORMANCE – MOTOR (CAP-M)</td></tr>
<tr><td>STEPS</td><td>Om</td><td>Acc</td><td>Rep</td><td>Tim</td><td></td><td colspan="5">STEP: Flipping pancake (Follow up – Stuart)</td></tr>
<tr><td>Orient body towards stove top</td><td></td><td></td><td></td><td></td><td></td><td>Expected</td><td>Observed</td><td>Excessive</td><td>Missing</td><td>Timing</td></tr>
<tr><td>Reach to pan</td><td>X</td><td></td><td></td><td></td><td></td><td rowspan="10">Shoulder: Flexion
Elbow: Flexion
Wrist Unit: Rotate using right upper limb
Terminal Device (open): Right and left shoulder adduction and flexion
Terminal Device (Close): Return left and right shoulder to neutral
Neck: Flexion</td><td rowspan="10">Shoulder:
Elbow: Extension
Wrist Unit:
Terminal device (open):
Terminal Device (close):
Neck: Flexion</td><td rowspan="10">Elbow: Extension</td><td rowspan="10">Shoulder: Flexion
Wrist Unit: Rotate using right upper limb
Terminal Device (open): Right and left shoulder adduction and flexion
Terminal Device (Close): Return left and right shoulder to neutral</td><td rowspan="10"></td></tr>
<tr><td>Pre-position prosthesis</td><td>X</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Open terminal device</td><td>X</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Close terminal device on handle of pan</td><td>X</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Stabilise fry pan</td><td>X</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Open terminal device to release handle of fry pan</td><td>X</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Realign body</td><td>X</td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>TPM: 1/8 = 12.5%</td><td></td><td></td><td></td><td></td><td></td><td>7</td><td>2</td><td>1</td><td>5</td><td></td></tr>
</table>

Figure 16. Participant 1: Stuart – ULPA follow-up assessment of flipping a pancake.

4.2 Participant 02 – Leon

At the time of the study "Leon" (pseudonym) was a 42-year-old male who had sustained an amputation of his dominant right upper limb at the transradial level. The amputation occurred after Leon sustained severe burns two years prior to this study. He reported phantom limb *sensation* less than daily, and nil phantom limb *pain* at any time. He reported using his prosthesis rarely and did not use it for functional tasks.

His current prosthesis was a body-powered prosthesis with a 5XA terminal device and an Otto Bock active hand. He had a quick-disconnect locking-wrist unit so he could alternate between the two terminal devices. For this study, Leon used the 5XA terminal device. He had been using a prosthesis for the past 18 months, but had only been wearing it two to three times a month for 30-minute periods for cosmetic reasons. Leon reported that he did not use the prosthesis for functional tasks. His stump was not well formed due to a large amount of hypertrophic scarring that had been caused by skin grafts. Leon attended therapy with the explicit goals of wanting to be able to do more cooking, and washing and folding clothes with the prosthesis.

At the start of the study period, Leon lived alone in a unit; however, he visited his mother regularly and stayed with her at least two nights each week. He received assistance from his mother to complete cleaning tasks and although he reported that he could cook, he stated that he often just bought takeaway food as it was easier. He was not employed during the study period and was not actively pursuing work. He reported that although he continued to engage in some leisure activities, they were mostly passive, such as watching TV. He reported that he enjoyed going camping but had not done this since his injury.

4.2.1 Prosthesis rejection and occupational role engagement. Prior to engaging in the study, Leon reported only one significant factor impacting on his prosthesis use: he found it was quicker and easier to complete a task without using the prosthesis (see Table 8). No other factors were reported as impacting on the choice to use the prosthesis. Leon reported that although he wanted to do more, he didn't use his prosthesis and was reliant on his mother. For this scale 1 = no impact at all, 2 = little impact, 3 = moderate impact, 4 = significant impact, 5 = most significant impact.

Following PRPP Intervention, the factors that affected Leon's prosthetic use shifted from personal factors to prosthetic factors, with the physical effort or force required to use the prosthesis increasing from a score of 2 (little impact) to 4 (significant impact) (see Table 8, right-hand column).

Table 8

Participant 2: Leon – Pre- and Post-Prosthetic Rejection Factors

Rejection Factors	Pre	Post
Prosthetic factors		
The weight of the prosthesis is too heavy	1	2
The look or cosmetics of the prosthesis is not what I want	1	1
The prosthesis is uncomfortable or hot	2	2
The physical effort or force required to use the prosthesis	2	4
Difficulty getting the prosthesis on and off	1	1
Personal factors		
Difficulty using the prosthesis for what you want to do	1	1
The concentration required to use the prosthesis	1	1
The prosthesis is useful, but not worth the effort	1	1
The prosthesis is not what I expected it to be	2	1
It is quicker or easier to complete tasks without the prosthesis	5	2

Occupational role engagement was evaluated using the GAS based on the goals that Leon selected. These goals were developed in collaboration with the investigator, who set the expected level of goal attainment (see Table 9). The discussion involved confirming with Leon that these goals were based on an expectation that he would be using his prosthesis. For Leon, the goals of cooking and cleaning were more important (2) and more difficult (1) than the goals of folding clothes (important = 1 and difficult = 0). The baseline performance was reported by Leon as –1. At the end of the treatment period, the goals received a score of +1 if they had been achieved an outcome better than expected. Leon reported that all of these goals achieved a better than expected outcome (+1). GAS-standardised scores were calculated, which indicated a GAS change of 24.8 points (baseline = 37.6; post-treatment = 62.4). The T score should be distributed around the value of 50 with a standard deviation of 10 indicating a higher than normal result (Krasny-Pacini, et al. 2013). Cooking and cleaning were specifically trained as part of the PRPP Intervention, while folding clothes was intentionally not trained.

Table 9

Participant 2: Leon – Goal-Setting Criteria Based on Goal Attainment Scale

Level of Attainment	Cooking	Cleaning	Folding Clothes
Much less than expected (–2)	Engage in a cooking task less than once a week.	Clean the house and do the washing-up less than once a week.	Get help from Mum to do the folding, but put clothes away independently.
Less than expected (–1)	Engage in a cooking task at least once a week.	Clean the house and do the washing-up once a week.	Fold some of the clothes (around 50%) and put away the clothes
Expected level (0)	Engage in cooking tasks 2–3 times a week.	Clean the house once a week and do the washing-up 2–3 times a week.	Fold most of the clothing (more than 75%) and put away independently.
Better than expected (+1)	Engage in cooking tasks 4–5 times a week.	Clean the house once a week and do the washing up 4-5 times a week.	Fold clothing within two days of washing and put used clothes away most days of the week.
Much better than expected (+2)	Engage in a cooking task every day of the week.	Clean the house once a week and do the washing-up every day of the week.	Fold clothes within one day of a washing load and put used clothes away each day.

4.2.2 Measuring the impact of PRPP Intervention on occupational performance: PRPP Assessment – Stage One. The PRPP Assessment is composed of two stages that are used to evaluate performance mastery (Stage One) and cognitive strategy use (Stage Two).

Stage One and Stage Two both form the assessment record and are presented together. Stage One: Performance Mastery is on the left-hand side of the charts in Figures 17 to 20 and is the focus of this section. It deals with occupational performance as measured through task mastery. Stage Two is explored in section 4.2.4.

4.2.2.1 Pre-intervention assessment. Leon identified that cooking and cleaning up afterwards were tasks that he wanted to focus on. Pre-intervention assessment was conducted in the ADL kitchen, where he was asked to make pancakes and then clean up after this task. The criterion for both of tasks was set at 100%. His task mastery score was 55% for making pancakes in the PRPP Assessment Stage One: Performance Mastery. After completing the cooking task, his task mastery of cleaning up and washing the dishes was evaluated. He achieved a score of 50% for these tasks. The frequency of errors are indicated in Figures 17 and 18 (left-hand columns).

The errors were predominantly related to Leon not using his prosthesis effectively for the task, and the additional time required to plan the task resulted in him getting some steps out of order – for example, starting to mix the batter prior to adding all the required items. Leon self-corrected these errors, which resulted in timing errors rather than an omission error. Leon had difficulty holding on to the containers, which led to problems of trying to mix the ingredients. He was also not able to effectively use the stovetop controls. Initially he did not turn the dial correctly, which resulted in difficulty with cooking the pancake and flipping it.

4.2.2.2 Post-intervention and follow-up assessments. The assessment was repeated at the end of the intervention period. At his request, Leon selected the same task to demonstrate the improvement in his performance. The steps involved were the same and his task mastery score increased to 95%. His accuracy errors were eliminated and there was an improvement in his timing errors as well (see Figure 19).

During the follow-up assessment six weeks after the intervention period, Leon requested to complete the cooking task of making spaghetti bolognese, which he reported was now a common meal that he was cooking. He demonstrated no errors during the completion of this task (see Figure 20).

THE PRPP SYSTEM SCORING SHEET

Client Name: Leon | Date: | Task: Making pancakes

3(--) = Performance of this descriptor meets criterion expectations; reasonable time, without assistance; without prom

2(?) = Performance of this descriptor meets criterion expectations but indicates concern due to timing or prompts needed

1(X) = Performance of this descriptor does not meet criterion expectations; inhibits performance

STAGE ONE ANALYSIS: CRITERION %_______________

STEPS	**ERRORS**			
	Acc	**Rep**	**Om**	**Ti**
Get flour				
Get eggs				
Get milk				
Get sugar				
Get butter				
Get vanilla				
Get measuring cup				
Get bowl				
Measure and add flour	X			
Measure and add milk	X			
Measure and add vanilla				
Melt and add butter				X
Crack and add egg	X			X
Measure and add sugar				X
Mix	X			X
Locate pan				
Turn on stove	X			
Add pancake mix				X
Flip pancake	X			
Serve				

PERCENTAGE SCORE:______ 11/20 = 55%

STAGE TWO ANALYSIS RATING

		1(X)	2(?)	3(--)
PERCEIVE	**ATTENDING**			
	Notices	1	2	③
	Modulates	1	2	③
	Maintains	1	2	③
	SENSING			
	Searches	1	2	③
	Locates	1	②	3
	Monitors	①	2	3
	DISCRIMINATING			
	Discriminates	1	2	③
	Matches	1	2	③
	Regulates	1	2	③
RECALL	**RECALLING FACTS**			
	Recognises	1	2	③
	Labels	1	2	③
	Categorises	1	2	③
	/ SCHEMES			
	Contextualises to time	①	2	3
	/ place	1	2	③
	/ duration	①	2	3
	/ PROCEDURES			
	Uses objects	1	②	3
	Uses body	①	2	3
	Recall steps	①	2	3
PLAN	**MAPPING**			
	Knows goal	1	②	3
	Identifies obstacles	①	2	3
	Organises	①	2	3
	PROGRAMMING			
	Chooses	1	2	③
	Sequences	1	2	③
	Calibrates	1	②	3
	EVALUATING			
	Questions	①	2	3
	Analyses	①	2	3
	Judges	①	2	3
PERFORM	**INITIATING**			
	Starts	1	2	③
	Stops	1	②	3
	CONTINUING			
	Flows	①	2	3
	Continues	1	2	③
	Persists	①	2	3
	CONTROLLING			
	Times	①	2	3
	Coordinates	1	②	3
	Adjusts	1	②	3

Figure 17. Participant 2: Leon – pre-intervention PRPP Assessment of meal preparation task.

