

WHAT ARE YOU LOOKING AT? INVESTIGATING VISUAL
OBSERVATIONAL BEHAVIOUR OF OCCUPATIONAL THERAPISTS AND
UNTRAINED OBSERVERS

by

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DEDICATION PAGE

I dedicate this thesis to Adam, Julia, Isabel and my parents Gordon and Ellen.

Thank you for everything! <3

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ABSTRACT

Assessments within occupational therapy frequently are dominated by observation-based information gathering. However, it remains unknown how therapists gather and interpret visual information, and there have been few systematic attempts to explore what the therapist is “seeing” or how this contributes to decision-making.

Three experiments were designed to track the eye movements (fixations, fixation durations, saccades and saccade amplitudes) of Occupational Therapists (OT) and control participants (NonOT). The studies investigated eye movement differences between groups while viewing different stimuli content (stroke versus not-stroke), stimuli image presentation (both static image and dynamic video), and task demands (either with instructions and task requirements, or without). Ten licensed occupational therapists, and ten age, gender, and education-level matched participants completed the experiments. It was predicted that differences in eye movements would be seen between groups for stroke content but not necessarily non-stroke content, given the different knowledge and experience about stroke between groups.

The overall results did not consistently demonstrate differences between groups with regard to eye movement across all three studies. Where differences were found, there was evidence to suggest it was due to top-down influences of content and task instructions. In the absence of differences for eye movement, the groups did differ in ratings of image safety, providing reason to suspect covert attention may play a key role in information gathering for decision-making tasks. There were no differences between groups for eye measures within key safety regions of interest as identified by an *ad-hoc* expert OT panel. The lack of overt visual fixations by OT to these regions of interest, even when the overall safety rating was in agreement with the expert panel, challenges the concept of what it means to ‘look at something’.

The results of the three studies point to a complex relationship between decision-making and observational behaviour in occupational assessment, and highlight the need to explore more than simply “what” therapists look at but also what they “see”. Observation is the gateway to therapeutic intervention, and is a foundational skill for Occupational Therapy. Attempts to study and understand characteristics of observation can therefore provide valuable information relating to therapy practice.

LIST OF ABBREVIATIONS USED

AOTA	American Occupational Therapy Association
ADL	Activities of daily living
CAOT	Canadian Association of Occupational Therapists
IADL	Instrumental Activities of Daily Living
L	Left
LE	Lower extremity
ms	Millisecond
NonOT	Non occupational therapist matched participant
OT	Occupational therapist participant
R	Right
ROI	Region of interest
SE	Standard Error
UE	Upper extremity
wc	Wheelchair
#	Number

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CHAPTER 1 INTRODUCTION

1.1 OCCUPATIONAL THERAPY AND STROKE REHABILITATION

Occupational therapy is a health profession defined by its role to enable optimal participation in occupations that give meaning and purpose to one's life by focusing interventions and education on the individuals' abilities or through modifications to the occupation or the environment (World Federation of Occupational Therapists, 2011). When health and the ability to live independently are challenged, occupational therapists assist with restoring function or developing new patterns for everyday living skills. Because of this expertise, occupational therapists are key members of the interdisciplinary team for stroke rehabilitation (Stroke Unit Trialists' Collaboration, 1997). Stroke affects nearly 50,000 individuals in Canada every year and is the leading cause of adult disability with approximately 315,000 individuals living with mild, moderate or severe disability (Lindsay et al., 2010). Following a stroke, the survivor may encounter one or more challenges with cognition, perception, language, sensation or motor function which ultimately leads to challenges with the ability to safely live independently.

Occupational therapists' assessment of clients post stroke engaging in everyday occupations requires attention to, and acquisition of information related to, many interacting factors of the person, occupation and environment (Law et al., 1996; Canadian Association of Occupational Therapists [CAOT], 2009; American Occupational Therapy Association [AOTA], 2002; Brentnall & Bundy, 2009). Diagnosis and standardized assessment results alone are insufficient for definitive decision-making regarding occupational performance (Law & Phelp, 2002; Hedberg & Larsson, 2004). Therapists should also adhere to evidence informed practice guidelines which require the integration of their knowledge and experience, client preferences, and research evidence for the formulation of the therapeutic intervention plan (Sackett, Rosenberg, Gray, et al., 1996; CAOT, 2007; CAOT, 2009). Central to the demonstration of practice competencies for

gathering information, assessment, and professional reasoning (CAOT, 2007) are the therapist's observation skills.

1.2 OBSERVATION AS A FOUNDATIONAL SKILL FOR PRACTICE

Observation skills permeate occupational therapy practice in neurological rehabilitation - from a necessary skill underlying assessment findings, through to explicit requirements listed in employment advertisements. Occupational therapists rely on their observation skills to gather information, make recommendations and plan interventions. Observation and the resultant analysis are considered a part of the 'experiential' domain contributing to occupational therapy (OT) evidence-based practice (CAOT, 2009) and a profession specific skill (AOTA, 2008). Informal direct observation assessments have been traditionally used with clients when standardized assessments are not available or feasible (e.g., clients cannot complete the assessment as outlined in the standardized methodology, the therapist is not trained in the assessment, or the standardized assessment does not measure the client's therapeutic concern, limiting factors, or desired outcome) (Bottarri, Dassa, Rainville & Dutil, 2010; Coster, 2008; and Weinstock-Zlotnick, & Hinojosa, 2004).

Much emphasis within the research and occupational therapy practice community has been directed toward developing evidence-based and ecologically valid performance instruments for evaluating and predicting a client's functional ability. Many of these instruments – e.g., I/ADL profile, (Botarri et al., 2010); Assessment of Motor and Process Skills (Fischer, 2003); and Arnadottir OT-ADL Neurobehavioural Evaluation (Arnadottir, 1990) – utilize observation as the primary method for gathering data. Based upon the client observation, practitioners synthesize their perception, knowledge, experience and judgments into a rating of performance.

While researchers analyzing the scoring measures for specific activity of daily living (ADL) instruments have raised the concern over observation error and resultant scoring inconsistencies (Merritt, 2011; Bottari et al., 2010), little attention has been paid to the observer's observational behaviour during the use of standardized assessments.

Psychometric assessment properties have focused on content validity, intra or inter-rater reliability (e.g., Brentnall & Bundy, 2009) and do not account for ‘where’ the participants gathered their visual observation data for the specific assessment, or ‘how much’ observation error may be present.

1.3 MODEL OF OBSERVATION

Figure 1.1 illustrates a conceptual model of some of the possible influences on a therapist’s observation capacity, information processing and resultant decisions or actions. Input filters serve to gather information which interacts with other top-down observer based factors. The top-down influencing factors include profession specific competencies (e.g., CAOT, 2007), evidence based practice guidelines, and consideration of the person factors (e.g., contextual influences of the client and environment. Professional capacity synthesizes evidence from multiple sources, including practice guidelines for the profession (e.g., CAOT, 2009), research and practice (e.g., stroke rehabilitation: Lindsay et al., 2010), and the experiential domains of the therapist and client. Additionally, the observation context of the person, activity, participation and environmental context (e.g., Law et al., 1996; World Health Organization International Classification of Functioning, 2001) also influence the top-down knowledge of the observer.

The predominant sensory input filter during observation, and the focus of the work presented here, is visual attention. During observation of occupational performance, it is important to understand that human vision is active and that visual attention may be overt (movement of the eyes to areas of interest) or covert (gathering information from the surround without eye movement) (Duchowski, 2007). Both overt and covert visual attention interact with the observer’s top-down knowledge and experience in an ongoing real-time fashion to allow for cognitive processing at the point of fixation (overt) and surround (covert) to inform and direct the next fixation location (Henderson, Brockmole, Castelhana, & Mack, 2007). Visual attention can be influenced by bottom-up features or salience within a scene (e.g., colour, intensity, and orientation; Wolfe, 1998), or directed by the observer’s top-down knowledge and experience. Seminal work by Yarbus (1967)

demonstrated the influence of top-down knowledge on observers by changing the task instructions and measuring eye movement responses. The shift in observers' eye movement patterns in response to different commands indicated a purposeful shift in the locations the observers looked at in order to gather the required information for the task.

Although certain aspects of observation skill might be general or domain neutral (the ability to notice that a client might not move one side, or that an individual used two hands to type on a keyboard), many elements of observation skill are likely to be due to training (i.e., domain-specific knowledge). For example, the salience of a particular stimulus depends on the context in which the observation is taking place, and is therefore modulated by the observer's prior knowledge. Likewise, stimulus recognition depends upon the observer's prior knowledge, and decision-related processes necessarily require domain-specific knowledge. Domain specific infers that the knowledge or experience of the observer can be categorized to one specific topic or domain and has been found to facilitate pattern recognition among observers in other fields (e.g., Kundel, Nodine, Krupinski, & Mello-Thoms, 2008; Hayes & Chen, 2008).

Occupational therapists with neurological rehabilitation experience might demonstrate their domain-specific knowledge, experience and decision-making through the completion of an assessment instrument rating or the documentation of the client's abilities via narrative note. The decision-making process in occupational therapy has indeed been studied from the perspective of professional capacity and contextual influences. Studies have investigated the decision-making process from the perspective of clinician experience (e.g., Unsworth, 2001), ability to use relevant information (e.g., Bennett & Bennett, 2000), and practice culture influences on evidence-based practice uptake (e.g., Kristensen, Borg, & Hounsgaard, 2012), but little consideration has been directed toward the input filters of the observer and how these may affect the information processing and decision-making process.

It is important to understand how the visual information is being directed and what is influencing the observer's interpretation of the visual stimuli. Decisions based upon the

information gathered, and reflection upon strategies used, all serve to build our understanding of observation. The ability to direct attention toward salient information, perceive the content, and interpret the information to formulate a decision implies that top-down or domain-specific knowledge is required. However, the role that visual attention plays within the decision-making process requires further exploration.

1.4 OBSERVER FALLIBILITY

Observation is a complex activity that depends not just on the properties of the world, but on the knowledge and skills of the observer (Brentnall & Bundy, 2009). There have been few systematic attempts to explore what the therapist is “seeing” when observing in a practice setting. One might assume that qualified therapists are able to observe occupational performance with a high degree of precision and are capable of noticing all relevant pieces of information in the environment.

However, research from psychology has repeatedly demonstrated that human observation is alarmingly fallible; observers miss seeing things despite the appearance they are looking directly at it (Rensink, 2000), or fixate on areas of important information (or perhaps task irrelevant information) at the exclusion of other areas of information (Berbaum et al., 2001). In clinical practice, this could translate into a therapist missing key safety infractions (e.g., brakes not applied before a transfer) despite appearing to look directly at them, or observing features of a client which are not critical for decision-making. If the therapist gathers incorrect client evidence because of observational failure (or misinterpretation of the observation itself), the therapist is unlikely to formulate relevant questions for critical appraisal of the pertinent research evidence (Rappolt, 2003). Additionally, errant observations – seeing something that is not there, or missing something that is there (Bernhardt, Matyas, & Bate, 2002) – could lead to ineffective intervention plans not accurately directed at the person, occupation or environment issues underlying the limitation with occupational performance and engagement (Hsieh et al., 2010).

While not directly measuring observation, Bottari, Swaine, and Dutil (2007) found that highly experienced occupational therapists had difficulty accurately attributing errors in activities of daily living (ADL) performance to either an underlying disability, or to occasional distractibility in healthy adults, without contextual information during the evaluation process. Similarly, Hickey, Milosavljevic, Bell, & Milburn (2006) found that experienced physiotherapists' ability to identify shoulder symptoms through movement analysis alone - without knowledge of the client's clinical history - was insufficient. Hickey et al. (2006) noted the therapists "should have" been looking for key movement markers identified in the existing evidence-based practice literature – but these important markers were missed. The use of clinically accepted observation assessments and the failure of therapists to incorporate or connect evidence based practice in their observations points to a fundamental challenge with observation skills, and how associated knowledge underlying therapeutic practice can be biased.

Many of the high-stakes observations by occupational therapists (e.g. leading to assessments, interventions, safety judgments and/or long term arrangements) occur during potentially very brief data gathering opportunities. The reasons for observation brevity may be the result of the client's assessment availability (Bottari et al., 2007), practice restrictions for appointment time, the client's abilities to complete the assessment, or early termination of the assessment by the therapist. Early termination may be related to significant client safety infractions (e.g., not attending to the left arm and attempting to place it on a hot burner) or that observers limit further information gathering due to the quick interpretation of features or pattern recognition driven by their top-down knowledge or experience. Pattern recognition can be efficient, but it can also lead to omission errors; this is known as 'satisfaction of search', due to the fact that observers terminate searching behaviour when they are satisfied that a particular pattern has been identified (Kundel et al., 2008). Kundel and colleagues (2008) found that expert radiologists were more efficient than novices in finding major radiograph abnormalities, but minor issues within the same image were often missed as the search was terminated.

Experience and expertise increases the clinician's ability to use multiple-category reasoning to support their clinical judgments (Hayes & Chen, 2008), but it is unclear if

their observation skills also change. Indeed, a kinematic analysis carried out by Bernhardt et al. (2002) found that experienced physiotherapists were no better at observing for movements associated with upper limb recovery following stroke (speed, jerkiness and path indirectness for upper limb movement) compared to less experienced clinicians; however, the authors speculated that more experienced therapists would arrive at a faster and more accurate interpretation of the observed movement impairments. Novice clinicians take more time and must create a new mental representation based upon biomedical knowledge related to a specific case, and therefore tend to rely more on reading information related to their case than on using the information presented by the client, including their own observations of the client (Kerstholt et al., 2006).

Observation, including identification of key pieces of data, pattern recognition, and interpretation of significance and meaning, has been recognized as a key element in medical decision making (Shapiro, Rucker & Beck, 2006). One approach for observation improvement has been to incorporate the humanities into the curriculum to enhance knowledge development in terms of pattern recognition and more holistic clinical observation. As an example, Shapiro, Rucker, and Beck (2006) compared students who studied an arts-based pattern recognition training versus traditional dermatological condition training. Those with the arts training did not have the same level of clinical dermatological pattern recognition for actual intervention planning compared to those who received the more traditional clinical teaching approach (e.g., mentorship for diagnostic specific pattern recognition). This difference in pattern recognition as a result of the training speaks to the need for development of domain-specific knowledge and experiences to assist with shaping the interpretation of the visual input from observations.

The occupational therapist ultimately utilizes information gained from observation to inform their interpretation and analysis of the overall performance as well as to identify performance components in need of remediation or compensation during treatment. If the client is deemed to be a safety risk based upon the therapist's perception and resultant interpretation of the observations, the assessment results could lead to a recommendation which changes the stroke survivor's ability to return or stay within their home environment. Observation error has the potential to dramatically affect the decision-

making process with a cascade effect on evaluation of the client's level of function, intervention selection(s) and ultimately discharge or placement recommendations.

Therefore, to ensure best practice by occupational therapists working in stroke rehabilitation, it would be useful to understand how effective observation is performed. Recognition of the complex nature of observation may lead to important insights into the nature of observation skill development and the role it plays in decision-making and clinical practice. A comprehensive understanding of observation may suggest opportunities to improve training programs for new and experienced therapists.

1.5 OBSERVATION AND EYE TRACKING

Other studies in an array of fields have taken a different approach to studying observation patterns, expertise and decision-making via measurement of eye movements in order to understand how the visual system integrates available information to guide eye movements optimally (Malcolm & Henderson, 2010). Experts can differ from non-experts in many stages of information processing, including with respect to the structure of their semantic representations (how individuals typically process information such as objects). Investigations have studied experts such as pilots searching control panels, soccer goalies anticipating ball placement, radiologists identifying tumour and fractures, and dance choreographers anticipating movement (e.g., Bellenkes, Wickens, & Kramer, 1997; Savelsbergh, Williams, van der Kamp, & Ward, 2002; Kundel, Nodine, Krupinski, & Mello-Thoms, 2008; and Stevens et al., 2010).

Tracking eye movements provides an unobtrusive, sensitive, real-time behavioural index of ongoing visual and cognitive processing (Henderson & Pierce, 2008). The assumption underlying this technique is that a person's overt visual attention, and subsequently the gaze, is drawn to objects of interest in order to bring them into the higher resolution foveal view. The eye movement data may help to gain insight into what the observer found interesting or what captured their attention (Duchowski, 2007) and how the observer directed the eyes to task-relevant stimuli in the environment (Castelhano, Mack, Henderson, 2009). Measuring observational patterns through eye-

movement tracking allows the quantification of observation: the number of locations fixated (fixation count), time spent at the location (fixation duration), and saccadic activity (eye movements – both number and amplitude or how far the eyes moved) all serve to build our understanding of observation beyond the imprecise notion of simply “looking at things”.

Previous studies exploring an observer’s interaction with unfamiliar real-world images have suggested that there are two main information sources guiding oculomotor behaviour during observation. The first source is considered ‘bottom-up’, reflecting the physical characteristics of the image such as colour, luminance and intensity (Koch & Ullman, 1985; Itti & Koch, 2000). Second, the visual system uses the observer’s high-level knowledge (‘top-down’) in combination with scene context to guide eye movements (Torralba, Oliva, Castelhana, & Henderson, 2006; Malcolm & Henderson, 2009). More informative scene regions often receive more fixations and are suggested to represent ongoing cognitive operations as well as perceptual processes during scene viewing. The visual representations are transformed into meaning through a complex interaction of cognition, perception and short term memory for the identification of objects and scene perception (Henderson & Hollingworth, 1999).