THE PRPP SYSTEM SCORING SHEET

Client Name: Leon | Date: | Task: Cleaning up after cooking

3(--) = Performance of this descriptor meets criterion expectations; reasonable time, without assistance; without prom
2(?) = Performance of this descriptor meets criterion expectations but indicates concern due to timing or prompts needed
1(X) = Performance of this descriptor does not meet criterion expectations; inhibits performance

STAGE ONE ANALYSIS: CRITERION %______________

STEPS	ERRORS Acc	Rep	Om	Ti
Put lids on containers	X			
Place containers back in cupboard				
Turn on tap				
Add detergent				
Wash up used items with a brush	X			
Turn off tap				X

PERCENTAGE SCORE:_____ 3/6 = 50%

STAGE TWO ANALYSIS RATING

		1(X)	2(?)	3(--)
PERCEIVE	**ATTENDING**			
	Notices	1	2	③
	Modulates	1	2	③
	Maintains	1	2	③
	SENSING			
	Searches	1	2	③
	Locates	1	2	③
	Monitors	①	2	3
	DISCRIMINATING			
	Discriminates	1	2	③
	Matches	1	2	③
	Regulates	1	2	③
RECALL	**RECALLING FACTS**			
	Recognises	1	2	③
	Labels	1	2	③
	Categorises	1	2	③
	/ SCHEMES			
	Contextualises to time	1	2	③
	/ place	1	2	③
	/ duration	1	②	3
	/ PROCEDURES			
	Uses objects	1	2	③
	Uses body	①	2	3
	Recall steps	1	2	③
PLAN	**MAPPING**			
	Knows goal	1	2	③
	Identifies obstacles	①	2	3
	Organises	①	2	3
	PROGRAMMING			
	Chooses	1	②	3
	Sequences	1	2	③
	Calibrates	①	2	3
	EVALUATING			
	Questions	1	2	③
	Analyses	①	2	3
	Judges	①	2	3
PERFORM	**INITIATING**			
	Starts	1	2	③
	Stops	1	2	③
	CONTINUING			
	Flows	①	2	3
	Continues	1	2	③
	Persists	1	2	③
	CONTROLLING			
	Times	1	2	③
	Coordinates	1	2	③
	Adjusts	①	2	3

Figure 18. Participant 2: Leon – pre-intervention PRPP Assessment of cleaning task.

THE PRPP SYSTEM SCORING SHEET

Client Name: Leon | Date: | Task: Making pancakes

3(--) = Performance of this descriptor meets criterion expectations; reasonable time, without assistance; without prom

2(?) = Performance of this descriptor meets criterion expectations but indicates concern due to timing or prompts needed

1(X) = Performance of this descriptor does not meet criterion expectations; inhibits performance

STAGE ONE ANALYSIS: CRITERION %______________.

STEPS	ERRORS Acc	Rep	Om	Ti
Get flour				
Get eggs				
Get milk				
Get sugar				
Get butter				
Get Vanilla				X
Get measureing cup				
Get bowl				
Measure and add flour				
Measure and add milk				
Measure and add vanilla				
Melt and add butter				
Crack and add egg				
Measure and add sugar				
Mix				
Locate pan				
Turn on stove				
Add pancake mix				
Flip pancake				
Serve				

PERCENTAGE SCORE:_____ 19/20 = 95%

STAGE TWO ANALYSIS RATING

		1(X)	2(?)	3(--)
PERCEIVE	**ATTENDING**			
	Notices	1	2	③
	Modulates	1	2	③
	Maintains	1	2	③
	SENSING			
	Searches	1	2	③
	Locates	1	②	3
	Monitors	1	2	③
	DISCRIMINATING			
	Discriminates	1	2	③
	Matches	1	2	③
	Regulates	1	2	③
RECALL	**RECALLING FACTS**			
	Recognises	1	2	③
	Labels	1	2	③
	Categorises	1	2	③
	/ SCHEMES			
	Contextualises to time	1	2	③
	/ place	1	2	③
	/ duration	1	2	③
	/ PROCEDURES			
	Uses objects	1	2	③
	Uses body	1	②	3
	Recall steps	1	2	③
PLAN	**MAPPING**			
	Knows goal	1	2	③
	Identifies obstacles	1	②	3
	Organises	1	2	③
	PROGRAMMING			
	Chooses	1	2	③
	Sequences	1	2	③
	Calibrates	1	2	③
	EVALUATING			
	Questions	1	②	3
	Analyses	1	2	③
	Judges	1	2	③
PERFORM	**INITIATING**			
	Starts	1	2	③
	Stops	1	2	③
	CONTINUING			
	Flows	1	2	③
	Continues	1	2	③
	Persists	1	2	③
	CONTROLLING			
	Times	1	2	③
	Coordinates	1	2	③
	Adjusts	1	2	③

Figure 19. Participant 2: Leon – post-intervention PRPP Assessment of cooking task.

THE PRPP SYSTEM SCORING SHEET

Client Name: Leon | Date: | Task: Making spaghetti bolognese

3(--) = Performance of this descriptor meets criterion expectations; reasonable time, without assistance; without prom

2(?) = Performance of this descriptor meets criterion expectations but indicates concern due to timing or prompts needed

1(X) = Performance of this descriptor does not meet criterion expectations; inhibits performance

STAGE ONE ANALYSIS: CRITERION %______________

STEPS	**ERRORS** Acc	Rep	Om	Ti
Get pot				
Get pan				
Get mince				
Get oil				
Get canned tomatoes				
Turn on stove				
Boil kettle				
Defrost mince (microwave)				
Add oil to pan				
Add mince to pan				
Stir mince				
Add boiled water to pot				
add pasta				
Open tomatoes				
Add tomatoes to pan				
Stir mince and tomatoes				
Drain pasta				
Serve pasta with sauce				

PERCENTAGE SCORE:_____ 18/18 = 100%

STAGE TWO ANALYSIS RATING

		1(X)	2(?)	3(--)
PERCEIVE	**ATTENDING**			
	Notices	1	2	③
	Modulates	1	2	③
	Maintains	1	2	③
	SENSING			
	Searches	1	2	③
	Locates	1	2	③
	Monitors	1	2	③
	DISCRIMINATING			
	Discriminates	1	2	③
	Matches	1	2	③
	Regulates	1	2	③
RECALL	**RECALLING FACTS**			
	Recognises	1	2	③
	Labels	1	2	③
	Categorises	1	2	③
	/ SCHEMES			
	Contextualises to time	1	2	③
	/ place	1	2	③
	/ duration	1	2	③
	/ PROCEDURES			
	Uses objects	1	2	③
	Uses body	1	2	③
	Recall steps	1	2	③
PLAN	**MAPPING**			
	Knows goal	1	2	③
	Identifies obstacles	1	2	③
	Organises	1	2	③
	PROGRAMMING			
	Chooses	1	2	③
	Sequences	1	2	③
	Calibrates	1	2	③
	EVALUATING			
	Questions	1	2	③
	Analyses	1	2	③
	Judges	1	2	③
PERFORM	**INITIATING**			
	Starts	1	2	③
	Stops	1	2	③
	CONTINUING			
	Flows	1	2	③
	Continues	1	2	③
	Persists	1	2	③
	CONTROLLING			
	Times	1	2	③
	Coordinates	1	2	③
	Adjusts	1	2	③

Figure20. Participant 2: Leon – follow-up PRPP Assessment of meal preparation task.

4.2.3 Measuring the impact of the PRPP Intervention on cognitive strategy application – PRPP Assessment Stage Two: Cognitive Strategy Use.

Leon's ability to apply cognitive strategies during effective task performance was analysed using PRPP Assessment Stage Two: Cognitive Strategy Use of the PRPP System of Task Analysis: Assessment & Intervention for each of the tasks he completed for pre-intervention, post-intervention and follow-up assessment. The results of these assessments are detailed in Figures 17 to 20.

4.2.3.1 Pre-intervention assessment. Leon achieved PRPP total scores of 67 and 85 for his two pre-intervention assessments. Individual quadrant scores are outlined in Figures 17 and 18. During the pre-assessment, cognitive strategies for Recalling Schemes and Recalling Procedures (Recall quadrant); Mapping, Programming and Evaluating (Plan quadrant); and Continuing and Controlling (Perform quadrant) were noted as areas of difficulty. The specific strategies that were impacting on task performance were Using the Body (in this analysis, the prosthesis is considered part of the body). Leon did not Question his own performance, and so did not Evaluate specific issues he was experiencing or Adjust his plans when completing the task. He often Persisted with his selected choices (such as the position of his terminal device) even though it was not effective. He was unable to keep track of where he was in the task and did not perform the task in an appropriate Sequence. As a result, he demonstrated poor task performance and was not effective in the use of his prosthesis.

4.2.3.2 Designing PRPP Intervention. The results of the assessment were used to plan for the PRPP Intervention session. The PRPP System of Task Analysis: Assessment & Intervention provides a framework for developing an intervention plan that targets the specific cognitive strategies that are required to improve task performance. After the initial assessment was complete and the cognitive strategies were evaluated, the general Stop, Attend/Sense; Think "remember"; Think "figure out"/"checkout"; Do structure was used to develop a specific cognitive strategy sequence. The prompting strategy was developed to mirror information processing and provide a coherent flow through the task.

Stop is used to prevent errors from occurring and was used in most of the prompting sequences developed for Leon. Attend/Sense targets cognitive strategies from the Perceive quadrant, and for Leon the cognitive strategy of Monitors was targeted. Think “remember” targets cognitive strategies from the Recall quadrant and Use Body was targeted. The Think “figure out” prompt targets cognitive strategy errors in the Plan quadrant, and the strategies of Questions, Analyse and Judge were targeted as a sequence of evaluating and decision-making. Do is used as the prompt to target cognitive strategies in the Perform quadrant of which Flows and Persists were targeted.

An example of a prompting sequence used for Leon is as follows:

Stop, look at your prosthesis. Remember that we are trying to use the prosthesis more. Ask yourself what is the best way to approach this step, and then get started. Remember to keep on going.

Similarly to Stuart, as Leon increased his ability to use his prosthesis and internalised the prompting sequence, the treating therapist was able to reduce the number of prompts that they provided, which encouraged generalisation of the prompting sequence to other tasks. As noted in the GAS scores achieved by Leon, mastery of the specific task of folding clothes was achieved even though it was not targeted as part of the PRPP intervention.

4.2.3.3 Post-intervention and follow-up assessments. Post-intervention, Leon’s PRPP Assessment scores increased from 67 to 101, and at the follow-up assessment continued to improve to 105. Table 10 and Figure 24 indicate the changes in the scores. Improvements were observed in each quadrant; however, the Recall, Plan and Perform quadrants demonstrated the greatest level of improvement.

In the post-intervention analysis, there was a marked improvement in cognitive strategy use, although there were some minor issues with the Use Body, Identify Obstacle and Question strategies. There was more consideration given to pre-positioning the terminal device prior to attempting the steps of the task, and at times when it wasn’t set up correctly, these resulted in the descriptor errors above.

During the follow-up assessment, there were no cognitive strategy errors observed. As mentioned previously, the task of opening a can of tomatoes was selected by the participant as a task that he had completed outside of the therapy sessions and was directly related to his goals. This achievement demonstrates that Leon not only improved his performance as a result of his participation in the treatment program but also indicates his ability to use the skills that he learnt in therapy and apply them to his everyday life.

Table 10
Participant 2: Leon – PRPP Stage Two Scoring

Cognitive Strategy	Pre-Intervention Score (Task 1)	Pre-Intervention Score (Task 2)	Post-Intervention Score	Follow-Up Score
Attending	9	9	9	9
Sensing	6	7	8	9
Discriminating	9	9	9	9
Perceive quadrant	24	25	26	27
Recalls facts	9	9	9	9
Recalls schemes	5	8	9	9
Recalls procedures	4	7	8	9
Recall quadrant	18	24	26	27
Mapping	4	5	8	9
Programming	3	5	9	9
Evaluating	3	5	8	9
Plan quadrant	10	15	25	27
Initiating	5	6	6	6
Continuing	5	7	9	9
Controlling	5	7	9	9
Perform quadrant	15	20	24	24
PRPP total score	67	84	101	105

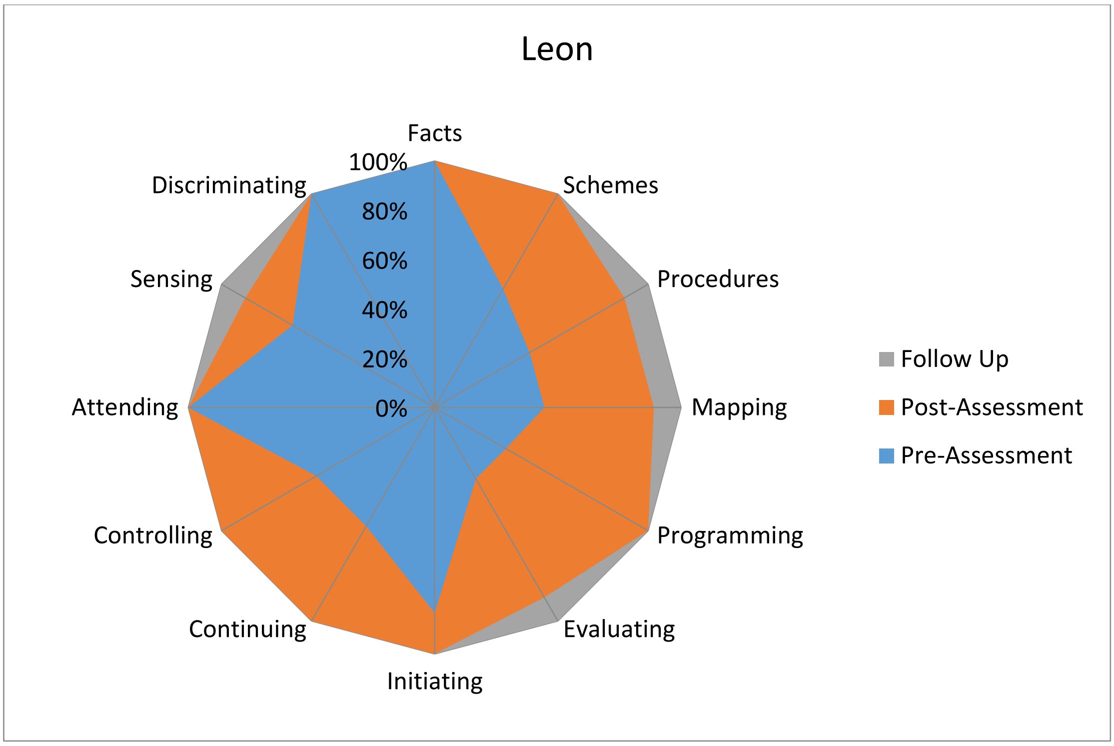

Figure 21. Participant 2: Leon – PRPP Stage Two analysis.

4.2.4.3.1 Intrapersonal component capacities. Leon reported a moderate level of depression at the pre-intervention assessment (see Table 11). This had reduced to within normal limits at the time of the post-intervention assessment. His reported levels of anxiety and stress were within normal limits at his pre- and post-intervention assessments.

Leon's sense of general self-efficacy increased following the PRPP Intervention (see Table 12). The initial score of 24/40 increased to 30/40 following intervention. This indicated an increase from below expected levels to the population-based norm post-intervention (29/40) (Luszczynska et al., 2005).

Table 11
Participant 2: Leon – DASS 21

DASS 21	Pre	Post
Depression	8	0
Anxiety	2	0
Stress	4	0

Table 12
Participant 2: Leon – General Self-Efficacy Scale

General Self-Efficacy Scale	Pre	Post
I can always manage to solve difficult problems if I try hard enough.	2	3
If someone opposes me, I can find the means and ways to get what I want.	3	3
It is easy for me to stick to my aims and accomplish my goals.	2	3
I am confident that I could deal efficiently with unexpected events.	1	3
Thanks to my resourcefulness, I know how to handle unforeseen situations.	3	3
I can solve most problems if I invest the necessary effort.	3	3
I can remain calm when facing difficulties because I can rely on my coping strategies.	1	3
When I am confronted with a problem, I can usually find several solutions.	3	3
If I am in trouble, I can usually think of a solution.	3	3
I can usually handle whatever comes my way.	3	3
Total score	24	30

4.2.4 Measuring the impact of the PRPP intervention on biomechanical capacity: ULPA – Task Performance Mastery (TPM) and Comparative Analysis of Performance – Motor (CAP–M).

4.2.4 Measuring the impact of the PRPP intervention on biomechanical capacity: ULPA – Task Performance Mastery (TPM) and Comparative Analysis of Performance – Motor (CAP–M). Leon's capacity to apply his biomechanical abilities to the task was evaluated using the ULPA, which included analysis of the movements required to operate the prosthesis and all other actions required for task performance. The ULPA consists of two parts: Part One: Total Performance Mastery (TPM) is presented on the left-hand side of the ULPA score sheets; Part Two: the Comparative Analysis of Performance – Motor (CAP–M) is presented on the right-hand side of each ULPA score sheet. As outlined in section 3.6.4, the TPM evaluates performance errors across all task steps, while the Part Two: CAP–M focuses on the most problematic step of the task.

4.2.4.1 Pre-intervention assessment. For the pre-intervention assessment, the task of flipping a pancake was selected. The results of the ULPA for this assessment are detailed in Figure 21. Leon was required to hold the handle of the pan with his prosthesis whilst his other hand used a spatula to flip the pancake. As Leon did not pre-position his terminal device, he was required to change how he reached for the pan to compensate. This resulted in a Part One: TPM score of 50%. The Part Two: CAP–M for this step shows the missing motor action of using the wrist rotator, but also indicates the excessive shoulder abduction used to position his arm in a place where he could utilise his terminal device.

4.2.4.2 Post-intervention assessment. After the PRPP Intervention, Leon completed the same task of making a pancake. The results of the ULPA for this assessment are detailed in Figure 22. He successfully completed the task and only demonstrated errors of accuracy when orientating his body towards the stove and realigning his body after releasing the pan. This resulted in a Part One: TPM score of 75%. The Part Two: CAP–M for this step shows excessive movements of shoulder abduction and neck flexion, which was the result of Leon not aligning himself correctly.

4.2.4.3 Follow-up assessment. At the six-week follow-up appointment, Leon made spaghetti bolognese and the task component of opening a can of tomatoes was selected for analysis using the ULPA. His Part One: TPM score for this assessment was 100%, and the Part Two: CAP–M indicates no excessive, missing or timing errors in his motor actions. The results of the ULPA for this assessment are detailed in Figure 23.

TASK PERFORMANCE MASTERY (TPM)				
STEPS	Om	Acc	Rep	Tim
Orient body towards stove top		X		
Reach to pan		X		
Pre-position prosthesis	X			
Open terminal device				
Close terminal device on handle of pan				
Stabilise fry pan				
Open terminal device to release handle of fry pan				
Realign body		X		
TPM: 4/8 = 50%				

COMPARATIVE ANALYSIS OF PERFORMANCE – MOTOR (CAP-M)				
STEP: Flipping pancake (Pre-assessment - Leon)				
Expected	Observed	Excessive	Missing	Timing
Shoulder: Flexion	*Shoulder:* Abduction	*Shoulder:* Abduction		
Elbow: Flexion	*Elbow:* Flexion			
Wrist Unit: Rotate using right upper limb	*Wrist Unit:*		*Wrist Unit:* Rotate using right upper limb	
Terminal Device (open): Right and left shoulder adduction and flexion	*Terminal Device (open):* Right and left shoulder adduction and flexion			
Terminal Device (Close): Return left and right shoulder to neutral	*Terminal Device (Close):* Return left and right shoulder to neutral			
Neck: Flexion	*Neck:* Flexion	*Neck:* Flexion		
Torso: Flexion	*Torso:* Flexion	*Torso:* Flexion		
8	*7*	*3*	*1*	

Figure 22. Participant 2: Leon – ULPA pre-assessment of flipping a pancake.