1.6 SCENE PERCEPTION

Scene perception requires the observer to integrate the visual information with their knowledge and experience in order to interpret or understand what they are ‘seeing’ beyond simply identification or categorization (e.g., identifying if a target object is present or not, recognizing if an object is out of its context). Previous studies have investigated scene perception in terms of task instruction manipulation (Castelhana, Mack & Henderson, 2009; Castelhana & Henderson, 2007; Rayner, Smith, Malcolm, & Henderson, 2009), memory target search, cultural differences (Rayner, Castelhana, & Yang, 2009), colour (Castelhana & Henderson 2008) and semantic inconsistencies (Võ, & Henderson, 2009). However, there has been limited work in terms of scene perception and decision-making skills in health-care contexts. The studies that have begun to investigate attributes of skilled observers in health-care have used target studies, where

observers are searching for a specific object or feature, with static images and decision-making in the area of radiology (Kundel, Nodine, Conant, & Weinstein, 2007).

However, these search for target studies have limited application to the area of rehabilitation and occupational therapy which require perception of the scene during dynamic performances of individuals across varied activities and environments. Observing a client completing an instrumental activity of daily living, such as cooking a meal, would require the observer to interpret multiple person and environmental features beyond simple identification. The observer would need to access previous knowledge or experience to understand the relationships among the person, occupation and environment in a more global fashion – particularly if they were to determine if the scene was safe or not. Attention acts at the front end of the system to select information from the visual array for enhanced processing, but attention alone does not determine perception. Scene perception requires the observer to encode the information, compare the incoming selected information with previously stored knowledge and experience for interpretation and in order to respond accordingly (Henderson et al., 2007).

1.7 EDUCATIONAL AND PRACTICE IMPACT OF OBSERVATION RESEARCH

This thesis work was inspired by recurring issues surrounding observation skills gathered from years of clinical and teaching experience in the area of neurorehabilitation. Visual fallibility is likely an issue in many sensitive (or high stakes) areas of human function (e.g., driving a motor vehicle), including but not limited to clinical evaluation. However, it is fascinating that clinical conclusions are made without acknowledging the limitations or abilities of the visual system and how these may contribute to either the correct decision, or perhaps to a poor clinical judgment.

The purpose of this work is to begin building a theoretical account of skilled observation in occupational therapy, with a longer-term goal of informing our educational and practice frameworks. A standard method for training health care professionals involves the use of pictures and video-based representations of cases for analysis and rating of performance. Key aspects or features of educational videos are often highlighted by the

instructor as important areas to ‘look’ at in order to answer specific clinical questions – or react to safety issues with clients. For example, if a client is falling backwards during a transfer from the toilet to a wheelchair, then the head, shoulders, hips and feet may be identified by an instructor as important specific locations for observers to attend.

However, what would be important to teach is the spatial relationship among those locations and how it relates to the concept of maintaining the center of mass over the base of support. The ‘looking’ should be with this concept in mind rather than simply an identification of distinct features.

It is assumed that individuals get *better* at identifying client issues from observation with practice and experience – but it is not known how the observation patterns change, or if the patterns are influenced by knowledge, experience, features attended within the observation, or whether the judgements reached are better. While there are assumptions that experienced clinicians or ‘experts’ know what to identify in the visual stimuli, it is not known which task-specific stimuli or features should be attended to and integrated into the learner’s repertoire of recognition.

While other fields (e.g., psychology, human factors) help to inform about eye tracking methodology, eye movement pattern differences, most of the experimental literature does not involve observing everyday living skills – which is the practice context for occupational therapy. Everyday living skills can be performed in a variety of iterations lending them to less predictive observation patterns for planning and movement completion. The large range of possible methods for completing the same task leads to less opportunities for the observer to develop pattern recognition and expertise for interpretation and decision-making. Even the simple task of donning a shirt requires consideration of the person abilities and the interaction with the environment in which the activity is taking place. Complexity is added to learning patterns for knowledge development when the client donning the shirt may not have typical movement, cognitive or perceptual skills – such as a client post stroke.

Observation of everyday activities is an emerging research area, and it has not yet been studied in occupational therapy. In order to dissect the puzzle of how observation contributes to decision-making, the first step chosen was to design a series of experiments in which the eye movements of occupational therapists and non-healthcare matched subjects were tracked under varying viewing conditions (task demands). The differences in viewing conditions and instructions allowed for the exploration to detect if there were indeed differences in eye movements between groups, and furthermore if differences were related to domain-specific knowledge.

1.8 THESIS OVERVIEW

This thesis contains three studies and corresponding manuscripts. For each study, the connection to the overall theme of the dissertation is outlined in the preceding bridging chapter. The research approach in all studies was to measure eye movements and compare the trained occupational therapy participants (OT) with the non-healthcare matched participants (NonOT). Eye movements were measured in all studies using stimuli related to clients post-stroke. The static image studies (Chapters 3 and 7) also included stimuli unrelated to stroke or health care. The specific studies differ in terms of additional factors included to aid in the determination of what influences the observational patterns of OT and NonOT.

1.8.1 Participants

Participants considered for inclusion in the trained group were occupational therapists (OT) with five or more years of neurorehabilitation experience and licensed with the College of Occupational Therapists of Nova Scotia (COTNS). The non-trained group (NonOT) were recruited to closely match the trained group in terms of age, physical sex and education (degree level). Participants for the NonOT group were not eligible if they had previous health profession training or experience. The exclusion of participants with healthcare training for the NonOT group was purposeful in order to guarantee, as much as possible, that the groups were age/gender/education matched with the OT group,

thereby leaving the primary difference between the groups being whether or not healthcare training had been received. The careful matching process provided for removing any possible physiological or educational influences not related to healthcare training that may otherwise have presented confounding variables.

1.8.2 Observation Experience Survey

Aside from formal education, observation experience may also be influenced by other life experiences interests and skills (Duchowski, 2007). In order to measure differences in observation experiences among participants, a survey was constructed to capture the natural observation opportunities from their day to day experience(s) in the areas of driving, parenting, athletics, performing arts, and video gaming. The occupational therapists were also asked questions about their general practice profile and their professional practice and education experiences. Questions on the survey were formatted in either closed or partially closed-ended questions to decrease the step of having to recall or categorize information. After completing the informed consent signature page, each participant completed the survey online using Opinio Survey software (Opinio 6.4.1, Copyright 1998-2011 Object Planet). The responses were stored on Dalhousie's Opinio server (<https://surveys.dal.ca/opinio/admin/index.jsp>) until the information were exported to SPSS v.17.0™ for further statistical analysis. Please see Appendix A for the survey questions all participants completed.

1.8.3 Visual Stimuli Development

The visual stimuli for all three studies were created or selected by the author. Additionally, the training of the simulated clients, photography, videotaping, image digitizing, and editing of all stimuli for use in Experiment Builder, were all carried out by the author. The visual stimuli were specifically created for each study and included both domain-specific and domain-neutral content. The domain-specific content related to the OT group's knowledge and practice experience and included images of simulated clients post-stroke completing basic and instrumental activities of daily living. Domain-neutral images were used for the static image studies (Chapters 3 and 7) were collated from a

network of images that were either submitted to, or belonged to, the author. The simulated client images were developed specifically for these studies. Simulated clients (rather than stroke survivors) were selected for the content development to decrease the potential for harm, particularly during the staging of the unsafe content. The two individuals who portrayed the post-stroke stimuli were experienced with the role of portraying a client with post-stroke motor issues during functional activities prior to receiving training from the author.

1.8.4 Research Questions

The studies were designed to investigate eye movement differences between groups while viewing different stimuli content (stroke versus not stroke), stimuli image presentation (both static image and dynamic video), and task demands (either with instructions and task requirements, or without). Given the purposeful difference in delineating the experimental group in terms of domain-specific knowledge and experience, it was anticipated that the OT group would demonstrate differences in eye measures while viewing stroke images when compared to the NonOT group; whereas, there was no expectation that the groups would differ in eye measures during naturalistic scenes and non-stroke image content.

More specifically, the three studies presented in this thesis were designed with the following hypotheses in mind:

1. Differences would be found in eye movement patterns between the OT and NonOT observers while viewing static images portraying a simulated client post-stroke (domain-specific content), while differences would not be found for domain-neutral content (Study 1: Chapters 2 and 3; Study 3: Chapter 6 and 7).
2. Differences would be found in eye movement patterns between the OT and NonOT observers while viewing dynamic images (videos) portraying a simulated client post-stroke (domain-specific content) (Study 2: Chapters 4 and 5).

3. Differences would be found between the OT and NonOT with respect to decision-making about safety subsequent to viewing static images of simulated client post-stroke (domain-specific content), while differences would not be found for domain-neutral content. Differences would also be found for varying duration exposures (including short 150 ms 'gist' duration, a 1000 ms duration, and a 3000 ms duration) (Study 3: Chapter 6 and 7).

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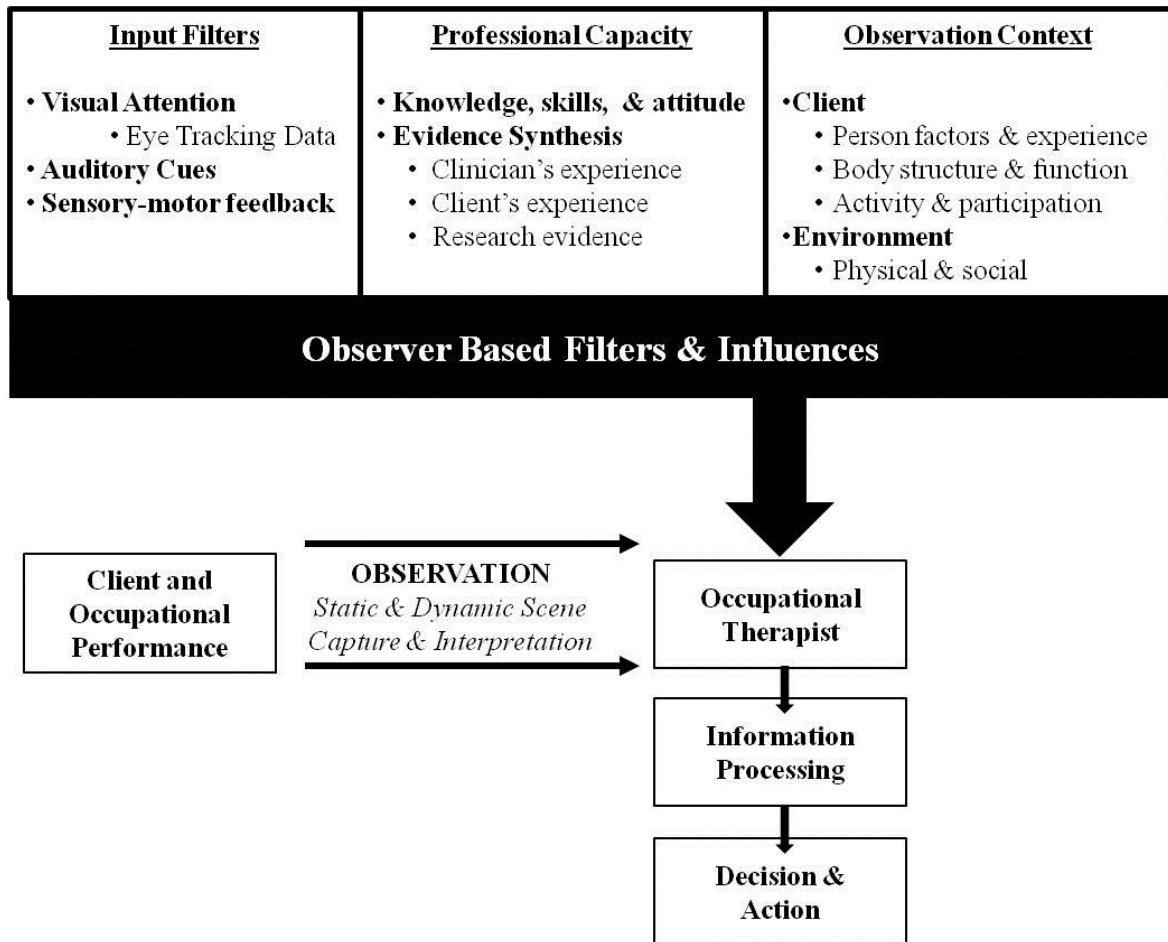


Figure 1.1 Conceptual Model of Observation in Occupational Therapy

CHAPTER 2 FREE (STATIC) VIEWING STUDY

INTRODUCTION

2.1 RATIONALE

The first study utilized static images of domain-specific information (images of clients post-stroke) and domain-neutral images (landscapes from around the world) to measure if differences in global measures of eye movement (fixation count, fixation duration, saccade count and saccade amplitude) existed between the OT and NonOT participant groups. While the subjects were told there was a memory task at the end of viewing the images, it was not designed to be a study in memory. Instead, the memory condition provided the same pretense for which to explore the visual stimuli, but still allowed for each participant to freely explore the image without any immediate task to complete per image presented.

2.2 RESEARCH HYPOTHESES

It was predicted that differences in eye movement parameters (fixations, fixation durations, saccades, saccade amplitudes) would be found between groups for the domain-specific information, but not for the domain-neutral stimuli – as there seemed no *a priori* reason to expect participants to explore naturally occurring landscapes differently from each other. It was also expected that differences between image types may occur due to the influence of bottom-up features related to the image content.

2.3 VISUAL STIMULI

The study explored the influence of domain specificity by using clinically related images (domain-relevant) together with general scenes from around the world (domain-neutral). The static stimuli for this study included 20 images: 10 of a simulated client post-stroke completing self-care, mobility and home-making tasks, and 10 urban or rural landscape scenes from around the world. The single memory condition image was a landscape that was not part of the images viewed in preparation for the ‘memory test’. The simulated

client post-stroke images portrayed varying levels of motor impairment and functional ability.

2.4 AUTHOR ROLE IN THIS STUDY

MacKenzie, D.E., & Westwood, D.A. (2012). Occupational therapists and observation: What are you looking at? *Occupational Therapy Journal of Research: Occupation, Participation and Health*, Oct 5. [Epub ahead of print] doi: 10.3928/15394492-20120928-01

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The primary author was responsible for concept and design; simulated client training; visual stimuli creation; data collection; analysis and interpretation; manuscript writing and revision.

CHAPTER 3 OCCUPATIONAL THERAPISTS AND OBSERVATION: WHAT ARE YOU LOOKING AT?

3.1 ABSTRACT

Visual observation is a fundamental skill underlying all occupational performance assessments in occupational therapy. The purpose of this study was to determine if eye movement patterns differ between occupational therapists and non-healthcare professionals during observation of static images portraying a client post-stroke (domain-specific content) or naturalistic scenes (domain-irrelevant content). Ten licensed occupational therapists (OT), and ten age, gender, and education-level matched participants (NonOT) completed the study. Participants viewed two counterbalanced blocks of 10 images (scene and stroke) under the pretext of preparing for a memory test. The OT group differed in the viewing strategies during observation as well as in how they directed their eyes (higher frequency of fixations, shorter fixation durations, and increased saccade count) for domain-specific and domain-irrelevant images alike. Observation patterns used by occupational therapists are presumably related to top-down influences that are not necessarily related to domain-specific knowledge, but perhaps to general experience with carrying out assessments using observational methods.

3.2 INTRODUCTION

3.2.1 Observation as the Foundation of Occupational Performance Assessment

Therapist observation is the foundation of many informal and standardized assessments used for development of therapeutic intervention plans, and/or discharge recommendations in neurorehabilitation (Cooke, McKenna, & Fleming, 2005; Bottari, Swaine, & Dutil, 2007; Brentnall & Bundy, 2009; Canadian Association of Occupational Therapists, 1999, 2009; American Occupational Therapy Association, 2002).

Observation is particularly important for the assessment of individuals unable to accurately self-report function due to executive processing challenges (Sager, Dunham, Schwantes, Mecum, Halverson, & Harlowe, 1992; Abreau et al., 2001) or unable to answer questions (Bottari et al., 2007; Quake-Rapp, Miller, Ananthan, & Chiu, 2008).

Consequently, performance-based measures using naturalistic observations are often used for evaluation or prediction of function and/or safety within the environment. Despite the fact that direct observation proves an ecologically valid assessment opportunity for occupational performance, the observer collecting the information remains a potentially limiting factor in the accuracy of the assessment (Brentnall & Bundy, 2008). Improving observational skill and performance through training is difficult because there has been little research on the perceptual, attentional, and cognitive factors underlying effective observation in Occupational Therapy.

One straightforward approach to studying observation is to measure what people look at using eye-tracking technology, guided by the assumption that the targets of eye movements represent objects that are of interest to the observer. It is widely recognized that the human visual system integrates many sources of information to guide eye movements when exploring scenes (e.g., Malcolm & Henderson, 2010). Tracking eye movements therefore offers an unobtrusive, sensitive, real-time behavioural index of ongoing visual and cognitive processing (Henderson & Pierce, 2008). By tracking the eye movement it is assumed that the path of movement may help us gain insight into what the observer found interesting, what captured their attention, or how the observer

directed the eyes to task-relevant stimuli in the environment (Duchowski, 2007; Castelhana, Mack, Henderson, 2009).

Practitioners routinely observe, describe and interpret visual information, but little attention has been given to the act of observation itself: “[l]ooking is often assumed” (Bardes, Gillers, & Herman, 2001, p 1157). Measuring observational patterns through eye-movement tracking allows quantification of: the number of locations fixated (fixation count), time spent at the location (fixation duration), and saccadic activity (eye movements) all of which build our understanding of observation beyond the visual mechanics of simply “looking”.