TASK PERFORMANCE MASTERY (TPM)					
STEPS	Om	Acc	Rep	Tim	
Orient body towards stove top		X			
Reach to pan					
Pre-position prosthesis					
Open terminal device					
Close terminal device on handle of pan					
Stabilise fry pan					
Open terminal device to release handle of fry pan					
Realign body		X			
TPM: 6/8 = 75%					

COMPARATIVE ANALYSIS OF PERFORMANCE – MOTOR (CAP-M)				
STEP: Flipping pancake (Post-intervention - Leon)				
Expected	Observed	Excessive	Missing	Timing
Shoulder: Flexion *Elbow:* Flexion *Wrist Unit:* Rotate using right upper limb *Terminal Device (open):* Right and left shoulder adduction and flexion *Terminal Device (Close):* Return left and right shoulder to neutral *Neck:* Flexion *Torso:* Flexion	*Shoulder:* Flexion, Abduction *Elbow:* Flexion *Wrist Unit:* Rotate using right upper limb *Terminal Device (open):* Right and left shoulder adduction and flexion *Terminal Device (Close):* Return left and right shoulder to neutral *Neck:* Flexion *Torso:* Flexion	*Shoulder:* Abduction *Neck:* Flexion *Torso:* Flexion		
8	*9*	*3*		

Figure 23. Participant 2: Leon – ULPA post-assessment of flipping a pancake.

TASK PERFORMANCE MASTERY (TPM)					
STEPS	Om	Acc	Rep	Tim	
Orient body towards bench					
Reach to can					
Pre-position prosthesis					
Open terminal device					
Close terminal device on can					
Stabilise can					
Open terminal device to release can					
Realign body					
TPM: 8/8 = 100%					

COMPARATIVE ANALYSIS OF PERFORMANCE – MOTOR (CAP-M)				
STEP: Opening a can of tomatoes (Follow up – Leon)				
Expected	Observed	Excessive	Missing	Timing
Shoulder: Flexion, internal rotation *Elbow:* Flexion *Wrist Unit:* Rotate using right upper limb *Terminal Device (open):* Right and left shoulder adduction and flexion *Terminal Device (Close):* Return left and right shoulder to neutral *Neck:* Flexion *Torso:* Flexion	*Shoulder:* Flexion, internal rotation *Elbow:* Flexion *Wrist Unit:* Rotate using right upper limb *Terminal Device (open):* Right and left shoulder adduction and flexion *Terminal Device (Close):* Return left and right shoulder to neutral *Neck:* Flexion *Torso:* Flexion			
9	*9*			

Figure 24. Participant 2: Leon – ULPA follow-up assessment of opening a can of tomatoes.

Chapter 5
Discussion

In this chapter, study findings are discussed in the context of their implications for clinical practice, future research and education. This clinically based research study was focused on occupational therapy for adults with an upper limb prosthesis, with the objective being to increase prosthetic use. The study used occupational performance as a measure of successful prosthetic use. Its in-depth design enabled a detailed examination of assessment processes, intervention planning, implementation and evaluation. The research questions have been considered and addressed throughout the discussion. The first research question, "What factors are associated with prosthesis rejection, and how do these influence the occupational role engagement of people with an upper limb amputation?" has been addressed in discussion point 5 and 7.

The second research question of "What occupational performance and capacity component issues do adults with an upper limb amputation demonstrate when engaging in meaningful tasks with a prosthesis?" has been addressed in discussion points 1 and 2.

The third research questions of "What impact does the Perceive, Recall, Plan and Perform (PRPP) Intervention have on role engagement and occupational performance of adults with an upper limb amputation?" has been addressed in discussion point 4.

The final research questions of "What impact does the PRPP Intervention have on the individual component capacities of adults with an upper limb amputation when engaging in meaningful tasks with a prosthesis?" has been addressed in discussion points 3, 4 and 6.

5.1 Discussion Point 1: Measuring Occupational Performance

A unique occupational therapy assessment system was applied in this research in a novel clinical setting to study upper limb prosthetic use and the findings indicate that it is appropriate to use for this population. The PRPP Assessment, which evaluated task mastery and the application of cognitive strategies during task performance, was particularly useful even in the absence of a specific cognitive impairment.

The standardised processes for administration and scoring the PRPP Assessment contrast with traditional methods of assessing task performance in this clinical population, which typically include functional observations that subjectively evaluate performance. Observations are often evaluated and recorded in a non-standardised way (Creek, 2010). Occupational therapists are trained in task analysis, which provides a method for breaking down tasks into their required steps (O'Toole, 2011).

The PRPP Assessment Stage One: Performance Mastery provides a systematic way to conduct task analysis and a standardised method for evaluating errors in task performance. It adopts a task analytic approach to evaluation that is useful in understanding the steps of the task and the types of errors that occur and where they happen (Chapparo & Ranka, 2007).

When evaluating the performance of both participants prior to intervention, there was a commonality in the type of errors that were recorded and categorised using the PRPP Assessment Stage One: Performance Mastery method. In both instances, the participants demonstrated predominantly errors of accuracy, rather than omission, repetition or timing errors. This would be expected from individuals with what could be classified as a motor performance impairment (Spencer, 2003). This classification of errors enables the treating therapist to understand the cause of task performance errors and therefore be in a position to develop education or training strategies that target such errors. Errors of omission, for example, may indicate that an individual does not know the required steps of the task, suggesting an errorless learning approach may be suitable, whereas in this instance, the errors of accuracy represent the step being attempted but not being completed correctly, suggesting that shaping may be a more suitable intervention technique.

In this research, the PRPP Assessment Stage One: Performance Mastery was found to be an appropriate method for evaluating the performance errors of individuals using a prosthesis, and the classification of errors assisted in developing a clear understanding of the performance issues that each participant had experienced. Prior to intervention, the two participants had been evaluated as performing approximately half the required task steps with no errors (Stuart – 40% and Leon – 55%).

5.2 Discussion Point 2: Measuring Cognitive Strategy Use

The second stage of the PRPP Assessment evaluated cognitive strategy use during meaningful everyday occupations. The two participants did not have any documented cognitive deficits; however, both demonstrated poor cognitive strategy use during task performance when using a prosthesis. Soede (1982) demonstrated that the use of a prosthesis required additional cognitive load. The results of the PRPP Assessment Stage Two: Cognitive Strategy Use would support this contention. The learning of a new task, or applying a new tool, requires additional cognitive effort (Bouwsema, van der Sluis, & Bongers, 2008; Soede, 1982), and it is hypothesised that the complexity of using a prosthetic limb (a new tool) could result in the cognitive strategy deficits that were observed.

People who sustain physical impairments may have to think harder about how, when and where to move their bodies for optimum occupational performance (Chapparo, Ranka, & Nott, 2017). In particular, difficulty in thinking about and planning movements, re-learning movement or learning new movements, maintaining goal-directed movements, or using sensory-motor feedback systems to adjust the quality of physical actions can all be impacted during occupational performance, even in the absence of a specific cognitive impairment (Rock & Atkins, 1996; Wolpert, Diedrichsen, & Flanagan, 2011). The findings of this pilot study parallel these assertions and highlight the importance of the classification of the PRPP System of Task Analysis: Assessment and Intervention as an assessment of occupational performance and cognitive strategy use, not a cognitive capacity assessment.

The pattern of cognitive strategy errors demonstrated by both participants prior to the PRPP Intervention was similar. The graph in Figure 25 has been generated to overlay the PRPP Stage Two: Cognitive Strategy Use analysis from the pre-intervention assessments of both participants. The errors in cognitive strategy use are similar for both participants. A consistent error in the Perceive quadrant (Sensing sub-quadrant) between both participants was the Monitors descriptor. The participants did not keep track of their prosthetic limb during the task and it was often left sitting to their side. Due to the loss of a limb, the usual sensations and proprioceptive feedback gathered from the arm are not present (Smurr, Gulick, Yancosek, & Ganz, 2008), and therefore there may need to be additional cognitive effort applied to monitoring where the limb is in space (Bouwsema, van der Sluis, & Bongers, 2014).

People who have physical impairment that has been caused by musculoskeletal disorders, such as upper limb amputation, have to use thinking strategies to learn how to move again, or to move in a different way, or to compensate for lost movement

(Chapparo et al, 2017). In the Recall quadrant (Procedures sub-quadrant) the Use Body cognitive strategy was consistently low for both participants during the pre-intervention assessment. As stated previously for this research, the prosthesis was considered to be part of the client's body rather than a task object, which meant that the recalling of strategies for prosthetic use was evaluated using the Use Body assessment item.

One of the common areas of training for all prosthetic users is the concept of pre-positioning, which is the deliberate choice of how to position the terminal device prior to starting a step of a particular task. It is a step required to ensure that the position of the prosthesis matches the intended task use (Smurr et al., 2008; Spencer, 2003). It is a step that both participants experienced difficulty with. Pre-positioning is dependent on several cognitive processes, but key to pre-positioning are the strategies of Use Body, Identify Obstacle, Organise, Choose, Question, Analyse and Judge. These strategies are associated with all three sub-quadrants of the Plan quadrant (Mapping, Programming and Evaluating). The Plan quadrant is associated with complex, multistep or novel tasks, particularly where there are many choices (Nott & Chapparo, 2008), such as completing a multi-stepped cooking task whilst selecting an appropriate position for the terminal device during task performance. Nott and Chapparo (2012) evaluated the construct validity of The PRPP Assessment, highlighting that the Plan quadrant contained the most complex processing strategies, particularly, Judges, Analyses, Identify Obstacles, Organises and Questions. Prior to intervention, both participants experienced significant difficulties with these strategies as indicated in Figure 25. Poor ability to effectively use these cognitive strategies resulted in poor Flow. In this research, poor Flow was evident when the participants needed to use a trial-and-error approach to determine the best position of the terminal device. The cognitive strategy of Flow is evaluated as part of the Perform quadrant (continuing sub-quadrant) and is considered to be a complex strategy (Nott & Chapparo, 2012). Difficulty with this strategy is indicated in Figure 25 for both participants.