Previous studies exploring an observer’s interaction with unfamiliar real-world images have suggested there are two main information sources guiding oculomotor behaviour during observation. The first source is considered ‘bottom-up’, reflecting the image’s physical characteristics or saliency features such as colour, luminance and intensity (Koch & Ullman, 1985; Itti & Koch, 2000). Second, the visual system uses ‘top-down’ influences such as the observer’s high-level knowledge, priorities, goals, and task instructions (Torralba, Oliva, Castelhana, & Henderson, 2006; Malcolm & Henderson, 2009). Studies have found that top-down influences have the capacity to override the bottom-up features within a real scene, allowing observers to adapt their viewing strategy to the cognitive and behavioural activity required for the assigned task (Boot, Becic, & Kramer, 2009; Baluch & Itti, 2010). To state it in another way, a person’s knowledge (and/or domain specific training) represents a top-down ability to override the instinctual behaviour of being visually attracted to more salient physical characteristics that drive bottom-up oculomotor behaviour.

The idea that knowledge is fundamental to observation contrasts with a simpler, intuitive view which suggests that observational skill is a general ability that can be applied with equal accuracy and efficiency in virtually any situation. A model is presented in Figure 3.1 which summarizes potential influences on the therapist during the observation and interpretation process of a dynamic (e.g., activity of daily living) or static (e.g., structural

home evaluation) scene. Although certain aspects of observation skill might be general (the ability to notice that a client might not move one side, or that a child is using two hands to catch a ball) – many elements of observation skill are likely to be due to their training (i.e., domain-specific knowledge). For example, the salience of a particular stimulus depends on the context in which the observation is taking place, and is therefore modulated by the observer's prior knowledge. Likewise, stimulus recognition depends upon the observer's prior knowledge, and decision-related processes necessarily require domain-specific knowledge.

The present study was designed as a first attempt to determine if there are any obvious observation differences between occupational therapists and individuals without healthcare training. The purpose for this group-based comparison is to see if healthcare training is associated with fundamental differences in observation behaviour, and how these behaviours are modulated by the content of the visual scene in relation to the observer's prior training and expertise.

Eye movements were monitored while participants viewed domain-specific (i.e., simulated patients with stroke) and domain-irrelevant (i.e., geographical scenes) static images under the guise of a visual memory test. Top-down influences in observational behaviour were isolated because participants in both groups viewed the same images thereby equating all bottom-up sources of influence. If the prior knowledge of the occupational therapists is a critical component of top-down influence on observational behaviour, then one would expect to detect differences between groups for the domain-specific but perhaps not domain-irrelevant images.

3.3 METHOD

3.3.1 Goals of Study:

This pilot study sought to establish if there was a difference in eye movement patterns between trained (occupational therapists) and non-trained (non-healthcare professionals) observers during free observation (i.e., no instructions or restrictions of where the participants could look) of static images portraying a simulated client post-stroke

(domain-specific content) and naturalistic scenes (domain-irrelevant content).

Comparisons of self-reported observation strategies between the two groups were also explored.

3.3.2 Participants:

Participants recruited for the trained group (OT) included licensed occupational therapists with five or more years of neurorehabilitation experience. The non-trained group (NonOT) included participants matched to the occupational therapy group for age, gender and highest degree attained, but with no previous healthcare education or experience.

The initial contact for both groups was purposive and triggered a *word of mouth* recruitment process. Interested participants contacted the primary investigator and completed a self-screening process prior to participating. Eligible participants were required to meet the following conditions: (i) normal or corrected-to-normal visual acuity wearing contact lenses; (ii) no known visual or neurological condition restricting any of the following: coordinated eye movements, visual and cognitive processing skills, head and neck control in a seated position, or coordinated upper limb fine motor control. All participants provided informed, written consent. This study was reviewed and approved by the University's office of Human Research Ethics Administration.

Twenty participants completed this study: 10 licensed occupational therapists (OT) and 10 matched participants (NonOT). Each group included 8 females and 2 males. Participants ranged in age from 30 to 50 years. The OT group was equally distributed in practice experience (all had greater than 6 years of neurological occupational therapy experience), practice setting (acute, rehabilitation, private practice, or combination thereof), and client caseload (infancy/childhood, adolescent/adult, older adult, or combination thereof).

3.3.3 Apparatus and Stimuli

To capture participants' naturally occurring observation experiences from everyday living (i.e., employment description, driving, parenting, television viewing, and participation history [active participant, observer or coach/director/teacher] in sport, the arts or video gaming), an online survey was developed using Opinio Survey software

(Opinio 6.4.1, Copyright 1998-2011 Object Planet). The OT group answered an additional set of five questions describing their practice profile and professional education experiences with observation training methodologies.

The photographic stimuli were developed by the primary investigator, digitized and broken into two image blocks by content: naturalistic scenes (scene) and simulated client post-stroke (stroke). The scene content images included a variety of landscape or built environments not specialized to a particular knowledge group. The stroke content images were representative of images typically used in neurorehabilitation teaching, and portrayed typical movement patterns and interactions of a post-stroke simulated client participating in self-care, productivity, leisure or mobility tasks. The images were presented in full colour on a 32 inch monitor, with a refresh rate of 140 Hz.

The SR Research Experiment Builder software was used in combination with EyeLink[®] II (SR Research Ltd., Mississauga, ON) video-based eye-tracking system to create and carry out this study. The EyeLink[®] II has a sampling rate of 500 Hz; spatial precision $<0.01^\circ$ and spatial accuracy $<0.8^\circ$ RMS error. Calibration of the EyeLink[®] II was carried out in the same horizontal viewing plane used to display the static images. The eye-tracker recorded eye position and movement duration, as well as compensations for head movement. Viewing was binocular, but only the right eye was tracked.

EyeLink DataViewer[™] software (SR Research Ltd., Mississauga, ON) was used to extract key dependent measures related to eye movement during the study. In keeping with similar eye movement studies, eye-tracking dependent variables collected for this experiment included fixation count, fixation duration, fixation horizontal and vertical positions, saccade count, and saccade amplitude (Castelhano et al., 2009). Additional dependent variables were derived from the collected data to characterize the amount (span) of image viewed (standard deviation of fixation locations). Data management and statistical analysis was completed with Microsoft Excel 2007 (Microsoft, Redmond, WA) and PASW[®] Statistic 17.0 software (SPSS Inc., Chicago, 2009).

3.3.4 Procedure

Following completion of the observation experience survey, participants donned the EyeLink® II head mounted eye-tracking system and sat approximately 36 inches (91 cm) from the monitor. There was no restriction in head movement so as to provide a naturalistic viewing condition for the participants. The EyeLink® II calibration and validation process was completed at the beginning of the experiment to ensure point of gaze verification could be achieved from all nine eye calibration locations on the computer screen.

The sequence of events for each trial is depicted in Figure 3.2. Participants were shown two counterbalanced blocks of 10 images (scene and stroke) under the pretext of preparing for a memory test. To decrease the tracking error, each trial (image presentation) began with a drift correction procedure which required participants to fixate on a central fixation cross for a minimum of 250 ms prior to the images appearing. Each image was shown for 3.0 seconds. Following the 20 images, one additional image was presented for the memory condition. Participants were asked if they had seen this image in the previous 20 images and provide their response on the keyboard (Y or N). The time between the question appearing and the keyboard response was recorded (response time). Following this, participants were given up to two minutes to reflect upon and verbally report their viewing strategy in preparation for the memory condition.

3.3.5 Data Analyses

The observation experience survey data were analyzed using the Mann-Whitney U test to compare responses of the two groups. Separate mixed analyses of variance (ANOVAs) were completed for each of the dependent measures related to eye movements, including the factors Group (OT vs. NonOT; between-subjects) and Image Type (stroke vs. scene; within-subjects). An alpha threshold of .05 was used for all analyses. Only significant effects are reported. Effect sizes are presented as partial eta squared. These values can be interpreted using the following parameters: values between 0.01– 0.05 indicate a small effect, values between 0.06–0.13 indicate a medium effect, and values of 0.14 and greater indicate a large effect.

3.4 RESULTS

3.4.1 Observational experience survey data

No statistical differences found between the OT and NonOT groups in the 17 observation experience questions, with the exception of two questions: the average time spent 'watching friends or family in a sporting event' ($p < .05$), with the lower rank sums of the OT group indicating they averaged less time per week than the NonOT group; and, the average time spent 'observing an artistic dance or visual display event' ($p < .05$), with the higher rank sums of the OT group indicating they spent more time per week. The overall similar observational experience profile suggests that the major identifiable difference between the matched groups was the domain specific training and practice experience of occupational therapy. The occupations of the NonOT group included accounting, administration, engineering, internet/computer technology and teaching.

There was a significant difference between groups (Fisher's exact, $p < .001$) with regard to the yes/no question "*Do you think you had any particular strategy while viewing the pictures in preparation for the memory task?*" All of members of the OT group reported adopting a viewing strategy, while only 2 of the NonOT group reported using a strategy. The general themes of strategies employed included schemes such as scanning the entire image, looking for details or numbers of objects, and attempting to understand what was happening in the image. However, this difference in self-reported viewing strategy did not manifest itself in a measurable difference in the ability of the two groups to correctly determine if the memory image had been part of the previous image group: the Fisher's Exact test revealed no significant difference between the OT group and NonOT group with respect to correctly recalling the memory image (OT = 6/10 correct, NonOT = 2/10 correct). Further, a t-test comparison also found no significant difference with their respective response times for entering their decision regarding the memory image (OT=3.3 s, NonOT=3.7 s).

3.4.2 Eye movement data

Table 1 reports the details of the significant main effects found for Group and Image Type. No significant interactions were found for any of the dependent measures. The main effects of Group showed the OT group demonstrated significantly more fixations, shorter fixation durations, and more saccades than the NonOT group when viewing the image content. There were several significant main effects of Image Type, demonstrating that the composition differences between the scene and stroke images affected how the participants viewed the images (e.g., fixations and saccades). These effects of Image Type are simply illustrative of the image structure – the stroke images generated less horizontal and more vertical span due to the presence of a person central in the image.

3.5 DISCUSSION

Despite the fact that all of the same visual image features were present for both groups, the OT visual data patterns were significantly different than the NonOT group. The OT group demonstrated more fixations, shorter fixation durations and more saccades in viewing both image conditions than the matched NonOT group. Additionally, each individual in the OT group reported utilizing a specific viewing strategy, which was significantly different from the NonOT group (wherein only 2 of 10 reported a specific strategy). It is unclear, however, if the use of a systematic viewing strategy is necessarily more effective than having no systematic strategy since the two groups performed equally well in the subsequent recognition test.

All participants were provided the same instructions for viewing the static images, so the findings in this study cannot be explained by different task requirements but rather by some other source of top-down influence upon eye movement patterns. As indicated earlier, the only variation between the participant group characteristics was the level of healthcare training. Therefore it is reasonable to attribute at least some of the measured differences in viewing patterns between the groups to a difference in top-down influence related to this training or to the characteristics of individuals attracted to this career path. Even though the ‘objective’ task requirements were the same, there is no way to ensure that participants in each group responded similarly to the task instructions.

The difference in visual data between groups is similar to the findings of Land and Hayhoe (2001) who found that fixation sites appear to be less related to saliency (i.e., the visual components of the image) when meaningful scenes are viewed during active viewing tasks. Where available, a person's visual system will combine multiple sources of information to guide fixation placement and duration (Malcolm & Henderson, 2010). Previous studies have suggested there is an interactive relationship between the initial scene view (Land & Hayhoe, 2001), task knowledge and the subsequent specificity of directing eye movements (Castelhano & Henderson, 2007). In other words, observers can efficiently guide their attention in a top-down manner, adapting their viewing strategy to the cognitive and behavioural activity required for the assigned task (Boot et al., 2009).

As such, it may not be surprising that the fixation count, fixation duration and saccade count of the OT group were different than the NonOT group during the viewing of domain specific images (i.e., simulated stroke). However, it is interesting that participants in the OT group also viewed non-domain specific (i.e., naturalistic scenes) content differently, since they presumably do not have any specific expertise in viewing these types of images. This finding suggests the observation patterns of the OT group were different from the NonOT regardless of image type, implying that the source of top-down influence underlying the observational approach is not necessarily related to acquired knowledge about stroke. It is plausible that the top-down memory strategy employed by the OT group may have drawn upon differences in observation training experiences between the two groups.

Considering the matching process and similarity on the observation experience surveys, the findings here indicate that the OT group *did* observe things differently than the NonOTs, but it is not yet clear why. It could be due to their training, work experience, performance effect and/or other contextual elements within their practice. The OT group spent less time fixating and more time scanning. Perhaps the domain specific training or expertise for occupational therapists also includes the ability to quickly direct visual attention to multiple sources for the purpose of gathering information. Indeed, this is

similar to the therapeutic assessment and intervention process itself, which requires consideration of the person based factors, the environmental constraints or supports, and the occupational components or demands simultaneously. While the findings point to differences in top-down influences, the exact influences were not the focus of this research and are yet to be determined. Questions investigating these differences warrant subsequent study.

3.5.1 Implications for Practice and Directions for Future Study

Direct observation can be an ecologically valid component of occupational performance assessment. However, it has been argued that the observer is a key source of error and thus unreliability (Brentnall, Bundy & Scott Kay, 2008). Clearly, observation is a complex activity that depends not just on the properties of the world, but on the knowledge and skills of the observer. Research from other fields has repeatedly demonstrated that human observation is alarmingly fallible; observers miss seeing things despite appearing that they are looking directly at it (Rensink, 2000); or fixate on areas of important information (or perhaps task irrelevant information) at the exclusion of other areas of information (Berbaum et al., 2001). In clinical practice, this could translate into a therapist missing key safety infractions despite appearing to look directly at them, or observing features of a client which are not critical for decision-making. If the therapist gathers incorrect evidence because of observational failure (or misinterpretation of the observation itself), they are unlikely to formulate relevant questions for critical appraisal of the pertinent research evidence (Rappolt, 2003). Additionally, errant observations – seeing something that is not there, or missing something that is there (Bernhardt, Matyas, & Bate, 2002) – could lead to ineffective intervention plans that are not accurately directed at the person, occupation or environment issues underlying the limitation with occupational performance and engagement (Hsieh et al., 2010).

While it is common to suggest that increased time is required to train observers to improve interrater agreement (Quake-Rapp et al., 2008) and accuracy of ADL assessments (Christie, Bedford, & McCluskey, 2011), just what should be trained (and how that training should be done) has yet to be identified and addressed. The results of

the present study represent an initial foray into understanding the nature of observation in occupational therapists, but additional research is required to build upon this foundation and to provide guidance for observational training initiatives.

Observation remains as the gateway to therapeutic intervention, forming the foundation of therapeutic assessment. Attempts to study and understand characteristics of observation can therefore provide valuable information relating to therapy practice. By studying how trained therapists observe, it may be possible to identify sources of error in observation and, moreover, how such errors may affect subsequent clinical decision-making. Ideally, such information could be used to shape the education and training of students and therapists in order to improve the quality of care. The need to better understand how observation and observation skill contributes to formulating effective and efficient intervention plans should be a priority for research, education and practice.

3.5.2 Limitations

The current analysis may not be representative of the larger population due to small sample sizes. The likelihood of statistical type I errors may be inflated in the present study due to the use of individual analyses for separate dependent measures, a decision intended to preserve statistical power in the face of a relatively small sample size. There may also be inherent differences within each observer's ability, acquired knowledge or experience and practice which were not captured with this study, and which might have contributed to performance in the task. It is important to recognize that eye tracking methodology can determine what a person is looking at but not necessarily to what they are paying attention (Duchowski, 2007).