The ability of the PRPP Stage Two: Cognitive Strategy Use assessment to highlight errors is vital in understanding what is limiting the ability of an individual to use a prosthesis. A suggested outcome measure for individuals with an amputation of the upper limb is the Block and Box test (Resnik, Borgia, Silver, & Cancio, 2017). This test is a measure of how quickly an individual can move blocks from one side of a box to the other over a divider in the middle. It is essentially a measure of terminal device control and the ability to move a prosthetic limb through space. As all of the blocks are the same size and shape, the need to change the position of the terminal device is not required. In this instance, increasing the ability of an individual to control their prosthesis and increase their score on the Block and Box test may not translate into real-world activities. The PRPP Assessment provides a standardised, reliable measure of task performance, which is based on tasks that have been selected by an individual, depending on their goals and requirements.

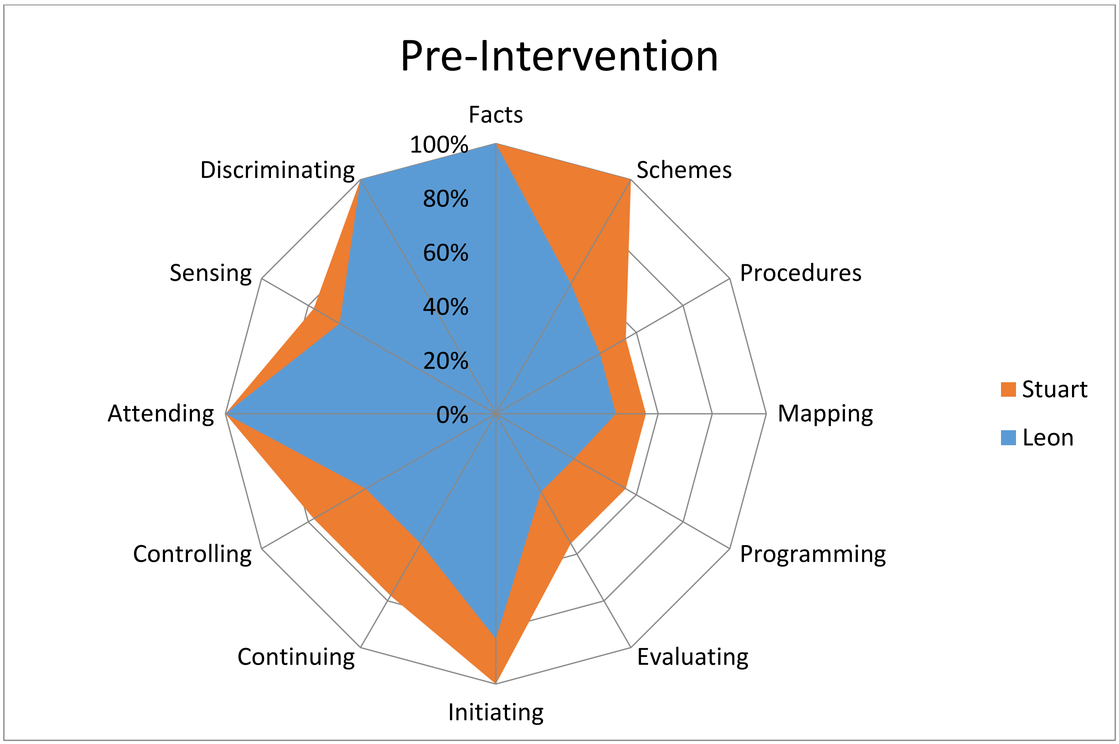

Figure 25. PRPP Assessment Stage Two: Cognitive Strategy Use – Pre-Intervention.

The PRPP Assessment (Stage One and Stage Two) was effective in evaluating occupational performance using a prosthesis and provided an understanding of why certain aspects of tasks were difficult. The overall pattern of cognitive strategy deficits – as indicated in Figure 25 – was critical in highlighting the key areas that were targeted during the intervention phase. The results from this small study suggest that further exploration of how the PRPP System of Task Analysis: Assessment and Intervention can be adapted to other physical-based areas of occupational therapy practice is warranted.

5.3 Discussion Point 3: Outcome Measures – Motor Performance

In addition to evaluating occupational performance and cognitive strategy use, the research design for this study also included a novel assessment of Upper Limb Motor Performance (ULPA). The ULPA Part Two: Comparative Analysis of Performance –

(CAP–M), has a comparative analysis component that is useful in determining the missing and excessive motor components of task performance when using a prosthesis. It compares the expected task movements and the observed task movements in order to identify and categorise motor errors.

The ULPA Part Two: CAP–M highlights that the main issues experienced when using a prosthesis can be classified as either involving excessive or missing movements. This system of classification provides very relevant information about how the individual is using the prosthesis during task performance and enables the therapist to determine what aspects of using the prosthesis are causing the person to perform compensatory or excessive movements. This clinical assessment provides an important piece of information as overuse injuries are very common among adults with an amputation of the upper limb (Jones & Davidson, 1999). Being able to identify excessive movements that result in performance limitations enables the occupational therapist to address prosthetic control issues and minimise overuse injuries in the context of functional performance.

When the ULPA Part Two: CAP–M assessment method was applied to the two participants, it identified that both participants were exhibiting shoulder elevation of the amputated side when using the prosthesis, a movement that is not required for correct prosthetic use. However, having been made aware of this, the treating therapist was then able to assist both participants to become conscious of this excessive movement and could provide prompts to reduce this unnecessary action.

The ULPA Part Two: CAP–M can also highlight aspects of the task where movements are missing. Prior to the intervention of the study, Stuart had not initiated use of his prosthesis during a task, which highlighted the need for training that would target knowing when to use the prosthesis during task performance. The ULPA Part Two: CAP–M also identified that when Stuart did start to use his prosthesis, he did so with excessive movements that affected his task performance. As this indicated that he had difficulty incorporating the prosthesis into completing a task, training could be targeted to ensure that he was both able to know when to use the prosthesis and to be able to use it effectively in undertaking a task.

5.4 Discussion Point 4: The PRPP Intervention Program

The PRPP Intervention provides a structured and systematic framework that is targeted to improve cognitive strategy use. An assumption of the PRPP System of Task

Analysis: Assessment and Intervention is that if task performance is impacted by poor cognitive strategy use, then by targeting this, the individual should be able to improve their ability to perform the required task (Chapparo & Ranka, 2007; Chapparo et al., 2017). In this study, post -intervention improvement in task performance was observed with task mastery increasing in both instances, as detailed in Figures 7 to 11 and Figures 17 to 20 in Chapter 4.

In this study, the PRPP Intervention provided a structured prompting sequence that enabled the participants to learn the cognitive strategies that were required for effective prosthetic use, and this in turn enabled them to perform tasks effectively with their prostheses. The ability to apply cognitive strategies appropriately has been linked with task mastery (Nott & Chapparo, 2012; Nott, Chapparo, & Heard, 2009).

Both the participants demonstrated an increase in cognitive strategy use (PRPP Stage Two: Cognitive Strategy Use) and improved task mastery (PRPP Stage One: Performance Mastery). This indicates that the PRPP Intervention had a positive impact on the ability of the participants to perform tasks, which was confirmed by their goal attainment results. The case study design enabled an in-depth examination of how the PRPP Intervention impacted on each of the two individuals who participated in the study and the results have demonstrated that PRPP Intervention can provide a framework for effective intervention to increase task mastery, cognitive strategy use and prosthetic use. Generalisation of the training conducted during the PRPP Intervention sessions enabled the two participants to achieve goals that were not targeted during the intervention. The focus of PRPP Intervention on cognitive strategies that can be generalised across tasks enabled these individuals to participate in a wider range of meaningful activities and resulted in an increase in the reported self-efficacy of both participants.

Occupational performance significantly improved on tasks that were important to each study participant. This research has also confirmed the link between improved cognitive strategy use and improved task performance. Learning how to apply the prosthesis required the two participants to use the most appropriate cognitive strategies to achieve the requirements of the allocated tasks. The findings from this study provide initial evidence that the PRPP System of Task Analysis: Assessment and Intervention is a suitable intervention system for use with adults with an amputation of the upper limb and may provide a framework for targeting the specific behaviours required for effective prosthetic use.

The current literature, whilst outlining general principles of training, does not provide specific intervention frameworks that can ensure that the instructions given are tailored to meet the needs of this population. In providing training to adults with an upper limb amputation, the step of pre-positioning is required for effective prosthetic use. The current literature recommends that clients are provided with education on how to select an appropriate position of the terminal device task by task (Smurr et al., 2008). The PRPP Intervention provides a systematic way to provide this education so that it becomes embedded within task performance. The intervention provided by this research, focused training on ensuring accurate use of the prosthesis for the steps of the task. Instruction on prosthetic control was provided where needed during the initial stages of the intervention, and a training arm was used by the treating clinician to demonstrate to the participants how to use their limb prosthesis. The intervention of providing instruction on prosthetic use is considered the primary role of occupational therapy in the treatment of adults with a prosthesis (Spencer, 2003).

The training methods included within the PRPP Intervention approach involve generalisation being incorporated from the outset in working with clients on prosthetic use. The prompting structure is based on the descriptors that need to be targeted and hence the way that prompting is delivered is focused on targeting the descriptor behaviour rather than a task-specific behaviour. In this way, cognitive strategies such as Use Body, Identify Obstacle, Organise, Choose, Question, Analyse and Judge, which are all vital in the process of pre-positioning, are targeted as the way to process information to best determine how to pre-position the device. A number of these descriptors were combined and targeted together during the intervention period and, consequently, pre-positioning was taught as a pattern of information processing rather than as a specific “best choice” for each task.

This also provides for these cognitive strategies to be targeted for other steps of the task where a similar error may occur, and they enabled each participant to develop his own method and rationale for the selection of the position of the terminal device for each step. This showed that strategies learnt during intervention sessions were carried through outside of therapy. In contrast, Nott, Chapparo, and Heard (2008) found that participants with a traumatic brain injury were less able to generalise the learnt cognitive strategies to tasks performed after cessation of the PRPP Intervention. Nott et al. (2008) also found that participants with very severe brain injuries demonstrated less improvement than others, indicating that a minimum baseline level of cognition is required for this intervention to have the greatest impact.

The focus of this research was to address the cognitive load that impacts on the ability to use a prosthesis. The PRPP Intervention provided skills and knowledge that enabled the participants to utilise the prosthesis in tasks that were meaningful to them. Increased task mastery and increasing effective cognitive strategy use has an impact on increasing prosthetic use. The results indicate that the PRPP Intervention was effective in providing the skills required to use a prosthesis in real-world contexts and enabled those skills to be generalised as required. Effective cognitive strategy use is the ability to effectively collect, process and use information to achieve task performance, which indicates decreased cognitive load.