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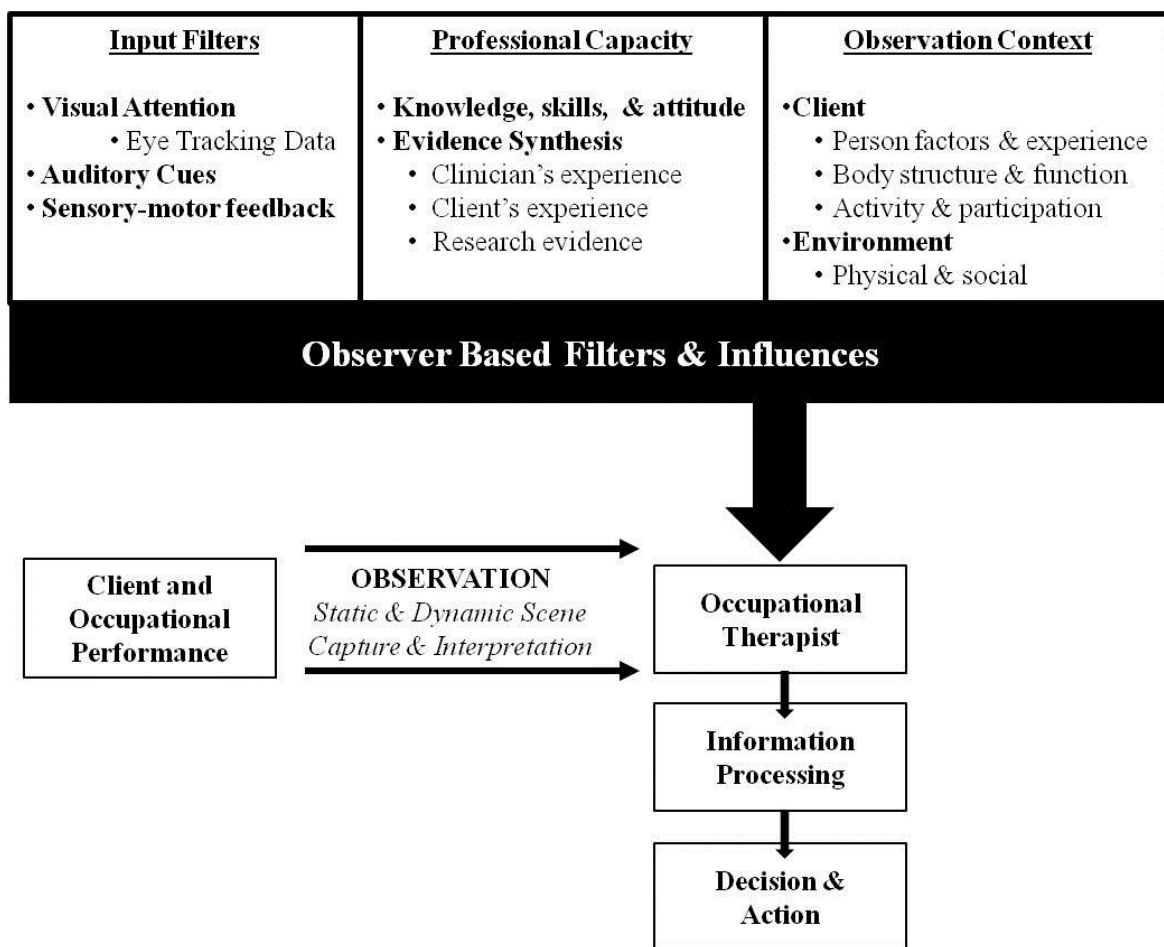


Figure 3.1 Model of Observation in Occupational Therapy

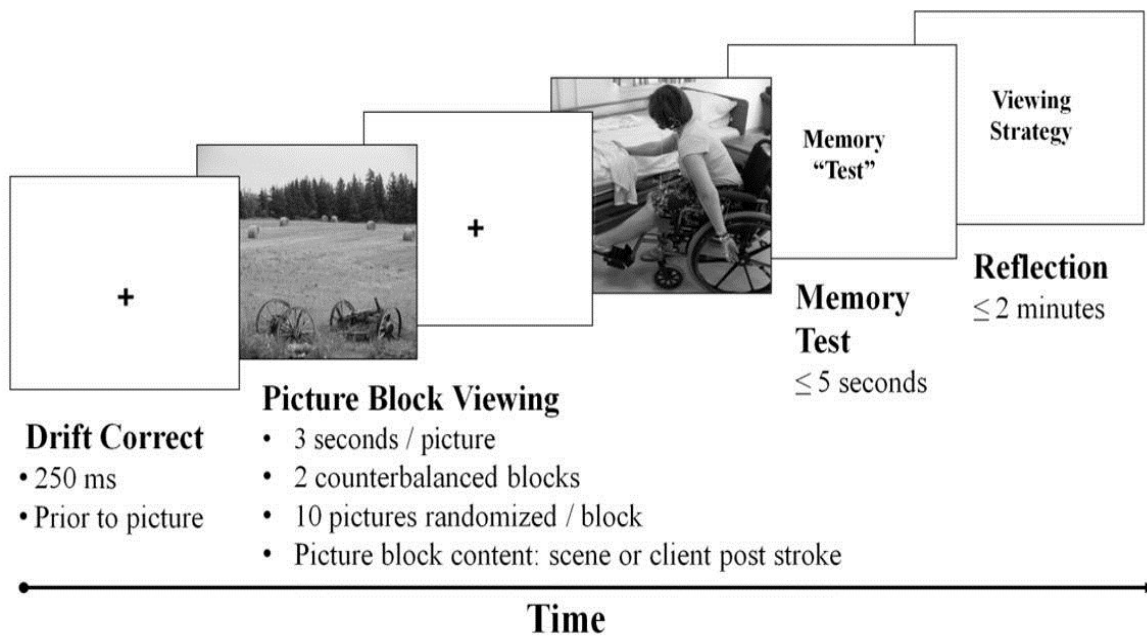


Figure 3.2 Experimental Procedure Representation

Table 3.1 Summary of Mean Values [standard error] for dependent variables

	Scene Content		Stroke Content		<i>F</i>	<i>p</i>	η_p^2
	OT	Non OT	OT	Non OT			
Fixation Count ^{a**}	11.75 [.47]	9.73 [.47]	11.51 [.46]	10.17 [.45]	7.34	<.05	.29
Fixation Duration (ms) ^{a**}	214.97 [19.12]	286.49 [19.12]	237.22 [17.16]	269.77 [17.16]	4.94	<.05	.22
Saccade Count ^{a*}	10.81 [.48]	9.40 [.48]	11.05 [.49]	8.94 [.49]	7.30	<.01	.28
Fixation Horizontal Span ^{b*}	199.10 [15.20]	165.07 [15.20]	100.99 [5.13]	95.00 [5.13]	79.98	<.01	.82
Fixation Vertical Span ^{b*}	101.13 [6.92]	83.56 [6.92]	144.53 [6.85]	130.06 [7.37]	97.86	<.01	.85
Fixation Horizontal Span weighted by Duration ^{b*}	199.58 [15.97]	164.76 [15.97]	99.81 [5.13]	94.99 [5.27]	74.84	<.01	.81
Fixation Vertical Span weighted by Duration ^{b*}	99.55 [6.90]	81.39 [6.90]	145.22 [7.68]	129.33 [7.68]	89.42	<.01	.83
Saccade Amplitude ^{b**} (visual degrees)	8.0 [.60]	7.08 [.60]	6.53 [.35]	6.18 [.35]	13.02	<.05	.42
Saccade Velocity ^{b**}	155.06 [8.46]	139.10 [8.46]	141.12 [5.82]	133.10 [5.82]	6.14	<.05	.25
Saccade Horizontal Span ^{b*}	285.57 [21.98]	237.51 [21.98]	142.91 [7.15]	135.51 [7.15]	79.88	<.01	.82
Saccade Vertical Span ^{b*}	142.57 [10.07]	116.86 [10.07]	206.51 [10.75]	185.18 [10.75]	92.08	<.01	.84

^a Main Effect of Group, ^b Main Effect of Picture
*Significant at <.01, **Significant at <.05

CHAPTER 4 DYNAMIC (VIDEO) VIEWING STUDY

INTRODUCTION

4.1 RATIONALE

The first study's finding that the OT group differed in eye measurements for both domain-specific images and domain-neutral images was a bit surprising. However, it is plausible that the OT's response to the condition of image exploration in anticipation of the 'memory' test may have evoked a domain-specific skill. The skill may be related to the experience of the OT group with the documentation process which requires the therapist to attend to many features within an observation period and hold that information for later recall during reporting of the features that affected client performance. The first study was designed to provide a sense of potential differences while viewing static images prior to exploring eye measurements between groups using dynamic visual stimuli. Occupational performance assessments in the practice setting are completed while observing a client completing a task. This mode of observation is not based upon static images, but rather it involves moving or dynamic visual stimuli as the client completes an activity. Therefore, this second study used dynamic stimuli of simulated clients post-stroke participating in three everyday activities. This offered the opportunity to capture eye movement during a dynamic naturalistic observation that is found in both practice and educational settings. Unlike the first static image study, participants were not provided with any instructions or pretense for which to view the videos presented in random order. This free viewing of dynamic stimuli condition allowed for each participant to adopt their own viewing strategy. Because there were no instructions provided to influence their eye movements, participants were asked to share their viewing strategy(ies) at the end of the viewing session for comparison.

4.2 RESEARCH HYPOTHESES

It was predicted that differences between groups would be found for eye movement parameters (fixations, fixation durations, saccades, saccade amplitudes) for each dynamic

viewing stimulus. Additionally, it was predicted that differences would be found in the viewing strategies reported with the OT group reporting similar strategies.

4.3 VISUAL STIMULI

Three dynamic images (video) portrayed a simulated client post-stroke for this study. A female was the simulated client for the video demonstrating a sit pivot toilet transfer to wheelchair as well as the video demonstrating reaching into a kitchen cupboard while standing on a narrow step stool. The third video was a male mowing grass using a manual push mower. The motor impairment level for each video was guided by the Chedoke-McMaster Stroke Assessment (Miller et al., 2008). The upper extremity was portrayed as Chedoke-McMaster Stage 2 hand and arm for both clients in all three videos. The lower extremity and foot was portrayed at a Chedoke-McMaster Stage 5 for the toilet transfer and kitchen videos, while for the grass cutting video portrayed as a Stage 6 leg and foot.

4.4 DATA CODING

Please refer to Appendix B for the detailed feature coding that was completed for each video prior to the combined Image Feature analysis as described Analysis section of the manuscript in Chapter 5.

4.5 AUTHOR ROLE IN THIS STUDY

MacKenzie, D.E., & Westwood, D.A.

Status of manuscript: submitted to the Canadian Journal of Occupational Therapy prior to PhD defense.

The primary author was responsible for concept and design; simulated client training; visual stimuli creation; data collection; analysis and interpretation; manuscript writing and revision.

CHAPTER 5 OBSERVATION PATTERNS OF DYNAMIC OCCUPATIONAL PERFORMANCE

5.1 ABSTRACT

Observation of a client's occupational performance is a dynamic process and it remains unknown how therapists gather visual information for this task. The purpose of this study was to use eye-tracking methodology to explore observational behaviour of occupational therapists and non-healthcare professionals when watching videos of simulated clients post-stroke participating in everyday activity. Ten licensed occupational therapists, and ten age, gender, and education-level matched participants completed the study. Contrary to our past work with static image viewing, we found limited evidence of differences in eye movement characteristics between the two groups although results did support the role of bottom-up information such as visual motion as a determinant of looking behaviour. These results suggest that understanding observational behaviour in therapists can be aided with eye-tracking methodology, but future studies should probe a broad range of factors that might influence observational behaviour and performance such as assessment goals, knowledge, and therapist experience.

5.2 INTRODUCTION

Observation of a client's occupational performance is a key component of both formal and informal assessment, capturing the interaction between person, environment and occupation. Observation can be conceptualized as the purposeful gathering of information or data by an observer through the use of various sensory systems. Consistent with the importance of observation in assessment, studies have attempted to understand and improve the assessment process through standardization of scoring guidelines and measurement of reliability and validity (e.g., Brentnall & Bundy, 2009). However, few studies have actually explored the actions carried out by the observer during the observation process itself. Consequently, it remains unknown how therapists gather their observation data, and if they gather it differently than (or in a manner that is superior to) an untrained observer simply "watching".

Drawing on the rich literature on eye-tracking as a tool for exploring the role of eye movements in visual tasks such as reading, search and memory tasks, we compared the observational behaviour of occupational therapists (OT) and non-health care professionals (NonOT) when freely inspecting static images consisting of domain-relevant stimuli (i.e., simulated clients post-stroke) and domain-neutral stimuli (i.e., landscapes) (MacKenzie & Westwood, 2012). Participants were instructed to simply view the images for a recognition memory task that would be administered after all images had been seen. We found the oculomotor behaviour of the OTs significantly different from the NonOTs and demonstrated an increased fixation counts, shorter fixation durations, and more saccade counts a variety of domain-relevant (simulated client post-stroke) and domain-neutral images (naturalistic scenes). Since the only measureable difference between the two groups studied was their occupational therapy training, the finding that the OTs viewed both type of images differently than the NonOTs suggests that a top-down direction of their visual attention played a dominant role for allocation of attention (Henderson, Brockmole Castelhana and Mack, 2007). Our results suggest that eye-tracking methodology is a useful tool for exploring observational behaviour in OTs, although the task was quite limited with respect to context in which assessment takes place in occupational therapy practice. For example, assessment is rarely if ever carried out with static images as movement is a key element of occupational performance.

Dynamic scenes are not only more clinically relevant than static images, they are also much richer in terms of visual information, containing time-varying information such as motion (Tatler, Hayhoe, Land & Ballard, 2011). Research suggests that ‘bottom-up’ features present in the stimulus (and independent of observer knowledge) like motion and continuous change of scene content are strong predictors of the likelihood that an observer will look towards a stimulus (Itti, 2005). Accordingly, one would predict that all observers, regardless of skill or ability, would tend to look at similar features of dynamic scenes such as things that are moving. However, ‘top-down’ knowledge or experience of the observer has also been shown to impact the viewing behaviour by

directing visual attention toward scene features that are thought to be important (Tatler, Hayhoe, Land and Ballard, 2011). Accordingly, there is reason to believe that trained therapists would tend to look at different features of a dynamic scene than untrained observers, based on the therapist's knowledge and experience with particular tasks and contexts (Polatajko, Mandich, & Martini, 2000).

Our previous finding of group differences during static image viewing supports the importance of top-down influences, while the finding that different picture types elicited differences in eye mechanics is consistent with a potential role for bottom-up factors. What is not known is the visual behaviour for therapists during dynamic scenes. Dynamic scenes might afford an expanded role for top-down knowledge since their knowledge/experience might anticipate or infer actor's intentions, and possible consequences of critical incidents that unfold over time based on, for example, knowledge of physical principles like inertia and static/dynamic balance (e.g., base of support). Physically salient features in each epoch are different so it is possible that differences may arise from bottom-up mechanisms. But as noted above, one could still say that different epochs elicit difference knowledge of what is happening and therefore could also be explained by top-down factors.

The present study was designed to gauge if there are differences in global measures of observation behaviour (i.e., saccade count, fixation count, fixation durations) between OTs and NonOTs when viewing content related to OT expertise (i.e., videos of simulated clients post-stroke). More specific measures of observation were also explored, by breaking down stimuli into particular regions of interest ("features") and phases ("activity epochs"). The present study was primarily descriptive, guided at suggesting directions for more targeted experimental analysis in future studies. Nevertheless, two broad hypotheses were proposed based on our past work with static images; (1) Bottom-up factors would matter for both groups, as evidenced by main effects of 'Features' and 'Epochs', and, (2) Top-down factors would matter, as evidenced by Group main effects, or interactions between Group and Features or Epochs.

5.3 METHOD

5.3.1 Goals of Study:

The primary goal of this study was to establish if there are differences in eye movement patterns between trained occupational therapists (OT) and non-trained/health (NonOT) observers during free observation of occupational performance (i.e., no instructions or restrictions of where the participants could look) of a simulated client post-stroke during three different videotaped tasks. A secondary goal was to explore differences in self-reported observation strategies between the two groups.

5.3.2 Participants:

Participants recruited for the OT group included licensed occupational therapists with at least five or more years of neurorehabilitation experience. The NonOT group included participants matched to the OT group for age, gender and highest degree attained, but with no previous healthcare education or experience. The initial contact for both groups was purposive and triggered a *word of mouth* recruitment process. Eligible participants were required to meet the following conditions: (i) normal or corrected-to-normal visual acuity wearing contact lenses; (ii) no known visual or neurological condition restricting any of the following: coordinated eye movements, visual and cognitive processing skills, head and neck control in a seated position, or coordinated upper limb fine motor control. All participants provided informed, written consent. This study was reviewed and approved by the University's office of Human Research Ethics Administration.

Twenty participants completed this study: 10 licensed occupational therapists (OT) and 10 matched NonOT participants. Each group included 8 females and 2 males.

Participants ranged in age from 30 to 50 years. The OT group was equally distributed in practice experience (all had greater than 6 years of neurological occupational therapy experience), practice setting (acute, rehabilitation, private practice, or combination thereof), and client caseload (infancy/childhood, adolescent/adult, older adult, or combination thereof). Participants reported similar observational experience profiles

suggesting that the major identifiable difference between the matched groups was the domain specific training and practice experience of occupational therapy.

5.3.3 Apparatus and Stimuli

The SR Research Experiment Builder software was used in combination with EyeLink[®] II (SR Research Ltd., Mississauga, ON) video-based eye-tracking system to create and carry out this study. The EyeLink[®] II has a sampling rate of 500 Hz; spatial precision $<0.01^\circ$ and spatial accuracy $<0.8^\circ$ RMS error. Calibration of the EyeLink[®] II was carried out in the same horizontal viewing plane used to display the video images. The eye-tracker recorded eye position and movement duration, as well as compensations for head movement. Viewing was binocular, but only the right eye was tracked.

EyeLink DataViewer[™] software (SR Research Ltd., Mississauga, ON) was used to extract four key dependent measures related to eye movement during the study, including number of features fixated (fixation count), time spent at the feature (fixation duration), and saccadic activity (eye movements – both number [saccade count], and distance spanned by the movement [saccade amplitude]) (Castelhana et al., 2009). Data management and statistical analysis was completed with Microsoft Excel 2007 (Microsoft, Redmond, WA) and PASW[®] Statistic 17.0 software (SPSS Inc., Chicago, 2009). Videos were recorded using a Canon XM2 mini-DV camcorder and subsequently edited using Adobe Premiere Pro 2.0. Natural uncut scenes, more representative of natural viewing situations, were used instead of professionally edited change of viewpoint videos (Dorr, Martinetz, Gegenfurtner, & Barth, 2010). The videos were presented in full colour and random order on a 32 inch monitor, with a refresh rate of 140 Hz. The audio component of each video was purposefully removed to ensure the measurable components of visual attention were driven by visual features of the videos. While auditory alerting may enhance visual search performance (Zou, Muller & Shi, 2012), auditory cues cannot be localized in an image making it difficult to link the auditory cue influence on the observation visual attention parameters.

The video stimuli of three different typical daily living events used for this study were developed by the primary author. Two of the videos included a female simulated client (post stroke with left hemiparesis) completing a kitchen task (standing on a kitchen step stool reaching into the second shelf of a cupboard) and a transfer task (sit-pivot transfer from a toilet to wheelchair). In these two videos, the simulated client portrayed the left arm/hand (L UE) as non-functional at the side of the body (Chedoke-McMaster Stage 2 hand and arm; Miller, et al., 2008). In the kitchen video, the left leg/foot (L LE) were functional for weight-bearing on a narrow surface (Chedoke-McMaster Stage 6 leg and foot) and in the toilet video the leg/foot did not take equal weight-bearing or hinder the transfer (McMaster Stage 5 leg and foot). The third video portrayed a male simulated client (post-stroke with right hemiparesis) pushing a manual lawn mower. The arm and hand were non-functional (Chedoke-McMaster Stage 2 hand and arm) and positioned in a pocket sling across the body. The left leg and foot were functional (Chedoke-McMaster Stage 6 leg and foot) during the ambulation in the grass video. The kitchen and toilet video had a static camera viewing perspective, while the grass cutting video had a changing viewing perspective as the client moved toward the camera.