5.5 Discussion Point 5: Client-Centred Approach

The research study was designed to ensure that a client-centred approach was taken. Goal setting was conducted in collaboration with the participants to ensure that the PRPP Intervention targeted meaningful occupations. The participants exceeded their expected goal attainment scores after the intervention period. As part of the study design, three goals were developed by the participants, but only two of those goals were targeted during the intervention sessions with the treating therapist. The achievement of the third goal demonstrated the ability of the PRPP Intervention to facilitate the generalisation of skills. This generalisation is important as it indicates that the participants were not reliant on the therapist to provide opportunities to practise the skills learnt during the PRPP Intervention. Generalisation is reported often as a key component of prosthetic training (Smurr et al., 2008; Spencer, 2003). As a result, each participant in this study could use their prosthesis in a way that suited their needs.

Prosthetic rejection is a major concern for health professional working with individuals with an upper limb amputation because of the cost of providing a prosthesis and the training involved in using a prosthesis (Biddiss, 2010; Biddiss & Chau, 2007a, 2007b). Biddiss (2010) argues that successful prosthetic use should be considered in the context of the needs of the individual, and so, prosthetic use for only certain tasks should be considered successful.

During the follow-up assessment with Stuart, it was noted that he did not use his prosthesis to hold the fry pan steady when flipping the pancake. When this was explored in order to determine if there were any cognitive strategy use errors, it was determined that there were no errors, as he had made a Choice about how to use the prosthesis for that aspect of the task. Overall, Stuart was using his prosthesis for a large proportion of the cooking tasks that he was completing.

This point highlights the need for therapists to be open to understanding how their clients want to use a prosthesis and to encourage them to experiment and use it how they see fit. Although understanding that increased prosthetic use is a goal of therapy, expecting 100 per cent use is not realistic or appropriate in all situations.

5.6 Discussion Point 6: Psychological Considerations

This study also examined the effect of the PRPP Intervention on self-efficacy, and the research results indicate that there had been an increase in reported self-efficacy for both participants. The focus of the PRPP Intervention is on developing strategies that can be used across all tasks, and therefore the goal is to increase task mastery and engagement in occupations. As task mastery increases, it may impact on perceptions of occupational competence and self-efficacy (Braveman, Kielhofner, Albrecht, & Helfrich, 2006).

Self-efficacy is the belief that an individual has about how well they can adapt and overcome adversity (Bosscher & Smit, 1998), and may play a role in the willingness of an individual to persevere (Bentsen, Wentzel-Larsen, Henriksen, Rokne, & Wahl, 2010). The results of this study indicate that when the cognitive strategies were effectively learnt and generalised, the participants could understand how to use their prosthesis for different tasks. This learning led to the participants increasing their attempts to engage in new tasks and to apply the cognitive strategies they had learnt to achieve greater task mastery. Increased task mastery, therefore, may be associated with increased self-efficacy (Christiansen, 1999).

5.7 Discussion Point 7: Prosthetic Rejection Factors

The goal of occupational therapy is to focus on the engagement of clients in their occupations. It also provides a framework for examining the desired task mastery and not just the increased use of a prosthesis by these clients. As highlighted by the responses to the questions asked of the participants during their interviews on the beliefs that influenced their prosthetic use, a change was noted in what they reported as influencing their decisions about prosthesis use from before the intervention to after it.

Stuart initially reported that the weight and the uncomfortable nature of the prosthesis influenced his decision not to use it prior to the PRPP Intervention. Even after the intervention, he still reported that the uncomfortable nature of the prosthesis and the concentration required to use it were still factors that influenced his decision of whether to use the prosthesis or not, but that they had reduced. Studies on factors that affect prosthetic use present these factors as stable or static (Biddiss & Chau, 2007a, 2007b; Ostlie et al., 2012); however, the evidence from this study suggests that they can change and adapt over time.

Leon reported that the only factor he considered in his choice of whether to use the prosthesis prior to the intervention was whether it was quicker and easier to do complete tasks without his prosthesis. Interestingly, he reported after the intervention that a factor that affected his choice was the force required to use the prosthesis. This was reflected in his responses to the interview questions, where he reported that prior to the intervention he was wearing his prosthesis only occasionally and was not using it for functional tasks. However, when his task mastery had increased, Leon reported in his post-intervention interview that he was engaging in functional tasks and actively using his prosthesis.

What these changes in factors represented for the participants was a re-evaluation of the cost-benefit analysis of using the prosthesis. Both participants reported that they were using the prosthesis more, that they had analysed the readjustment themselves, and that they had found the prosthesis was indeed useful at times, notwithstanding the fact that neither participant reported full-time use of the prosthesis.

This scenario reinforces the point that decisions to use a prosthesis are user-driven individual factors. A client-centred approach is supported by the positive results of the intervention, which indicate that changes in occupational performance that target significant occupations can enhance prosthetic use for meaningful activities.

5.8 Summary

The use of the PRPP System of Task Analysis: Assessment and Intervention for the assessment of the performance of adults with an amputation of the upper limb who are using a prosthesis provides information that is relevant to understanding the cognitive strategy use issues that affect task performance. The PRPP Assessment provides information that can assist with the development of an intervention program that addresses the cognitive load issues associated with prosthetic use and can enhance occupational performance. During the earlier stages of prosthetic training, where motor control issues may be at the forefront, the results of ULPA assessment can highlight the movements that are present, absent or excessive that are affecting the client's prosthetic use.

5.9 Limitations

Any consideration of the significance of these findings must be viewed with caution. This study was a pilot study that examined an intervention method not used in this population and the limited number of participants (n = 2) is not sufficient to make generalisations to the entire population. The two participants were recruited from a single clinical site in the Sydney metropolitan area. Both were males and had below elbow amputations. As there were no women recruited for the study, it is unknown if different results could have occurred where gender may have had an influence. As both participants had below elbow amputations and were using body powered devices, the use of externally powered prosthetics, or above elbow amputations may have resulted in differing outcomes. Both participants also had similar goals, which may have contributed to similar outcomes.

5.10 Significance

Despite the limitations listed above, this research makes an important contribution to occupational therapy theory and practice for people living with an upper limb amputation. The in-depth case studies presented give valuable information of benefit to therapists, researchers, educators and those living with the challenges that result from an upper limb amputation.

5.10.1 Theoretical contribution. This research has expanded the understanding of the link between elements of occupational performance. Cognitive load appears to influence occupational performance in clients with no known cognitive deficit. This reinforces the importance of adopting a comprehensive view of clients and considering all of the component capacities and how these contribute to task performance and role satisfaction. The findings also suggest information-processing theory is a suitable framework for developing occupational therapy interventions for adults with an upper limb amputation using a prosthesis. It also highlights the importance of occupation-based therapy in providing relevant and meaningful occupational therapy programs.

5.10.2 Clinical contribution. This research has reinforced the need to ensure that prosthetic training programs address cognitive load as a contributory factor to successful prosthetic use. It provides the foundation for establishing the PRPP Intervention as an appropriate intervention model with this clinical group. The PRPP System of Task Analysis: Assessment and Intervention provides an appropriate method for evaluating the task performance mastery of adults with upper limb amputation. It facilitates the understanding of the cognitive load experienced by prosthetic users. It also provides a structured framework for intervention that produces a demonstrated improvement in task mastery through the targeting of the underlying cognitive strategies required for more effective prosthetic use.

The PRPP Intervention also provides a robust prompting framework that targets the specific behaviours required for prosthetic use and reinforces the need to ensure that generalisation is a key component of an intervention program. The need for generalisation also reinforces the use of occupation-embedded assessment that examines occupational performance mastery and cognitive strategy application.

5.10.3 Empirical contribution. This is the first known research that supports the use of the PRPP System of Task Analysis: Assessment and Intervention and the ULPA for use with adults with an amputation of the upper limb. It also provides further evidence supporting the use of PRPP Assessment and PRPP Intervention and ULPA in general populations.

5.11 Recommendation

There are number of key recommendations that emerge from this research in the areas of future research, clinical practice and education.

5.11.1 Research. The results of this research support further investigation of cognitive load in training adults with an amputation of the upper limb and more extensive studies into the effectiveness of the PRPP Intervention with this population. It also supports the further investigation of the PRPP System of Task Analysis:

Assessment and Intervention with other physical-based diagnosis.

5.11.2 Practice. It is recommended that therapists consider incorporating treatment for cognitive load into prosthetic training programs as it may directly enhance occupational performance. Cognitive strategy training approaches, such as the PRPP Intervention, provide a structured framework that facilitates cognitive strategy application and the reduction of cognitive load.

5.11.3 Education. When training and education is provided to therapists working with adults with an amputation of the upper limb, it is recommended that education on cognitive load is included, which focuses on aspects of occupation-embedded assessment and intervention.

5.12 Conclusions

This study investigated the effect of cognitive strategy application intervention with adults using a prosthesis. With consideration of the limitations of the study, conclusions that may be drawn from the research include the following:

- Cognitive load appears to be a factor in the decision to use a prosthesis for functional tasks.
- The PRPP Assessment is suitable for the evaluation of cognitive strategy application during occupational performance when using a prosthesis.
- The ULPA is useful in evaluating the motor performance of adults using a prosthesis and identifying the specific movements required for effective prosthetic use.
- The PRPP Intervention provides a clinically effective framework for addressing task mastery and cognitive strategy use in adults with an upper limb amputation.
- Targeting cognitive strategies enables generalisation to occur, which further enhances effective prosthetic use in occupational performance.

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Health
Western Sydney
Local Health District

HREC Ref: ***(4107) AU RED HREC/14/WMEAD/377***
SSA Ref: ***AU RED SSA***

10 December 2014

A/Prof Ian Baguley
Brain Injury Rehabilitation Unit
Westmead Hospital

Dear A/Prof Baguley

Project title: 'What is the effect of cognitive strategy interventi on on the occupational performance of individuals with an upper limb amuptation using a prothesis?'

Thank you for your corresondence addressing the matters raised in the HREC's letter dated 4 November 2014 following single ethical review of the above project at its meeting held on 28 October 2014.

This HREC has been accredited by the NSW Department of Health as a lead HREC to provide the single ethical and scientific review of proposals to conduct research within the NSW public health system. This lead HREC is constituted and operates in accordance with the National Health and Medical Research Council's *National Statement on Ethical Conduct in Human Research* and the *CPMP/ICH Note for Guidance on Good Clinical Practice*.