5.3.4 Procedure

Participants donned the EyeLink[®] II head mounted eye-tracking system and sat approximately 36 inches (91 cm) from the monitor. There was no restriction in head movement so as to provide a naturalistic viewing condition for the participants. The EyeLink[®] II calibration and validation process was completed at the beginning of the experiment to ensure point of gaze verification could be achieved from all nine eye calibration features on the computer screen. To decrease the eye-tracking error, each video presentation began with a drift correction procedure. This study was purposefully devoid of instructions for the viewing period to allow for tracking what drew the observer's attention, as opposed to directing their attention for task completion. The use of a task or assessment to complete with domain specific video content would create bias against the NonOT group due to content expertise differences. Participants were only told they would be watching three videos of a simulated client post stroke and following

the viewing they would be asked a reflective observation question (i.e., “*Please list up to 3 strategies or points you used to assist with observing the video contents*”).

5.3.5 Data Coding and Epoch Descriptions

The four dependent eye measures were extracted for all videos. The data viewer software provides the coordinate locations of the eye gaze locations, but is unable to automatically marry the subjects’ visual gaze to features within the moving scene. Fixation locations (coded as features) were achieved by reviewing the gaze cursor overlay at 5% of real time speed and identifying the initial feature within the video associated with the fixation coordinates, frame number and time stamp (in milliseconds). Given that critical incidents occurred within each video at different points in time, our analyses were conducted on fixations by ‘feature’ and also by ‘features and epochs’ - where epoch refers to a period of time in the video where key activity components occurred. Table 5.1 contains a description of each epoch’s activity components per video and epoch length (in milliseconds). These analyses allowed us to focus more precisely on differences in observational performance between groups, since these differences could potentially be specific to particular features at specific instants in time.

All video stimuli were reviewed three to four times each by the primary author to code features, and an independent reviewer (occupational therapist not part of the study) randomly sampled each coded video to validate the feature coding schemes. Please note that saccade count and saccade amplitude are measures of eye movement between the fixated features, and thus could not be included in the specific Feature analysis. For the purpose of these analyses there was no differentiation of specific location within the categorization of environment or person features. All relevant and irrelevant locations within the environment or person were grouped within a feature category. For example, several locations on the right arm and leg were grouped together as the R UE/LE Feature than specific locations on the limb. Please refer to Appendix B for specific relevant and irrelevant features grouped within overall categories for analysis.

5.3.6 Data Analyses

A mixed analysis of variance (ANOVA) was first completed for each video to explore the effects of Group and Epoch for all of the dependent measures. Next a mixed ANOVA of Group by Epoch by Feature was completed for the fixation count and fixation duration dependent measures (saccade count and amplitude are not included in the Epoch by Feature analysis as they are movements between the fixated features). An alpha threshold of .05 was used for all analyses. Based on the results of Mauchly's test (alpha = .05), the Greenhouse-Geisser correction was applied for any violation of sphericity and the adjusted degrees of freedom are reported. Significant effects will be presented for each video separately. Effect sizes are presented as partial eta squared. These values can be interpreted using the following parameters: values between 0.01– 0.05 indicate a small effect, values between 0.06–0.13 indicate a medium effect, and values of 0.14 and greater indicate a large effect.

5.4 RESULTS

5.4.1 Grass Video

One of the NonOT cases was removed from the analysis during the feature coding due to an error in of the gaze overlay synchronization with the video content. There were no significant main effects or interactions in the Group by Epoch ANOVA. Please refer to Table 5.2 for all statistically significant results arising from the complete Group by Epoch by Feature analysis.

Interestingly, there was a significant main effect of Epoch for average fixation duration ($F(2, 34) = 131.16, \eta_p^2 = .45, p < .01$) but not fixation count; the mean fixation duration in the third epoch was significantly longer. Although each epoch in this video was essentially the same in terms of client movement, the image grew in size as the client approached the camera in successive epochs which might account for the change in fixation durations.

A significant main effect of Feature was found for fixation count ($F(5, 85) = 21.27, \eta_p^2 = .56, p < .01$) and fixation duration ($F(2.79, 47.34) = 16.08, \eta_p^2 = .49, p < .01$):

‘Environment’ had more fixations and for longer duration than any of the other features, with ‘L UE/LE’ having the fewest fixations and shortest fixation durations. The significant interaction of Epoch and Feature for fixation count ($F(5.84, 99.19) = 3.27, \eta_p^2 = .16, p < .01$) and fixation duration ($F(4.79, 81.41) = 2.41, \eta_p^2 = .12, p < .05$) was driven by the increased attention to the feature ‘neck/upper /lower trunk’ (compared to other features) during epoch 1 and to ‘L UE/LE’ (the unaffected arm and leg) (compared to other features) during epoch 3. Again, this may be related to movement of the client toward the camera in successive epochs, perhaps making different features more salient.

5.4.2 Kitchen Video

All significant results are reported in Table 5.3. In the Group by Epoch ANOVA there was a significant main effect of Epoch for fixation count ($F(2, 36) = 87.00, \eta_p^2 = .83, p < .05$) and saccade count ($F(2, 36) = 82.85, \eta_p^2 = .82, p < .01$), but this was expected due to the different lengths of the epochs (7220 ms, 3260ms and 4435ms). Of greater interest are the results from the Group by Epoch by Feature ANOVA. The main effect of Feature indicated participants had the most fixations ($F(2.37, 42.61) = 21.27, \eta_p^2 = .71, p < .01$) and longest durations ($F(2.89, 42.61) = 16.08, \eta_p^2 = .61, p < .01$) on the ‘environment’ and ‘R UE/LE’, while ‘LUE/LE’ and ‘neck/upper/lower trunk’ were the least inspected. The significant interaction of Epoch and Feature for fixation count ($F(4.39, 79.06) = 3.27, \eta_p^2 = .25, p < .01$) and duration ($F(3.65, 79.06) = 2.41, \eta_p^2 = .25, p < .05$) is driven by a high level of attention given to the ‘feet’ (compared to other features) in epoch 1 in which the client is adjusting her feet on a narrow stool, and also to the ‘environment’ (compared to other features) in epoch 3 in which the cups fall from the shelf.

5.4.3 Toilet Video

All significant results are reported in Table 5.4. As was the case for the kitchen video Group by Epoch ANOVA, significant main effects of Epoch for fixation ($F(3, 54) = 155.98, \eta_p^2 = .90, p < .01$) and saccade counts ($F(3, 54) = 143.98, \eta_p^2 = .89, p < .05$) are likely a reflection of the differing epoch time lengths (5,460, 4,454, 2,208 and 2,935 ms).

However, in the shortest epochs (3 and 4) the fixation duration and saccade amplitude are markedly different from epoch 1 and 2, indicating participants are not moving their eyes across the same distance as in the other epochs, and are dwelling longer at features. Interestingly, epochs 3 and 4 represent the most total body movement as well as safety concerns in the video.

In the Group by Epoch by Feature ANOVA, a main effect of Group ($F(1, 18) = 7.83, \eta_p^2 = .30, p < .05$) is found indicating that the OTs ($M = 1.38$) demonstrated significantly more fixations than the NonOTs ($M = 1.12$). The main effect of Feature for fixations ($F(3.73, 67.04) = 45.73, \eta_p^2 = .72, p < .01$) and duration time ($F(3.57, 64.34) = 29.24, \eta_p^2 = .62, p < .01$) found 'R UE/LE' had the most fixations with the 'L UE/LE' the least frequented. There was a significant main effect of Epoch for both fixation count ($F(3, 54) = 213.53, \eta_p^2 = .92, p < .01$) and fixation duration ($F(3, 54) = 345.62, \eta_p^2 = .95, p < .01$). The fixation count result was expected given the differing epoch durations, but the fixation duration result indicates there may be something in the scene changing how long participants dwelled on features. The interaction of Epoch and Feature for fixation count ($F(7.67, 138.01) = 8.20, \eta_p^2 = .31, p < .01$) and fixation duration ($F(7.86, 141.44) = 5.51, \eta_p^2 = .23, p < .01$) indicates that the participants changed their visual behaviour in response to the dynamic content within the epoch. The 'R UE/LE' and 'environment' garnered the largest fixation count and duration during epoch 1 and 2 when the client was searching for UE support prior to the transfer movement, while the 'Right side of the wheelchair' and 'environment' received an increased amount of fixations and time spent during the final epoch as the client descended into the wheelchair.

5.4.4 Self-Reported Observation Strategy

Participants were purposefully given no specific instructions for their observation, which allowed them to freely use their own viewing strategy (Tatler, Baddeley, & Gilchrist, 2005). In the absence of task instructions, it is interesting to note that the participants reported similar observation strategies. Responses from both groups clustered into three themes indicating an attempt to view the quality of movement (10 OT, 6 NonOT), the

safety of the person to complete the task (9 OT, 5 NonOT), and a scan of the environment beyond the person and task items (6 OT and 4NonOT).

5.5 DISCUSSION

Observations of performance are a mainstay of assessment in occupational therapy, but there is limited information about therapist behaviour in this context. Drawing on our past work with static image observation, the present study sought to discern if there was a difference in eye movement patterns between occupational therapists and non-healthcare professionals during free observation of occupational performance using dynamic scenes. It was predicted that there would be similarities in the observational performance of the OT and NonOT groups, related to highly salient stimuli; whereas differences might be found for features elements might only be salient to trained occupational therapists (i.e., potential safety concerns) who could direct their attention to certain features within the videos based upon their prior knowledge and training.

Our measurements identified several observational patterns that were shared by both groups, and are consistent with studies from other observational contexts which found that motion influences visual attention (e.g., Itti, 2005). As evidenced by the main effects of Feature and Epoch, and the interaction between Feature and Epoch in all three videos, fixations were not random or equally distributed throughout all the features and all epochs. These findings indicate that observers were guided by relatively specific features associated with movement during different epoch times. Where there was movement in an epoch, more fixations and longer fixation duration times occurred with one exception. In the activity epochs with large movements (toilet epochs 3/ 4) and/or where the movement becomes larger on the screen (grass epoch 3), the fixation duration increased and the saccade amplitude decreased. Saccade amplitude has been reported to be most affected by the size of stimulus presented (von Wartburg et al, 2007), so the amplitude change could be simply related to the relative size of the client as they move toward the camera (toilet epochs 3/4, and grass epoch 3).

Given the amount of oculomotor behaviour directed toward the environment during the epochs within all the videos, it is plausible that visual behaviour may not only be in response to movement or change in relative size of the image, but are fixated for future actions. Looking at the environment during hand placement for the toilet transfer, or looking at the shelf during the kitchen video, might be directed by top-down influences in anticipation of movement or interaction with the task object(s). While not part of this study, other studies of dynamic observation have shown that observers demonstrate ‘look ahead’ fixations anticipating their own movement or the next task component they must achieve (Land & Hayhoe, 2001). Additionally ‘joint attention’ behaviour (Mundy & Newell, 2007), wherein the observer is drawn to look at the same features being attended to by others, may also be influencing the participants visual behaviour (i.e., searching the same locations as the client in the video when placing the hand for support during toilet epoch 1, and looking into the cupboard prior to reaching for a cup in kitchen epoch 2) . This joint attention concept could serve to facilitate observation, or, it could also successfully misdirect the observer from searching other critical locations of inquiry, similar to how magicians are able to successfully use gaze to misdirect the visual attention of their audience (Kuhn, Tatler & Cole, 2009).

In contrast to our previous work with static images, the results of the present study reveal few differences between groups in observational behaviour. No Group main effect or interactions involving Group were seen for the ‘Kitchen’ or ‘Grass’ videos, whereas a significant main effect of Group was found for the ‘Toilet’ video. The lack of difference for the kitchen and grass video may be due to the commonality of the activity viewed whereas the significant main effect of Group in the ‘Toilet’ video, with the OTs making more fixations than the NonOTs, might indicate top-down influences on visual guidance related to knowledge of the OTs for a sit-pivot toilet transfer. Others have found that scene familiarity has elicited increased fixations and short durations for experts and is suggested to be related to efficiency in grasping the scene (Stevens, Winkler, Studies, et al., 2010).

Moreover, we did not identify any interactions with Group in any of the videos, indicating that the OTs and NonOTs distributed their fixations similarly to various features of the videos at each epoch. While the self-reported viewing strategies were similar, the lack of specific task viewing instructions may also have produced such diverse behaviours that no group differences could be detected. It has been well documented that instructions can affect viewing strategies and that there is a link between the task instructions and where we look (Land, Mennie & Rusted, 1999). In this case, by not providing instructions to the groups, the OT group may not have adapted their viewing strategy to the cognitive and behavioural activity required for the assigned task (Boot et al., 2009) or tap into their task knowledge and subsequent specificity of directing eye movements (Castelhano & Henderson, 2007).

The results of the present eye-tracking study provide the groundwork for future studies that attempt to understand the nature of observation by occupational therapists (and indeed other health care professionals) with the goal of improving observational assessment performance and training.

5.5.1 Implications for Practice and Directions for Future Study

One concern the results of this study highlight was the lack of visual behaviour directed toward the affected upper extremity in both the kitchen and toilet videos. While the arm did not contribute to task completion due to portrayed recovery status, it is of concern that the OT group did not at least investigate the limb differently than the NonOT group given the potential for safety concerns. Future studies need to explore a variety of factors associated with observational behaviour. Specific studies aimed at identifying safety hazards during viewing of dynamic stimuli require further investigation. Additionally, the use of instructions or specific assessment forms for the OT group to complete following dynamic scenes is important to explore and how they impact visual gaze behaviour for features viewed and the timing of the fixations.

5.5.2 Limitations

This study may not be representative of the larger OT population due to the limited range of dynamic scenes representing all activities of daily living, small sample size which

limited the power and post-hoc analysis for trends in the data suggesting differences in how the groups viewed the respective video features during activity epochs. It is important to recognize that eye tracking methodology can determine what a person is looking at but not necessarily to what they are paying attention (Duchowski, 2007). It is also recognized that attention is not only overt (fixating on a feature), but can be deployed covertly (no eye movement). The viewing angle and format of the videos were purposefully constructed to provide the perspective one might have if observing a client completing the task. However, inherent to providing this vantage point is the introduction of a photographer's central bias (Tseng, Carmi, Cameron, Munoz, & Itti, 2009). This bias may unwittingly direct the observer's attention to areas that the photographer found interesting, instead of exploring other areas of interest. The client was trained as per standard simulated client protocol, though the use of a simulation may raise potential for inaccuracies with diagnosis portrayal. Finally, there may be other differences within each observer's ability, acquired knowledge or experience and practice that were not captured with this study, and which might affect the ability to filter or attend to this study's components.

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Table 5.1 Video Epoch Descriptions and Durations

Toilet Epochs	Time (ms)
1. Head Seeking & right arm movement between the wall bar and wheelchair for UE support – epoch ends with R hand grasp on wall grab bar	5,460 ms
2. Trunk folding/unfolding and feet preparation for transfer movement. Right hand still holding wall bar.	4,454 ms
3. Lift off toilet seat and pivot to wheelchair. R hand still holding wall bar.	2,208 ms
4. Posterior thigh contact with wheelchair surface. Release of wall grab bar	2,935 ms
Kitchen Epochs	
1. Foot adjustment on step stool. R hand on counter. Head/neck/body begins to extend in preparation of hand lift off counter.	7,220 ms
2. Right hand lifts off from counter, reach to 2 nd open shelf and manipulates cups attempting to retrieve one cup off shelf.	3,260 ms
3. Cups start to fall off shelf and into sink, right hand leaves 2 nd shelf and returns back to counter	4,435 ms
Grass Epochs	
1. Gait cycle x 2 (Left Toe Off)	3,558 ms
2. Gait cycle x 2 (Left Toe Off)	3,496 ms
3. Gait cycle x 2 (Left Toe Off)	3,930 ms

Table 5.2 Grass Video - Dependent variable mean values [standard error]

Measure	Group	Epoch	Feature ^a					
			1	2	3	4	5	6
Fixation Count c*d*	NonOT	1	1.11 [0.29]	2.89 [0.40]	1.44 [0.29]	0.00 [0.12]	0.56 [0.42]	2.11 [0.49]
		2	0.67 [0.45]	2.00 [0.41]	1.33 [0.34]	0.33 [0.14]	1.00 [0.39]	2.89 [0.60]
		3	0.44 [0.32]	1.11 [0.35]	2.11 [0.44]	0.89 [0.33]	1.44 [0.42]	3.00 [0.55]
	OT	1	0.60 [0.28]	2.70 [0.38]	1.60 [0.27]	0.30 [0.11]	1.40 [0.40]	2.70 [0.47]
		2	0.80 [0.43]	1.00 [0.39]	2.30 [0.33]	0.10 [0.13]	1.20 [0.37]	2.80 [0.57]
		3	0.20 [0.31]	1.70 [0.33]	1.90 [0.42]	0.80 [0.31]	1.60 [0.40]	3.10 [0.53]
Measure	Group	Epoch	1	2	3	4	5	6
Fixation Duration b*c*d**	NonOT	1	373.30 [136.91]	1244.84 [215.53]	411.74 [107.92]	0.00 [48.56]	224.23 [154.85]	984.17 [223.28]
		2	183.11 [102.60]	684.93 [155.09]	566.87 [186.26]	120.00 [49.06]	339.37 [197.12]	1252.74 [274.13]
		3	114.22 [78.82]	337.75 [125.14]	795.99 [253.00]	316.46 [128.34]	608.44 [189.80]	1236.88 [301.27]
	OT	1	284.81 [129.88]	827.62 [204.47]	574.62 [102.38]	92.42 [46.06]	469.99 [146.90]	956.01 [211.83]
		2	198.82 [97.33]	390.81 [147.13]	876.17 [176.71]	28.40 [46.54]	637.21 [187.00]	985.19 [260.07]
		3	16.41 [74.77]	609.56 [118.72]	871.17 [240.02]	253.18 [121.75]	698.36 [180.06]	1015.65 [285.81]