I am pleased to advise that the HREC has now granted ethical approval of this **multicentre** research project to be conducted at:

- Westmead Hospital – Coordinating Chief Investigator A/Prof Ian Baguley
- Wyong/WoyWoy Hospitals – Chief Investigator Dr Stephen Chung

The following documentation has been reviewed and approved by the HREC

- NEAF submission code AU/1/FF9A110
- Protocol Version 1 undated
- Revised Master Participant Information and Consent Form version 2 dated 1 December 2014
- AM-ULA, version 2, dated 20 November 2014
- Austoms for Occupational Therapy,v ersion 2, dated 1 December 2014
- The PRPP System Scoring Sheet, version 2, dated 20 November 2014
- Goal Attainment Scale, version 2, dated 20 November 2014

HUMAN RESEARCH ETHICS COMMITTEE

Research Office, Research & Education Network (REN) Building
Westmead Hospital, Hawkesbury & Darcy Roads, Westmead NSW 2145
Telephone 02 9845 8183 Facsimile 02 9845 8352
Email: WSLHD-ResearchOffice@health.nsw.gov.au

WESTERN SYDNEY LOCAL HEALTH DISTRICT
ABN 48 702 394 764
WSLHD Office, Westmead Hospital Campus
Institute Road, Westmead NSW 2145
PO Box 533, Wentworthville NSW 2145
Telephone 02 9845 5555

- Upper Limb Preformance Analysis (ULPA) version 2, dated 20 November 2014
- Interview Data Collection – Pre Intervention, version 2, dated 20 November 2014
- Interfview Data Collection – Post Intervention, version 2, dated 20 November 2014

Please note the following conditions of approval :

- The Coordinating Chief Investigator will immediately report anything which might warrant review of ethical approval of the project in the specified format, including unforeseen events that might affect continued ethical acceptability of the project.
- **For clinical trials of implantable medical devices only –** The Coordinating Chief Investigator will confirm to the HREC that a process has been established for tracking the participant, with consent, for the lifetime of the device and will immediately report any device incidents to the Therapeutic Goods Administration (TGA).
- The Coordinating Chief Investigator will immediately report any protocol deviation / violation, together with details of the procedure put in place to ensure the deviation / violation does not recur.
- The Coordinating Chief Investigator will provide to the HREC in the specific format, proposed amendments to the research protocol or conduct of the research which may affect the ethical acceptability of the project, must be provided to the HREC to review in the specific format. Copies of all amendments when approved by the HREC must also be provided to the Research Governance Officer.
- The Coordinating Chief Investigator must notify the HREC, giving reasons, if the project is discontinued at a site before the expected date of completion.
- The Coordinating Chief Investigator must provide an annual report to the HREC and a final report at completion of the study, in the specified format. HREC approval is valid for 12 months from the date of final approval and continuation of the HREC approval beyond the initial 12 month approval period is contingent upon submission of an annual report each year. A copy of the Annual / Final Research Report Form can be obtained electronically from the Research Office on request.
- The HREC has the discretion to adopt other appropriate mechanisms for monitoring depending on the complexity, design and risk perceived including
  1. Discussion of relevant aspects of the project with investigators, at any time,
  2. Random inspection of research sites, data or consent documentation,
  3. Interview with research participants or other forms of feedback from them, and
  4. Request and review reports from independent agencies such as a Data Safety Monitoring Board.
- If your research project is an interventional trial, please ensure it is registered on one of the clinical trial registries, eg http://www.actr.org.au.
- It should be noted that compliance with the ethical guidelines is entirely the responsibility of the Coordinating Chief Investigator.

You are reminded that this letter constitutes *ethical approval only*. You must not commence this research project at a site until separate authorisation from the Chief Executive or delegate of that site has been obtained. Copies of this letter, together with any approved documents as enumerated above, must be forwarded to all site investigators for submission to the relevant Research Governance Officer.

Should you have any queries about the HREC's Terms of Reference, Standard Operating Procedures or membership, please contact the Acting Research Ethics Manager through the Research Office on 9845 8183 or emailing kellie.hansen@health.nsw.gov.au.

In all future correspondence concerning this study, please quote approval number ***(4107) AU RED HREC/14/WMEAD/377***

The HREC wishes you every success in your research.

Yours sincerely

Mrs Kellie Hansen
Acting Research Ethics Manager
WSLHD Research & Education Network

cc Ms Margaret Piper, Research Governance Officer

Principal Investigator	Dr Ian Baguley
Study Title	What is the effect of cognitive strategy intervention on the occupational performance of individuals with an upper limb amputation using a prosthesis?

Please complete the boxes below and return a copy of this page only to the WSLHD Research Office:

☐ *I acknowledge and accept the conditions of ethical approval listed above*

☐ *I will not commence this project at any site until separate written authorisation from the Chief Executive or delegate of that site has been obtained*

Chief Investigator *(Print Name)*	*Signature*	*Date*

Appendix B – Human Research Ethics Committee Approval: Charles Sturt University.

Charles Sturt University

OFFICE OF
ACADEMIC GOVERNANCE

Private Mail Bag 29
Panorama Avenue
Bathurst NSW 2795
Australia

Tel: +61 2 6338 4185
Fax: +61 2 6338 4194

16 October 2015

Associate Professor Ian Baguley
Brain Injury Rehabilitation Service
Westmead Hospital
Cnr Hawkesbury Road and Darcy Road
Westmead NSW 2145

Dear Associate Professor Baguley,

Charles Sturt University's (CSU) Human Research Ethics Committee (HREC) has reviewed your research proposal entitled ***"What is the effect of cognitive strategy intervention on the occupational performance of individuals with an upper limb amputation using a prosthesis?"***.

The CSU HREC operates in accordance with the National Health and Medical Research Council's *National Statement on Ethical Conduct in Research Involving Humans.*

I am pleased to advise that the project meets the requirements of the *National Statement*; and ethical approval for this research is granted for a twelve month period from 16/10/2015.

The protocol number issued with respect to this project is **2015/268**. Please be sure to quote this number when responding to any request made by the Committee.

Please note the following conditions of approval:

- all Consent Forms and Information Sheets are to be printed on Charles Sturt University letterhead. Students should liaise with their Supervisor to arrange to have these documents printed;
- you must notify the Committee immediately in writing should your research differ in any way from that proposed. Forms are available at http://www.csu.edu.au/__data/assets/word_doc/0012/963768/Report-on-Research-Project_20130503.doc
- you must notify the Committee immediately if any serious and or unexpected adverse events or outcomes occur associated with your research, that might affect the participants and therefore ethical acceptability of the project. An Adverse Incident form is available from the website: as above;

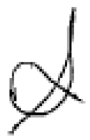
- amendments to the research design must be reviewed and approved by the Human Research Ethics Committee before commencement. Forms are available at the website above;
- if an extension of the approval period is required, a request must be submitted to the Human Research Ethics Committee. Forms are available at the website above;
- you are required to complete a *Report On Research Project*, which can be downloaded as above, by 16/10/2015 if your research has not been completed by that date;
- you are required to submit a final report, the form is available from the website above.

YOU ARE REMINDED THAT AN APPROVAL LETTER FROM THE CSU HREC CONSTITUTES **ETHICAL APPROVAL ONLY.**

If your research involves the use of radiation, biological materials, chemicals or animals a separate approval is required from the appropriate University Committee.

The Committee wishes you well in your research and please do not hesitate to contact the Executive Officer on telephone (02) 6338 4628 or email ethics@csu.edu.au if you have any enquiries.

Yours sincerely



Julie Hicks
Executive Officer
Human Research Ethics Committee
Direct Telephone: (02) 6338 4628
Email: ethics@csu.ed.au

This HREC is constituted and operates in accordance with the National Health and Medical Research Council's (NHMRC) *National Statement on Ethical Conduct in Human Research* (2007).

Appendix C – Interview Data Questions: Pre-Intervention

Interview Date: ____

Demographics

ID Number: ____

AGE: ____

Sex: M F

Highest level of education achieved: ______________________________

Injury History

Date of injury and amputation: ______________________________

____

History of injury:

____

____

____

____

____

____

Level of amputation:

____

Dominance prior to injury: Left Right

Has your dominance changed since your injury? Yes No

Social

QUESTION	Closed Answer	Comment
Who do you currently live with?		
Are these the same people that you lived with before your amputation?	Yes/No	

QUESTION	Closed Answer	Comment
Do your family or friends encourage you to try using your prosthesis to complete all the things you need to do?	Yes/No	
If your family helps – do they help out with things that you think you could do if you tried?	Yes/No	
When you go out in public, do you wear a prosthesis, cover your stump, or don't really think about what you do?	Prosthesis/cover stump /not worried	

Occupational Roles

Work

Are you currently working?	Yes/No	
What role do you currently work in?		
Is this the same as what you prior to your injury?	Yes/No	
What did you do prior to your injury?	N/A	
Have there been any modifications to the environment in which you work or modifications of work tasks to make it easier for you to do your job?	Yes/No	
Have you had to undertake any further training to allow you to work in your current job role?	Yes/No	

Self-Maintenance

Are you able to complete all of the tasks you need to do each day? Tasks like showering, dressing, cooking, cleaning etc?	Yes/No	
Do you currently receive any support from your family to complete any of these tasks?	Yes/No	
Do you receive any support from external services to complete any of these tasks?	Yes/No	

Leisure

Do you currently engage in any active leisure tasks – such as sport or fishing?	Yes/No	
Do you currently engage in any passive leisure tasks such as reading or listening to music?	Yes/No	
Are there any leisure tasks that you are unable to do because of your amputation or difficulty using a prosthesis?	Yes/No	

Goal Setting

If by the end of today you could do a task that you currently find difficult – what would that task be?	Yes/No	
What things would you like to achieve from this block of therapy?	Yes/No	

Stump Assessment

Shape of stump:

____

____

Scarring:

____

____

Tethering:

____

____

AROM:

____

____

____

Pain

Stump pain at Rest:

1 2 3 4 5 6 7 8 9 10

No Pain Worst pain

Stump pain During Activity:

1 2 3 4 5 6 7 8 9 10

No Pain Worst pain

Phantom limb sensations: Yes No

Type / description of sensation:

Frequency: All the time At least Daily Less than Daily

Known Triggers:

Impact on Daily tasks:

Impact on Prosthetic Use:

Phantom limb pain: Yes No

Type / description of sensation:

Frequency: All the time At least Daily Less than Daily

Known Triggers:

Impact on Daily tasks:

Impact on Prosthetic Use:

Medications:

Alt Management strategies:

1 2 3 4 5 6 7 8 9 10

No Pain Worst pain

Prosthesis

Type of Prosthesis:

____

Socket:

____

Number of bands:

____

During you average week how much would you use your prosthesis in terms of hours per day?