^a Feature: 1=Head/Face; 2= Neck/Upper/Lower Trunk; 3=R UE/LE; 4 = L UE/LE; 5 =Feet & Area; 6= Environment

^b Main Effect of Epoch ;

^c Main Effect of Feature

^d Interaction of Epoch and Feature

*Significant at <.01

**Significant at <.05

Table 5.3 Kitchen Video - Dependent variable mean values [standard error]

Measure	Group	Epoch	Feature ^a						
			1	2	3	4	5	6	
Fixation Count b** c* d*	NonOT	1	2.60	1.40	4.80	1.40	3.20	4.40	
			[0.45]	[0.49]	[0.55]	[0.37]	[0.92]	[1.08]	
		2	1.00	1.00	1.80	0.70	0.30	3.10	
		[0.21]	[0.24]	[0.43]	[0.45]	[0.25]	[0.62]		
		3	1.30	0.70	3.00	0.30	0.40	5.90	
		[0.35]	[0.19]	[0.69]	[0.22]	[0.24]	[0.66]		
OT	OT	1	3.00	1.60	3.50	1.70	4.90	5.70	
			[0.45]	[0.49]	[0.55]	[0.37]	[0.92]	[1.08]	
		2	0.70	0.50	2.40	0.60	0.80	4.50	
		[0.21]	[0.24]	[0.43]	[0.45]	[0.25]	[0.62]		
		3	1.40	0.50	3.50	0.50	0.30	6.80	
		[0.35]	[0.19]	[0.69]	[0.22]	[0.24]	[0.66]		
Fixation Duration c* d**	NonOT	1	1002.30	392.44	1804.81	704.32	1494.40	1162.34	
			[212.60]	[166.02]	[357.63]	[168.48]	[358.93]	[288.75]	
		2	459.19	222.01	663.16	135.60	114.82	1384.85	
			[113.97]	[68.29]	[197.33]	[91.53]	[85.52]	[238.03]	
		3	338.04	240.00	1306.77	168.42	104.01	1793.60	
			[100.85]	[66.94]	[260.72]	[85.56]	[72.28]	[202.22]	
	OT	OT	1	1080.82	598.35	1036.77	526.31	1680.01	1505.28
				[212.60]	[166.02]	[357.63]	[168.48]	[358.93]	[288.75]
			2	170.80	146.44	756.02	157.21	254.22	1311.61
			[113.97]	[68.29]	[197.33]	[91.53]	[85.52]	[238.03]	
		3	364.00	133.23	1170.36	97.64	109.82	2051.58	
			[100.85]	[66.94]	[260.72]	[85.56]	[72.28]	[202.22]	

^a Feature: 1=Head/Face; 2= Neck/Upper/Lower Trunk; 3=R UE/LE; 4 = L UE/LE; 5 =Feet & Area; 6= Environment

^b Main Effect of Epoch ;

^c Main Effect of Feature

^d Interaction of Epoch and Feature

*Significant at <.01

**Significant at <.05

Table 5.4 Toilet Video - Dependent variable mean values [standard error]

Measure	Group	Epoch	Feature ^a							
			1	2	3	4	5	6	7	8
Fixation Count b** c* d* e*	Non OT	1	2.10 [0.54]	2.80 [0.50]	4.70 [0.62]	0.10 [0.17]	0.10 [0.20]	1.80 [0.47]	0.90 [0.25]	3.90 [0.58]
		2	1.90 [0.47]	1.20 [0.37]	4.60 [0.56]	0.40 [0.22]	0.50 [0.22]	1.10 [0.50]	0.10 [0.12]	1.70 [0.50]
		3	0.70 [0.20]	0.40 [0.19]	1.20 [0.39]	0.00 [0.00]	0.10 [0.16]	0.30 [0.31]	0.10 [0.10]	0.80 [0.28]
		4	1.40 [0.39]	0.20 [0.13]	2.40 [0.44]	0.10 [0.07]	0.10 [0.26]	1.00 [0.54]	0.30 [0.24]	1.00 [0.39]
	OT	1	2.40 [0.54]	2.20 [0.50]	5.70 [0.62]	0.30 [0.17]	0.50 [0.20]	2.60 [0.47]	0.30 [0.25]	4.10 [0.58]
		2	1.10 [0.47]	1.10 [0.37]	5.30 [0.56]	0.40 [0.22]	1.00 [0.22]	1.20 [0.50]	0.20 [0.12]	2.40 [0.50]
		3	0.10 [0.20]	0.40 [0.19]	2.30 [0.39]	0.00 [0.00]	0.20 [0.16]	0.80 [0.31]	0.10 [0.10]	0.70 [0.28]
		4	1.50 [0.39]	0.20 [0.13]	2.40 [0.44]	0.00 [0.07]	1.20 [0.26]	2.10 [0.54]	0.30 [0.24]	1.20 [0.39]
Measure		1	2	3	4	5	6	7	8	
Fixation Duration b** c* d* e*	Non OT	1	732.70 [196.38]	846.77 [164.86]	1259.98 [171.60]	89.99 [72.48]	29.61 [48.07]	553.65 [132.02]	282.75 [73.74]	1032.81 [174.78]
		2	590.04 [154.48]	435.20 [136.55]	1339.19 [202.68]	104.38 [74.99]	134.85 [76.58]	332.80 [169.51]	10.02 [29.07]	489.58 [174.04]
		3	218.82 [71.41]	144.80 [83.87]	542.00 [196.08]	0.00 [0.00]	0.80 [30.83]	150.99 [124.30]	10.19 [23.47]	289.40 [92.38]
		4	433.21 [115.86]	103.19 [54.85]	755.25 [129.17]	15.60 [11.03]	16.81 [62.49]	637.01 [218.19]	83.40 [64.21]	250.98 [93.59]
	OT	1	764.05 [196.38]	615.14 [164.86]	1502.34 [171.60]	73.60 [72.48]	109.62 [48.07]	678.74 [132.02]	67.22 [73.74]	1069.60 [174.78]
		2	213.19 [154.48]	233.22 [136.55]	1474.05 [202.68]	115.17 [74.99]	332.39 [76.58]	349.20 [169.51]	57.19 [29.07]	669.59 [174.04]
		3	23.19 [71.41]	172.39 [83.87]	926.18 [196.08]	0.00 [0.00]	43.60 [30.83]	196.78 [124.30]	31.59 [23.47]	208.22 [92.38]
		4	333.62 [115.86]	31.60 [54.85]	596.59 [129.17]	0.00 [11.03]	293.61 [62.49]	614.82 [218.19]	65.21 [64.21]	234.20 [93.59]

^a Features: 1=Head/Face; 2=Neck/Body; 3=R UE/LE; 4 = L UE/LE; 5 = Feet; 6=R side WC; 7=L side WC, 8=Environment

^b Main Effect of Group, ^c Main Effect of Feature, ^d Main Effect of Epoch

^e Interaction of Epoch and Feature

*Significant at <.01, **Significant at <.05

CHAPTER 6 (STATIC) SCENE PERCEPTION INTRODUCTION

6.1 RATIONALE

The free viewing studies using static and dynamic visual images did not produce consistent differences in eye measures between groups. While the static image study (Study 1, Chapters 2 and 3) revealed differences between groups across domain-specific and domain-neutral image types, there were limited differences found in the dynamic viewing condition (Chapter 4 and 5) with one exception: in comparison to the grass cutting and kitchen cupboard videos, the toilet transfer video found differences between groups. The difference may have been related to the video content evoking a domain-specific response related to the OT knowledge or experience. In order to further explore potential differences in both eye measures and in observation skills related decision-making of OT and NonOT, this last ‘scene perception with safety decision-making’ study was designed.

The scene perception study used static images, but added the additional layers of image exposure times and task instructions. These manipulations were intended to explore two interrelated questions: (1) do OTs observe images differently from NonOTs when asked to make decisions that are related to their area of professional expertise (i.e., safety decisions), and (2) do OTs and NonOTs interpret safety differently in very brief exposure conditions (i.e., 150 ms) that limit the potential for eye movements, as compared to conditions in which multiple eye movements can be made (i.e., 1000 ms and 3000 ms).

Participants viewed images of both domain-specific (stroke) and domain-neutral (not-stroke) individuals completing independent living and leisure skills and were required to rate the safety of the image content using a 5 point scale. Additionally, image exposure times were manipulated to either restrict or allow eye movements to explore the image to gather information for the determination of image safety. Each image presented was randomly assigned to an exposure time of 150 ms, 1000 ms or 3000 ms. The 150 ms exposure time only allowed participants to glean a ‘gist’ of the scene and did not allow for any exploration of any areas of interest with eye movements. It was of interest to see

if this restricted exposure time was long enough gather a sense of scene safety. Increasing the scene exposure times allowed for active visual movement or fixation of objects and scene elements by participants. Given that occupational therapists often are required to make safety judgment decisions quickly in practice, or in reaction to an unsafe therapeutic encounter, differences may be expected to be found between groups in terms of safety ratings given the occupational therapists' knowledge and experience for this skill.

An *ad hoc* expert panel was used to validate image safety ratings as well as identify regions of interest critical for determining the safety of each image. The mean safety ratings were used to identify a sub-set of images for follow-up analyses based on specific regions of interest (ROIs). Two groups of images were selected that met the following criteria: (1) OTs, NonOTs, and experts agreed on the safety of the image (i.e., either safe or unsafe); (2) OTs and experts agreed on the safety of the image, but disagreed with the NonOTs.

6.2 RESEARCH HYPOTHESES

It was predicted that differences would be found between groups for the domain-specific (stroke) image safety rating with the OT group ratings aligned with the image content (safe or non-safe), but similar ratings would be found between groups for the domain-neutral stimuli (non-stroke). There were also differences expected with the scene gist condition (150 ms) with the OT group ratings aligned with the image content (safe or non-safe). Additionally, it was predicted that differences between groups in eye movement parameters (fixations, fixation durations, saccades, saccade amplitudes) would be found for the domain-specific images (stroke) at the 1000 ms and 3000 ms exposures, but no differences would be found for the domain-neutral stimuli (non-stroke). Finally, it was predicted that differences between groups for eye fixations or duration measures would be found within regions of interest (ROI) identified by an *ad hoc* expert panel for a sub-set of images.

6.3 VISUAL STIMULI

For the purpose of this study, the scenes developed by the primary author followed the definition of scene gist suggested by Castelhana & Henderson (2008) whereby the images were of individuals (non-stroke and simulated stroke) participating in real-world activities in which the viewer may have knowledge of content, spatial layout and semantically related information.

The study explored the influence of domain specificity by using clinically related images together with general everyday events. Domain-specific images contained simulated clients post stroke and domain-neutral images contained individuals from a range of ages participating in everyday activities. Both image blocks represented various self-care, productivity, mobility or leisure tasks, and were purposefully selected to portray safe, unsafe and ambiguous (neither safe nor unsafe) levels of safety. Participants viewed two counterbalanced blocks of 30 images presented randomly at assigned exposure times (150 ms, 1000 ms and 3000 ms).

6.4 AUTHOR ROLE IN THIS STUDY

MacKenzie, D.E., & Westwood, D.A.

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The primary author was responsible for concept and design; simulated client training; visual stimuli creation; data collection; analysis and interpretation; manuscript writing and revision.

CHAPTER 7 IS THAT SAFE? SCENE PERCEPTION AND SAFETY RATINGS

7.1 Abstract

Observation of occupational performance is key aspect of practice but it remains unknown how therapists observe and interpret visual information for this task. Occupational therapists and non-healthcare professionals were asked to use a 5-point scale to rate the safety of static images of simulated clients post-stroke and individuals without stroke completing everyday activities. Images were randomly assigned to one of three exposure times (150 ms, 1000ms and 3000ms). Eye movements were recorded and compared to determine differences in observational behaviour. Ten licensed occupational therapists (OTs) and ten age, gender, and education-level matched participants (NonOTs) completed the study. For all exposure durations, OTs had more polarized safety ratings compared to NonOTs for stroke-related image content, but there was little evidence of differences in eye movements between groups. Quite surprisingly, group differences in eye movements did not emerge in the analysis of specific regions of interest identified by an independent expert panel. These results point to a complex relationship between decision-making and observational behaviour in occupational assessment, and highlight the need to explore more than simply “what” features of the image are looked at overtly.

7.2 INTRODUCTION

Occupational therapists routinely use observation for evaluation, intervention planning and prediction of a client's functional ability and/or safety within the environment. Determining client safety is a critical practice process that greatly affects client well-being and decision-making for discharge or placement recommendations. Despite some preliminary work in this field from our laboratory, it remains unclear how the therapist gathers their visual information from a scene to inform their decision-making process.

In our previous work (MacKenzie & Westwood, 2012) we used eye-tracking methodology as a starting point toward understanding observational behaviour in occupational therapists. Our work was guided by the idea that where we look influences what we perceive, understand and remember about a scene (Henderson, Malcolm & Schandl, 2009). Oculomotor behaviour can be influenced by 'bottom-up' physical characteristics within the image such as colour or salience (e.g., Itti & Koch, 2000) and 'top-down' information such as the observer's high-level knowledge, priorities, goals, and task instructions (e.g., Torralba, Oliva, Castelhana, & Henderson, 2006; Malcolm & Henderson, 2010). We compared the eye movements made by occupational therapists and matched non-healthcare participants when viewing static images of stroke (domain specific content) and non-stroke content (domain neutral), and found differences between groups for both image types. This group main effect suggested a role for top-down processes in observational behaviour, although the lack of interaction between group and image type implied that this top-down influence is not likely related to specific knowledge about stroke but perhaps a more general observational strategy used by OTs when viewing any type of image. Additionally a main effect of image type was found, indicating that features in the different image types affected eye movements, confirming the well-known importance of bottom-up features influencing observational behaviour.

Our previous work was limited in two primary ways in order to restrict the scope of our initial foray. First, participants were purposefully not given specific instructions to judge the images so their eye movements were 'free viewing' in nature, and not restricted to a task completion. Second, we did not manipulate the duration of image presentation in

order to maintain a constant viewing duration throughout the study; this prevented any ability to determine how much information might have been gleaned by viewers had the duration been shortened to not allow any eye movements.

7.2.1 Task Instructions and Observation

Task instruction manipulation engages the observer's top-down knowledge. As a result, eye movement patterns are modified to gather specific information necessary for understanding the scene within the context of the task demands (e.g., Henderson, Brockmole, Castelhana & Mack, 2007). While bottom-up visual stimulus features (saliency) are still important, top-down influences primarily control the direction of eye movements (e.g., Torralba, Oliva, Castelhana & Henderson, 2006). In this study, task instructions would elicit top-down knowledge to guide eye movement as participants were required to determine a safety rating for each image presented. Safety rating may also draw upon the occupational therapy domain-specific knowledge to assist with decision-making as it relates to clients post-stroke and everyday living activities (e.g., pattern recognition for falls, use of tools and equipment).

7.2.2 Scene Gist

There is ample evidence that a short glimpse of a scene is enough to extract the global meaning – the so-called 'gist' of a scene (e.g., Castelhana & Henderson, 2008; Oliva & Schyns, 1997; Oliva & Torralba, 2006). Processing global image features is not reliant upon moving the eyes to individual objects for processing and is proposed to be mediated by parallel mechanisms (Oliva & Torralba, 2006). Expertise may assist with quick recognition as global information gathering is superior when scenes contain meaningful interactions or expectations about where objects should belong or are most likely to be found (e.g., Castelhana & Henderson, 2008). Studies have found that radiology experts were more efficient with global detection than novices, suggesting that expertise in image analysis may consist of a shift in the recognition mechanism from scan-look-detect to a look-detect-scan model (Kundel, Nodine, Conant, & Weinstein, 2007; Kundal, Nodine, Krupinski, & Mello-Thoms, 2008). Given the expertise of occupational therapy with everyday living skills and safety assessment, perhaps a glimpse of a scene is enough to gather a global impression of safety.

7.3 STUDY HYPOTHESES

This study aimed to establish if there are differences in safety ratings and eye movements between occupational therapists (OT) and non-healthcare trained matched individuals. It was predicted that the groups would differ for the domain-specific (stroke) image safety rating with the OT group ratings aligned with the image content (safe or non-safe), but no group differences would be found for safety ratings of domain-neutral stimuli (non-stroke). Differences between groups for safety ratings were expected for the scene gist condition (150 ms) with the OT group ratings aligned with the image content (safe or non-safe). Additionally, differences between groups were expected for eye movements with the domain-specific images (stroke) at the 1000 ms and 3000 ms exposures, but no differences would be found for the domain-neutral stimuli (non-stroke). Finally, it was predicted that differences between groups for eye fixations or duration measures would be found within regions of interest (ROI) identified by an *ad hoc* expert panel for a subset of 1000 ms and 3000 ms images

7.4 METHOD

7.4.1 Participants:

Twenty participants completed this study: 10 licensed occupational therapists (OT) and 10 participants with no previous health-care education or experience (NonOT). The OT group consisted of 8 females and 2 males, the NonOT group consisted of 8 females and 2 males. The age range of the OT group was 30 to 50 years old, all had greater than 5 years of experience, and self-identified practice location and client age group were equally distributed. The NonOT group was matched to the OT group in terms of age, gender and highest degree attained. As previously reported (MacKenzie & Westwood, 2012), participants were also similarly matched in terms of their reported levels of participation in naturally occurring everyday observation experiences (i.e., driving, parenting, athletics, performing arts, video gaming).