____

____

In that time that you use your prosthesis, how much use as a percentage, is the use for tasks?

Percentage – Functional use: % Cosmetic / non-Fx Use: %

Are there any specific task where you feel you have to use your prosthesis?:

____

____

____

Prosthetic rejection:

Please read each statement and indicate which statement best matches the impact of each of these factors on your use of your prosthesis.

1 = No impact at all

2 = Little Impact

3 = Moderate impact

4 = Significant impact

5 = Most significant impact

Prosthetic Factors

The weight of the prosthesis is too heavy	
The look or cosmetics of the prosthesis is not what I want	
The prosthesis is uncomfortable or hot	
The physical effort or force required to use the prosthesis	
Difficulty getting the prosthesis on and off	

Personal Factors

Difficulty using the prosthesis for what you want to do	
The concentration required to use the prosthesis	
The prosthesis is useful, but not worth the effort	
The prosthesis is not what I expected it to be	
It is quicker or easier to complete tasks without the prosthesis	

Prosthetic Checkout

Donn:	Yes	No	With difficulty	
Doff:	Yes	No	With difficulty	
Socket fit:	Good	Loose	Tight	
Operate terminal device:	Yes	No	With difficulty	
Operate wrist unit:	Yes	No	With difficulty	
Operate elbow:	Yes	No	With difficulty	N/A
Prosthetic review required:	Yes	No		

DASS21 *Name:* *Date:*

Please read each statement and circle a number 0, 1, 2 or 3 which indicates how much the statement applied to you *over the past week*. There are no right or wrong answers. Do not spend too much time on any statement.

The rating scale is as follows:

0 Did not apply to me at all
1 Applied to me to some degree, or some of the time
2 Applied to me to a considerable degree, or a good part of time
3 Applied to me very much, or most of the time

1	I found it hard to wind down	0 1 2 3
2	I was aware of dryness of my mouth	0 1 2 3
3	I couldn't seem to experience any positive feeling at all	0 1 2 3
4	I experienced breathing difficulty (eg, excessively rapid breathing, breathlessness in the absence of physical exertion)	0 1 2 3
5	I found it difficult to work up the initiative to do things	0 1 2 3
6	I tended to over-react to situations	0 1 2 3
7	I experienced trembling (eg, in the hands)	0 1 2 3
8	I felt that I was using a lot of nervous energy	0 1 2 3
9	I was worried about situations in which I might panic and make a fool of myself	0 1 2 3
10	I felt that I had nothing to look forward to	0 1 2 3
11	I found myself getting agitated	0 1 2 3
12	I found it difficult to relax	0 1 2 3
13	I felt down-hearted and blue	0 1 2 3
14	I was intolerant of anything that kept me from getting on with what I was doing	0 1 2 3
15	I felt I was close to panic	0 1 2 3
16	I was unable to become enthusiastic about anything	0 1 2 3
17	I felt I wasn't worth much as a person	0 1 2 3
18	I felt that I was rather touchy	0 1 2 3
19	I was aware of the action of my heart in the absence of physical exertion (eg, sense of heart rate increase, heart missing a beat)	0 1 2 3
20	I felt scared without any good reason	0 1 2 3
21	I felt that life was meaningless	0 1 2 3

General Self Efficacy Scale

Please read each statement and circle a number 1 – 4 which indicated how true you feel each statement is. There are not right or wrong answers.

The rating scale is as follows:

1. Not true at all
2. Hardly True
3. Moderately True
4. Exactly True

1	I can always manage to solve difficult problems if I try hard enough.	1	2	3	4
2	If someone opposes me, I can find the means and ways to get what I want.	1	2	3	4
3	It is easy for me to stick to my aims and accomplish my goals.	1	2	3	4
4	I am confident that I could deal efficiently with unexpected events.	1	2	3	4
5	Thanks to my resourcefulness, I know how to handle unforeseen situations.	1	2	3	4
6	I can solve most problems if I invest the necessary effort.	1	2	3	4
7	I can remain calm when facing difficulties because I can rely on my coping strategies.	1	2	3	4
8	When I am confronted with a problem, I can usually find several solutions.	1	2	3	4
9	If I am in trouble, I can usually think of a solution.	1	2	3	4
10	I can usually handle whatever comes my way.	1	2	3	4

Appendix D – Interview Data Questions: Post-Intervention

Interview Date: ______________________________

ID Number: ______________________________

Social

Has your living situation changed since you began this research study?	Yes/No	
If so, who are you currently living with?		

Occupational Roles

Work

Are you currently working?	Yes/No	
Is this the same role that you were when you began this research study?	Yes/No	
Have there been any modifications to your workplace during this research study?	Yes/No	

Self-Maintenance

Are you able to complete all of the tasks you need to do each day? Tasks like showering, dressing, cooking, cleaning etc?	Yes/No	
Do you currently receive any support from your family to complete any of these tasks?	Yes/No	
Do you receive any support from external services to complete any of these tasks?	Yes/No	
Has this changed since you started this research study?	Yes/No	

Leisure

Do you currently engage in any active leisure tasks – such as sport or fishing?	Yes/No	
Do you currently engage in any passive leisure tasks such as reading or listening to music?	Yes/No	
Are there any leisure tasks that you are unable to do because of your amputation or difficulty using a prosthesis?	Yes/No	
Has this changed since you started this research study?	Yes/No	

Goal Setting

Do you feel that you have achieved all the goals you set at the beginning of this research study?	Yes / No	

Pain

Stump pain at Rest:

____

____

____

1 2 3 4 5 6 7 8 9 10

No Pain Worst pain

Stump pain During Activity:

____

____

____

1 2 3 4 5 6 7 8 9 10

No Pain Worst pain

Phantom limb sensations: Yes No

Frequency: All the time At least Daily Less than Daily

Known Triggers:

Impact on Daily tasks:

Phantom limb pain: Yes No

Type / description of sensation:

Frequency: All the time At least Daily Less than Daily

Known Triggers:

Impact on Daily tasks:

Impact on Prosthetic Use:

Medications:

Alt Management strategies:

1 2 3 4 5 6 7 8 9 10

No Pain Worst pain

During you average week how much would you use your prosthesis in terms of hours per day?		Hrs
In that time that you use your prosthesis, how much use as a percentage, is the use for tasks?		
Percentage – Functional use: %	Cosmetic / non-Fx Use: %	

Are there any specific task where you feel you have to use your prosthesis that you did prior to this intervention?	Yes/No	
Did you find the treatment that was provided to you to be beneficial?	Yes/No	
What aspects of this treatment did you find to impact your ability to use your prosthesis the most?		

Would you suggest this mode of treatment to other people with the same injury as you?	Yes/No	

Prosthetic rejection:

Please read each statement and indicate which statement best matches the impact of each of these factors on your use of your prosthesis.

1 = No impact at all

2 = Little Impact

3 = Moderate impact

4 = Significant impact

5 = Most significant impact

Prosthetic Factors

The weight of the prosthesis is too heavy	
The look or cosmetics of the prosthesis is not what I want	
The prosthesis is uncomfortable or hot	
The physical effort or force required to use the prosthesis	
Difficulty getting the prosthesis on and off	

Personal Factors

Difficulty using the prosthesis for what you want to do	
The concentration required to use the prosthesis	
The prosthesis is useful, but not worth the effort	

The prosthesis is not what I expected it to be	
It is quicker or easier to complete tasks without the prosthesis	

DASS21 *Name:* *Date:*

Please read each statement and circle a number 0, 1, 2 or 3 which indicates how much the statement applied to you *over the past week*. There are no right or wrong answers. Do not spend too much time on any statement.

The rating scale is as follows:

0 Did not apply to me at all

1 Applied to me to some degree, or some of the time

2 Applied to me to a considerable degree, or a good part of time

3 Applied to me very much, or most of the time

1	I found it hard to wind down	0 1 2 3
2	I was aware of dryness of my mouth	0 1 2 3
3	I couldn't seem to experience any positive feeling at all	0 1 2 3
4	I experienced breathing difficulty (eg, excessively rapid breathing, breathlessness in the absence of physical exertion)	0 1 2 3
5	I found it difficult to work up the initiative to do things	0 1 2 3
6	I tended to over-react to situations	0 1 2 3
7	I experienced trembling (eg, in the hands)	0 1 2 3
8	I felt that I was using a lot of nervous energy	0 1 2 3
9	I was worried about situations in which I might panic and make a fool of myself	0 1 2 3
10	I felt that I had nothing to look forward to	0 1 2 3
11	I found myself getting agitated	0 1 2 3
12	I found it difficult to relax	0 1 2 3
13	I felt down-hearted and blue	0 1 2 3
14	I was intolerant of anything that kept me from getting on with what I was doing	0 1 2 3
15	I felt I was close to panic	0 1 2 3
16	I was unable to become enthusiastic about anything	0 1 2 3
17	I felt I wasn't worth much as a person	0 1 2 3
18	I felt that I was rather touchy	0 1 2 3
19	I was aware of the action of my heart in the absence of physical exertion (eg, sense of heart rate increase, heart missing a beat)	0 1 2 3
20	I felt scared without any good reason	0 1 2 3

21	I felt that life was meaningless	0 1 2 3

General Self Efficacy Scale:

Please read each statement and circle a number 1 – 4 which indicated how true you feel each statement is. There are not right or wrong answers.

The rating scale is as follows:

5 Not true at all
6 Hardly True
7 Moderately True
8 Exactly True

1	I can always manage to solve difficult problems if I try hard enough.	1	2	3	4
2	If someone opposes me, I can find the means and ways to get what I want.	1	2	3	4
3	It is easy for me to stick to my aims and accomplish my goals.	1	2	3	4
4	I am confident that I could deal efficiently with unexpected events.	1	2	3	4
5	Thanks to my resourcefulness, I know how to handle unforeseen situations.	1	2	3	4
6	I can solve most problems if I invest the necessary effort.	1	2	3	4
7	I can remain calm when facing difficulties because I can rely on my coping strategies.	1	2	3	4
8	When I am confronted with a problem, I can usually find several solutions.	1	2	3	4
9	If I am in trouble, I can usually think of a solution.	1	2	3	4
10	I can usually handle whatever comes my way.	1	2	3	4