The initial contact for both groups was purposive and triggered a *word of mouth* recruitment process. Interested participants contacted the primary investigator and

completed a self-screening process prior to participating. Eligible participants were required to meet the following conditions: (i) normal or corrected-to-normal visual acuity wearing contact lenses; (ii) no known visual or neurological condition restricting any of the following: coordinated eye movements, visual and cognitive processing skills, head and neck control in a seated position, or coordinated upper limb fine motor control. All participants provided informed, written consent. This study was reviewed and approved by the University's office of Human Research Ethics Administration.

7.4.2 Apparatus

The SR Research Experiment Builder software was used in combination with EyeLink[®] II (SR Research Ltd., Mississauga, ON) video-based eye-tracking system to create and carry out this study. The EyeLink[®] II has a sampling rate of 500 Hz; spatial precision <0.01° and spatial accuracy <0.8° RMS error. Calibration of the EyeLink[®] II was carried out in the same horizontal viewing plane used to display the static images. The eye-tracker recorded eye position and movement duration, as well as compensations for head movement. Viewing was binocular, but only the right eye was tracked. EyeLink DataViewer[™] software (SR Research Ltd., Mississauga, ON) was used to extract eye-tracking dependent variables of fixation count, fixation duration, saccade count, and saccade amplitude. Safety ratings per image were recorded via keyboard entry. Data management and statistical analysis was completed with Microsoft Excel 2007 (Microsoft, Redmond, WA) and PASW[®] Statistic 17.0 software (SPSS Inc., Chicago, 2009).

7.4.3 Stimuli

The photographic stimuli were developed by the primary investigator, digitized and broken into two Image type blocks by content: 30 images of a simulated client post-stroke completing everyday activities (stroke) and 30 images of individuals without stroke completing everyday activities (non-stroke). The stroke images contained either a male aged 45 or female aged 52, while the non-stroke images included individuals from all age ranges and genders. Both image blocks represented various self-care, productivity, leisure or mobility tasks, and were purposefully selected to portray safe, unsafe and ambiguous (neither safe nor unsafe) levels of safety. Images were displayed

in full colour to assist with fast recognition (Oliva & Schyns, 1997), as well as scaled to view people size as experienced in everyday living to effectively elicit a scene gist from a person's 'amassed knowledge' (Castelhana & Henderson, 2007). Images were presented on a 32 inch monitor with a refresh rate of 140 Hz.

In order to limit eye movement, but allow enough exposure to gather the scene 'gist', the minimum exposure time 150 ms was selected based upon the minimum time for scene coherence (100ms) and saccade latencies (150 – 175 ms) (e.g., Dobel et al 2007; Castelhana & Henderson, 2008; and Rayner, 1998). Exposure times of 1,000 ms and 3,000 ms allowed for eye movement.

7.4.4 Procedure

Prior to participation, a self-screening form was completed to ensure participants had no known visual or neurological conditions affecting eye movements, head and neck control in a seated position, cognitive processing abilities, or upper limb fine motor coordination. The primary author explained the sequence of events depicted in Figure 7.1 to each participant.

The EyeLink calibration and validation process was completed at the beginning of the experiment to ensure accuracy of the eye position recordings over the viewing area. Each trial was initiated by the participant's key press and began with a drift correction procedure to decrease the tracking error. Participants fixated on a central cross for a minimum of 250 ms prior to image display. A total of 60 randomized images were shown in 2 separate blocks (stroke and non-stroke) counterbalanced to control for a learning effect. Each participant viewed all 30 images in each block once. After each image, a 50 ms mask was presented to prevent a visual trace and impede visual information processing. The mask was created from a variation of unrecognizable jumbled pieces from the image blocks to allow for similar variation of colors and textures but no interpretable visual information (Castelhana & Henderson, 2008). Following the mask, the decision screen was presented and participants recorded their safety decision by key press using a 5 point scale [1 (safe) 2 (somewhat safe), 3 (neither safe or unsafe),

4 (somewhat unsafe), or 5 (unsafe)]. Participants were given up to 5 seconds to make their decision. A timeout screen was presented if no response occurred in the allocated time.

7.4.5 Expert Panel

An *ad hoc* expert panel of five occupational therapists was recruited to review safety content of all images to permit valid categorization of each image as ‘safe’ or ‘unsafe’. Experts were defined as licensed occupational therapists with five (5) or more years of neurorehabilitation practice experience. Panel members reviewed all 60 images and independently rated each image using the safety rating scale developed for the study. As a group, a Region Of Interest (ROI) was identified for each image considered most critical for safety rating determination. These ROIs were used for focused analyses of eye movement data to increase the precision of group-based comparisons. The panel had no viewing or decision time limit during the image safety rating or ROI determination. Panel members were not part of the study population.

7.4.6 Analyses

Expert panel mean safety ratings were used to categorize images as safe (mean rating of 1 – 2.4), ambiguous (mean of 2.5 – 3.5) and unsafe (mean rating of 3.6 - 5). Data from images with an expert mean rating in the ‘ambiguous’ range were removed prior to statistical analysis to maximize statistical power for subsequent comparisons of image type. Images and associated data removed included: three 150 ms non-stroke images; one stroke and one non-stroke 1,000 ms images; and one stroke and four non-stroke 3,000 ms. The remaining images were then coded as either a safe or unsafe image type. The safe images included: 4 stroke and 3 non-stroke of 150 ms exposure; 3 stroke and 3 non-stroke of 1,000 ms exposure; and 3 stroke and 4 non-stroke of 3,000 ms exposure. The unsafe images included: 6 stroke and 4 non-stroke of 150 ms exposure; 6 stroke and 6 non-stroke of 1,000 ms exposure; and 6 stroke and 2 non-stroke of 3,000 ms exposure.

Separate mixed ANOVAs explored the effects of Group (OT vs. NonOT), Image Type (stroke vs. non-stroke), Image Safety (Safe vs. Unsafe) and Exposure Duration (150 ms, 1,000 ms, and 3,000 ms) for the following dependent measures: mean safety rating,

fixation count, fixation duration, saccade count and saccade amplitude. ROI analysis was completed with independent samples t-tests for selected images. An alpha threshold of .05 was used for all analyses. For the mixed analysis of variance (ANOVA) results of Mauchly's test ($\alpha = .05$), the Greenhouse-Geisser correction was applied for any violation of sphericity and the adjusted degrees of freedom are reported. Effect sizes are presented as partial eta squared. These values can be interpreted using the following parameters: values between 0.01– 0.05 indicate a small effect, values between 0.06–0.13 indicate a medium effect, and values of 0.14 and greater indicate a large effect.

7.5 RESULTS

7.5.1 Safety Ratings

Please refer to Table 1 for the mean values of all dependent variables. As expected, a significant main effect of Image Safety ($F(1, 18) = 400.99, p < .05$) indicated that images rated as 'Safe' by the expert panel were also rated more safe by participants ($M = 2.30, SE = 0.09$) than 'Unsafe' images ($M = 3.84, SE = 0.11$). The main effect of Exposure ($F(2, 36) = 7.57, p < .05$) on mean safety rating indicated that participants gave slightly different ratings as a function of exposure duration: post-hoc pairwise comparisons using the Bonferroni adjustment indicated the mean safety rating for the 150 ms exposure ($M = 2.92, SE = 0.10$) was significantly different from the mean ratings for the 1,000 ms exposure time ($M = 3.18, SE = 0.09$), but not from the 3,000 ms exposure rating ($M = 3.11, SE = 0.11$). A significant main effect of Image Type ($F(1, 18) = 10.12, p < .01$) indicated that participants rated the Stroke images as more safe ($M = 2.86, SE = 0.09$) compared to the Non-stroke images ($M = 3.27, SE = 0.11$).

A significant interaction between Image Safety and Exposure ($F(2, 36) = 30.40, p < .01$) indicated that the differences in mean safety ratings between the Safe and Unsafe images varied across the different exposure times. The mean safety rating differences between the Unsafe and Safe images at the 150 ms (Safe $M = 3.54, SE = 0.11$; Unsafe $M = 2.29, SE = 0.13$) and 1,000 ms exposures (Safe $M = 3.76, SE = 0.10$; Unsafe $M = 2.61, SE = 0.11$) were very similar. However as the exposure time increased to 3,000 ms, this

difference increased dramatically with more pronounced safe (Safe $M = 2.00$, $SE = 0.12$) and unsafe (Unsafe $M = 4.21$, $SE = 0.13$) mean safety ratings.

Of greater relevance to our hypotheses were the effects involving Group. Overall, there was no significant main effect of Group ($F(1, 18) = 1.69$, $p = .21$). However, a significant interaction between Group and Exposure ($F(2, 36) = 4.18$, $p < .01$) indicated that the difference between groups for the mean safety rating changed for the different exposure durations. The magnitude of the differences in mean safety rating at the 150 ms (NonOT $M = 2.98$, $SE = 0.14$; OT $M = 2.85$, $SE = 0.14$) and 3,000 ms exposures (NonOT $M = 3.05$, $SE = 0.16$; OT $M = 3.16$, $SE = 0.16$) were similar between groups, but markedly increased at the 1,000 ms exposure (NonOT $M = 3.33$, $SE = 0.13$; OT $M = 3.03$, $SE = 0.13$). This interaction is suggestive that the overall group biases in ratings of safety are affected by exposure time in a non-linear way. A significant interaction between Group and Image Safety ($F(1, 18) = 16.67$, $p < .01$) indicated differences between OT and NonOT ratings of the Safe and Unsafe images. A 3-way interaction (see Figure 7.2) between Group, Image Type and Image Safety ($F(1, 18) = 7.16$, $p < .01$) qualified this interaction. Specifically, for stroke images, the OTs gave more pronounced ratings for safe ($M = 1.75$, $SE = 0.12$) versus unsafe ($M = 3.83$, $SE = 0.15$) images compared to the NonOTs who were less pronounced in their ratings for safe ($M = 2.50$, $SE = 0.12$) and unsafe ($M = 3.38$, $SE = 0.15$) images. In contrast, for the non-stroke images the two groups used similarly pronounced ratings for safe and unsafe images (OT: safe: $M = 2.43$, $SE = 0.16$, unsafe: $M = 4.05$, $SE = 0.18$; nonOT: safe: $M = 2.53$, $SE = 0.16$, unsafe: $M = 4.09$, $SE = 0.18$).

7.5.2 Eye Movements

There was a significant main effect of Exposure for fixation count ($F(1.09, 19.58) = 1027.73$, $p < .01$), fixation duration ($F(1.23, 22.08) = 63.92$, $p < .01$), saccade count ($F(1.11, 19.89) = 970.20$, $p < .01$), and saccade amplitude ($F(1.40, 25.15) = 231.27$, $p < .01$). As expected, the fixation count and saccade count increased as exposure time increased from 150 ms to 1,000 ms and 3,000 ms. What was not expected was the differences found between the 1,000 ms and 3,000 ms exposures for average fixation duration (1,000

ms: $M = 198.18$, $SE = 5.36$; and 3,000 ms: $M = 240.85$, $SE = 10.93$) and saccade amplitude (1,000 ms: $M = 6.15$, $SE = 0.24$; and 3,000 ms: $M = 7.65$, $SE = 0.35$). This finding may suggest participants explored a larger portion of the image and therefore used larger amplitude saccades, and consequently longer fixations at each location to process the greater amount of information.

A significant main effect of Image type for saccade amplitude ($F(1, 18) = 22.22$, $p < .01$) indicated Stroke images evoked larger saccades than non-Stroke images. A significant main effect of Image Safety for fixation count ($F(1, 18) = 6.81$, $p < .05$), saccade count ($F(1, 18) = 4.56$, $p < .05$), and saccade amplitude ($F(1, 18) = 9.93$, $p < .05$), indicated that participants moved their eyes more frequently but with smaller saccadic amplitudes between fixations for the Safe images as compared to the Unsafe images.

There was a 3-way interaction between Exposure, Image Type and Image Safety for fixation count ($F(1.15, 20.63) = 4.83$, $p < .05$) and saccade count ($F(1.21, 21.85) = 4.56$, $p < .05$). For stroke images, the pattern of increases in fixation count as exposure time changed was different for unsafe images (150 ms: $M = 1.15$, $SE = 0.04$ vs. 1,000 ms: $M = 4.56$, $SE = 0.13$ vs. 3,000 ms: $M = 11.36$, $SE = 0.32$) than for safe images (150 ms: $M = 1.09$, $SE = 0.04$ vs. 1,000 ms: $M = 4.87$, $SE = 0.13$ vs. 3,000 ms: $M = 11.30$, $SE = 0.42$), with the larger increase between 1,000 and 3,000ms exposures for unsafe images. This is in contrast to the pattern from non-stroke images, wherein the larger increase between 1,000 and 3,000 ms exposures was for the safe images (150 ms: $M = 1.15$, $SE = 0.04$ vs. 1,000 ms: $M = 4.52$, $SE = 0.14$ vs. 3,000 ms: $M = 11.38$, $SE = 0.22$) rather than for unsafe images (150ms: $M = 1.14$, $SE = 0.05$ vs. 1,000 ms: $M = 4.37$, $SE = 0.10$ vs. 3,000 ms: $M = 10.47$, $SE = 0.46$). Identical relationships for the differences in these patterns held also for saccade count.

Of more relevance was the 3-way interaction between Group, Image Type and Image Safety ($F(1, 18) = 7.16$, $p < .05$) for saccade amplitude. In particular, for stroke images, the OTs had similar amplitudes for both safe ($M = 5.30$, $SE = 0.30$) and unsafe ($M = 5.55$, $SE = 0.41$), but for non-stroke images had larger amplitudes for unsafe ($M = 4.99$, $SE =$

0.30) compared to safe ($M = 4.38$, $SE = 0.30$). This is in direct contrast to the pattern of the NonOTs wherein the stroke images evoked larger amplitudes for unsafe ($M = 5.55$, $SE = 0.41$) compared to safe ($M = 4.84$, $SE = 0.35$), while the non-stroke images resulted in similar amplitudes for both safe ($M = 4.15$, $SE = 0.30$) and unsafe ($M = 4.21$, $SE = 0.30$).

7.5.3 Region of Interest Analyses

The previous analyses could not reveal differences in the way specific regions of images were viewed by the Groups. To accomplish this purpose, four images were selected from the 1,000 and 3,000 ms exposure duration sets (150 ms exposure did not afford the opportunity for exploratory eye movements) for further analysis. Specific images were selected based upon the extent to which each Group agreed or disagreed with the expert panel's mean and mode safety ratings. Table 7.2 contains all image ratings (mean and mode) provided by the expert panel, OT and NonOT for all three image exposures. The table also indicates the images selected for region of interest (ROI) analysis. The selected image mean ratings were as follows: OT, NonOT and Expert panel in agreement of 'safe'; OT, NonOT and Expert panel in agreement of 'unsafe'; and OT and Expert panel or OT and NonOT in agreement. The rationale for image selection was to see if eye movements related to the ROIs were associated with the degree of agreement between groups regarding safety ratings.

Each image had one unique ROI identified by experts for analysis. For each image's ROI, fixation count and fixation duration (see Table 7.3) were analyzed; surprisingly there were no significant differences between groups for either measure. For two of the 4 images within the 1000 ms set, neither group showed any fixations within the identified ROI.

7.6 DISCUSSION

The present study was designed to investigate differences in eye behaviour and safety ratings for domain-specific and domain-neutral images between OT and NonOT groups. Image exposure time and image content were introduced to explore the notions of gist

and content expertise. For both groups, different safety ratings were provided for Safe versus Unsafe images for all image types and exposure durations, but these differences were more pronounced as the exposure time increased to 3,000 ms. Of particular relevance to the hypotheses, a three-way interaction between Group, Image Content and Image Safety revealed that for Stroke Images the OT provided more polarized safety ratings than the NonOT group, whereas the ratings were indistinguishable for Non-Stroke images. This interaction highlights the domain-specific, or top-down, influence within the OT group for decision-making whereby past knowledge or experience with judging safety may not only assist with determining a rating, it may also have influenced saccadic amplitude.

Based upon our previous study of static images (MacKenzie & Westwood, 2012), we expected to find significant differences between groups with global measures of eye behaviour during both domain-specific and domain-neutral content for the 1,000 and 3,000 ms exposures. This was not the case. We found the OTs moved their eyes similarly for Stroke images regardless of safety content, but greater distances during viewing Non-Stroke Safe images compared to Non-Stroke Unsafe images. Conversely, the NonOTs had larger saccade amplitudes for Unsafe Stroke compared to Safe, but demonstrated similar amplitudes for all Non-Stroke images. Unlike our previous study in which no specific task instructions were given, participants in the present study were given a specific goal for observation. Larger saccadic amplitudes have been found during search tasks in which higher order cognitive processes influence eye movement toward locations of interest for closer inspection (Torralba et al., 2006). Searching the scene to determine safety may result in a top-down influence similar to searching for a target in that participants may look for or recognize features or patterns based upon previous knowledge. Smaller saccadic amplitudes, such as those found for OT and Non-Stroke images may point to a 'satisfaction of search' concept, whereby once the observer has determined the image is safe or unsafe, no further scanning of the image is done (Berbaum et al., 2001). Smaller saccades may also point to 'checking' eye behaviour to gather more information about a specific feature (Kundel, et al., 2008), though cannot be

confirmed with the current results as the specific location of smaller saccades was not tracked.

We were both surprised and intrigued by the lack of difference between OTs and NonOTs with respect to the features of individual images deemed to be relevant for safety by an independent expert panel. A most striking finding was the OT group did not have fixations in the ROIs identified by experts in two images, even though they were in agreement for safety rating. In other words, members of the OT group reached the same safety decision as the expert panel without apparently looking at the specific feature deemed ‘most important’ for safety by those experts. This raises two interesting possibilities: 1) experts may not realize which features of the image they actually looked at, calling into question the reliability of self-reported gaze behaviour; and, 2) experts may be able to obtain visual information from regions of the visual scene that are not fixated directly (i.e., ‘close enough’ may be good enough). Others (e.g., Malcolm, & Henderson, 2010) have found that individuals may saccade toward a target, and either not make it or purposefully land nearby. The visual system uses multiple top-down information to facilitate search, and it is currently unclear if it is the target or the environment near the target which influences the direction of saccadic movement.

The fact that there were group differences in safety rating in the absence of eye movement differences leads us to propose two possible interpretations. First, perhaps both groups were actually looking at the same features and taking in similar information, but simply interpreting it differently because of what they know or have experienced (domain specificity). This is the simplest explanation and consistent with the observation that differences in safety ratings between groups were most pronounced for the stroke-related content, the domain in which groups would differ most obviously in knowledge and experience. Second, and not incompatible with the first interpretation above, the same features were overtly attended to by both groups, but they may have taken in dissimilar information by deploying covert attention differently or by using pattern recognition processes. As noted previously, eye tracking methodology can determine what a person is overtly looking at, but not necessarily to what they are paying attention

(Duchowski, 2007). Our findings provide us reason to pursue future investigations using methods that can gauge the location of both covert and overt attention. OTs may use covert attention to be discrete, efficient or perhaps because they are indifferent to the stimuli at hand. This study emphasizes the need for further investigation of observation-based decision-making because it seems clear that eye movements alone do not tell the whole story.

7.6.1 Implications for Practice

Our results clearly show that trained OTs were making more pronounced safety decisions than their untrained counterparts in the absence of differences for most of the measurements of eye movements. It would appear that the decisions may be influenced by more than the global eye movement measures and are either linked to previous experience and knowledge or differences in the use of covert attention. Because decision-making based upon observation impacts assessment findings, intervention planning and discharge planning for clients, the results of this study continue to point to a need for further research into the nature of observation in this context, which can ultimately result in better understanding to inform the education and training of OTs in observation skills. Future observation work should explore in more detail the use of covert attention (versus overt eye movements) in the observation process, and the role of specific content information (e.g., about stroke or movement analysis) in shaping the decision-making process.

7.6.2 Limitations

This study may not be representative of the larger population due to the small sample size which limited the power and post-hoc analysis for trends in the data suggesting differences in how the groups viewed the respective image features during exposure times. The subset of domain-specific material was limited to the representations of the stroke population and does not cover the gamut of potential OT practice examples illustrating safety situations. While every effort was made to balance the image sets in terms of safety and image type content, there may have been an unsafe image bias within the 1,000 ms image set (equal image type representation, but not equal safe vs. unsafe

representation). Participants were not trained to use the safety rating scale, so it is possible that individuals interpreted it differently. Finally, the sudden onset and offset of images and unpredictable duration may have influenced typical eye movement behaviour by the element of surprise (Tatler, Hayhoe, Land & Ballard, 2011). Since static image studies do not contain depth or motions cues (Tatler, Baddeley & Gilchrist, 2005) caution should be used when generalizing these results to the observation of dynamic stimuli.

7.7 REFERENCES

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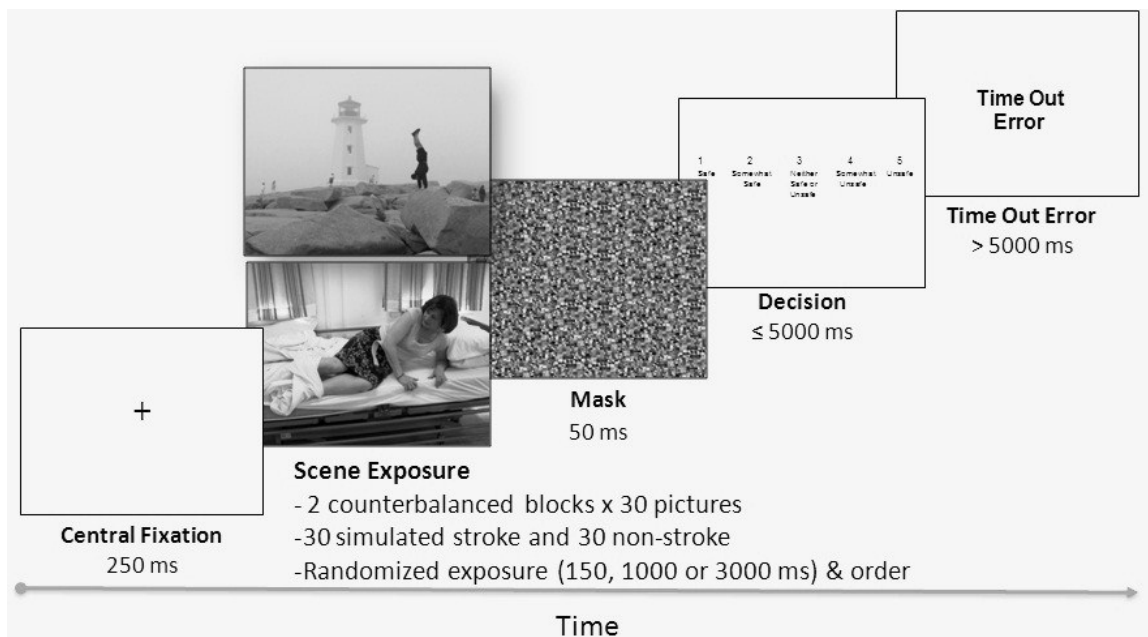


Figure 7.1 Scene Perception Experimental Procedure

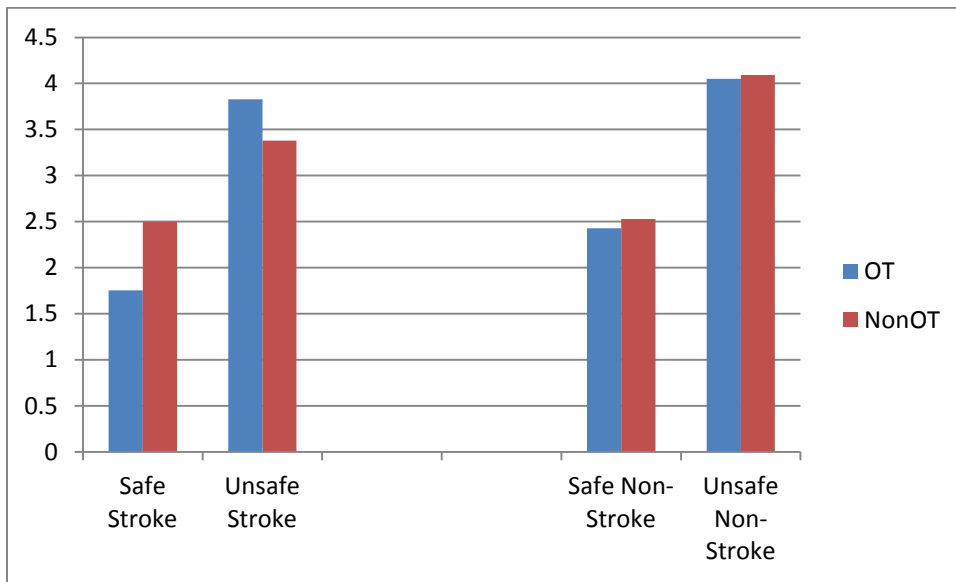


Figure 7.2 Mean Safety Ratings: Interaction Group by Image Type and Image Safety

Table 7.1 Summary of mean values [standard error] for dependent variables

	Unsafe				Safe			
	NonStroke		Stroke		NonStroke		Stroke	
	Non OT	OT	Non OT	OT	Non OT	OT	Non OT	OT
150 ms Exposure								
Safety Rating <small>a** b** c* d* e* f* g*</small>	3.73	3.63	3.22	3.59	2.37	2.45	2.63	1.73
	[0.19]	[0.19]	[0.16]	[0.16]	[0.24]	[0.24]	[0.16]	[0.16]
Fixation Count <small>a* b** h**</small>	1.15	1.13	1.13	1.17	1.17	1.13	1.08	1.10
	[0.08]	[0.08]	[0.06]	[0.06]	[0.09]	[0.09]	[0.05]	[0.05]
Fixation Duration <small>a* b**</small>	136.28	139.73	139.88	137.16	137.57	140.40	144.93	142.00
	[6.93]	[6.93]	[4.87]	[4.87]	[7.26]	[7.26]	[5.22]	[5.22]
Saccade Count <small>a* h*</small>	0.23	0.25	0.17	0.23	0.23	0.20	0.15	0.20
	[0.09]	[0.09]	[0.06]	[0.06]	[0.09]	[0.09]	[0.10]	[0.10]
Saccade Amplitude <small>a* b** c* f**</small>	0.45	1.01	1.54	0.75	0.52	0.36	0.91	0.95
	[0.34]	[0.34]	[0.63]	[0.63]	[0.27]	[0.27]	[0.51]	[0.51]
1000 ms Exposure								
Safety Rating <small>a** b** c* d* e* f* g*</small>	4.20	3.93	3.20	3.70	3.17	2.53	2.77	1.97
	[0.18]	[0.18]	[0.18]	[0.18]	[0.22]	[0.22]	[0.17]	[0.17]
Fixation Count <small>a* b** h**</small>	4.30	4.43	4.35	4.77	4.43	4.60	4.80	4.93
	[0.14]	[0.14]	[0.18]	[0.18]	[0.20]	[0.20]	[0.19]	[0.19]
Fixation Duration <small>a* b**</small>	218.36	205.01	205.02	182.22	212.18	206.08	182.79	173.80
	[8.27]	[8.27]	[10.04]	[10.04]	[14.95]	[14.95]	[9.28]	[9.28]
Saccade Count <small>a* h*</small>	3.47	3.75	3.70	3.93	3.63	3.83	4.17	4.07
	[0.13]	[0.13]	[0.20]	[0.20]	[0.20]	[0.20]	[0.22]	[0.22]
Saccade Amplitude <small>a* b** c* f**</small>	4.61	5.73	7.42	7.71	4.60	5.21	6.45	7.44
	[0.29]	[0.29]	[0.53]	[0.53]	[0.42]	[0.42]	[0.42]	[0.42]

	Unsafe				Safe			
	NonStroke		Stroke		NonStroke		Stroke	
	Non OT	OT	Non OT	OT	Non OT	OT	Non OT	OT
3000 ms Exposure								
Safety Rating <small>a** b** c*d*e* f* g*</small>	4.35	4.59	3.72	4.19	2.05	2.30	2.10	1.57
	[0.26]	[0.26]	[0.18]	[0.18]	[0.17]	[0.17]	[0.20]	[0.20]
Fixation Count <small>a* b** h**</small>	10.40	10.55	10.88	11.83	11.08	11.68	10.67	11.93
	[0.65]	[0.65]	[0.45]	[0.45]	[0.32]	[0.32]	[0.59]	[0.59]
Fixation Duration <small>a* b**</small>	281.74	237.17	245.60	213.67	242.47	222.33	268.28	215.50
	[32.88]	[32.88]	[12.73]	[12.73]	[9.16]	[9.16]	[27.40]	[27.40]
Saccade Count <small>a* h*</small>	9.60	9.48	10.08	10.93	10.20	10.93	9.83	11.23
	[0.73]	[0.73]	[0.47]	[0.47]	[0.34]	[0.34]	[0.60]	[0.60]
Saccade Amplitude <small>a* b** c* f**</small>	7.40	8.23	7.68	8.17	7.52	7.58	7.14	7.50
	[0.73]	[0.73]	[0.55]	[0.55]	[0.62]	[0.62]	[0.55]	[0.55]

^a Main Effect of Exposure

^b Main Effect of Image Safety

^c Main Effect of Image Type

^d Interaction Group x Exposure

^e Interaction Group x Image Safety

^f Interaction Group x Image Safety x Image Type

^g Interaction Exposure x Image Type

^h Interaction Exposure x Image Safety x Image Type

*Significant at <.01

**Significant at <.05

Table 7.2 Scene Perception Safety Ratings Per Image

150 ms Scene Perception Safety Ratings –Stroke Images										
Group	1	2	3	4	5	6	7	8	9	10
Expert Mean	5.0	1.0	5.0	1.2	1.2	5.0	4.8	1.6	5.0	5.0
OT Mean	3.5	1.8	3.7	1.5	1.4	2.3	3.5	2.2	3.8	4.5
NonOT Mean	2.4	3.7	2.6	1.8	2.0	3.3	3.4	3.0	3.4	4.2
Expert Mode	5	1	5	1	1	5	5	1	5	5
OT Mode	2	4	2	1	2	4	3	2	4	5
NonOT Mode	4	2	5	2	1	3	4	2	4	5

150 ms Scene Perception Safety Ratings – Non Stroke Images										
Group	1	2	3	4	5*	6*	7	8*	9	10
Expert Mean	1.0	1.4	2.0	4.6	3.0	3.4	4.0	3.0	4.2	4.0
OT Mean	2.1	3.2	2.1	3.4	3.7	3.0	4.0	3.5	4.0	3.1
NonOT Mean	2.6	2.5	2.0	3.5	4.3	3.4	3.7	2.9	4.2	3.5
Expert Mode	1	1	3	5	2	4	4	3	4	4
OT Mode	2	3	1	3	4	4	4	4	5	3
NonOT Mode	2	3	2	3	4	5	4	4	4	4

1 000 ms Scene Perception –Stroke Images										
Group	1	2**	3**	4	5	6	7*	8	9**	10
Expert Mean	2.4	4.6	4.4	4.0	2.0	5.0	3.0	4.8	1.0	5.0
OT Mean	2.4	2.7	3.8	3.8	1.8	3.9	2.0	4.5	1.7	3.5
NonOT Mean	3.6	2.1	2.4	2.9	3.1	4.5	2.25	4.3	1.6	3
Expert Mode	2	5	4	4	2	5	4	5	1	5
OT Mode	2	2	5	4	2	4	2	5	1	4
NonOT Mode	4	1	1	4	3	4	1	4	1	4

1 000 ms Scene Perception – Non Stroke Images

Group	1*	2	3	4	5	6	7	8**	9	10
Expert Mean	3.2	4.6	1.8	5.0	1.6	4.8	1.8	5.0	3.6	4.4
OT Mean	3.2	3.8	3.0	4.9	2.6	4.5	2.0	4.5	2.5	3.4
NonOT Mean	3.4	4.4	3.9	4.6	2.8	4.6	2.8	4.8	3.2	3.6
Expert Mode	4	5	1	5	2	5	2	5	4	5
OT Mode	3	4	3	5	2	5	2	5	4	4
NonOT Mode	4	5	3	5	2	5	4	5	5	4

3 000 ms Scene Perception –Stroke Images

Group	1	2**	3	4**	5	6	7	8*	9**	10**
Expert Mean	1.2	4.6	4.2	1.0	4.0	4.6	1.8	2.6	4.8	4.2
OT Mean	1.1	4.3	4.1	1.4	3.3	4.8	2.2	2.7	4.1	4.6
NonOT Mean	2.8	4.8	3.4	1.0	4.1	4.1	2.5	3.5	2.8	3.1
Expert Mode	1	5	4	1	4	5	2	2	5	4
OT Mode	1	5	4	1	4	5	1	2	4	5
NonOT Mode	2	5	4	1	5	4	2	4	4	2

3 000 ms Scene Perception – Non Stroke Images

Group	1*	2*	3	4*	5*	6	7	8	9	10
Expert Mean	3.2	3.0	4.0	3.4	2.6	4.0	1.4	1.0	1.8	4.2
OT Mean	4.3	4.2	4.4	4.6	2.6	2.7	1.3	1.8	3.4	4.9
NonOT Mean	4.3	3.8	4.3	4.7	3.4	3.4	1.5	1.2	2.1	4.4
Expert Mode	4	4	4	4	2	4	1	1	2	5
OT Mode	5	5	4	5	2	2	1	1	4	5
NonOT Mode	5	5	5	5	4	4	1	1	1	5

*images removed prior to overall analysis

**ROI Image

Table 7.3 Region of Interest fixation count and duration mean values [standard error]

	Fixation Count		Fixation Duration (ms)	
	NonOT	OT	NonOT	OT
1000 ms Exposure				
Safe Stroke ^a	0	0	0	0
	0	0	0	0
Unsafe Non-Stroke ^b	0.80	0.50	342.00	188.80
	[0.13]	[0.17]	[89.97]	[77.28]
Unsafe Stroke ^c	0	0	0	0
	0	0	0	0
Unsafe Stroke ^d	0.60	0.60	119.60	122.40
	[0.22]	[0.16]	[44.95]	[35.25]
3000 ms Exposure				
Stroke Safe ^a	1.00	1.60	250.40	299.80
	[0.30]	[0.48]	[96.31]	[89.71]
Stroke Unsafe ^b	1.00	1.20	236.80	234.80
	[0.42]	[0.44]	[101.72]	[85.68]
Stroke Unsafe ^c	0.80	1.20	158.40	139.60
	[0.25]	[0.58]	[56.12]	[51.52]
Stroke Unsafe ^c	3.00	3.60	535.50	673.70
	[0.62]	[0.46]	[100.27]	[86.16]

^a All Agree Safe

^b All Agree Unsafe

^c OT and Expert Agree Unsafe

^d OT and NonOT agree Unsafe, Expert Safe

CHAPTER 8 DISCUSSION

In this concluding chapter, the original research questions and hypotheses will be revisited within the context of the results from the three studies. Implications for the OT profession resulting from this work will be highlighted, and the study limitations will be reviewed and discussed. Finally, some potential avenues for future study will be provided.

Observation is used by many healthcare professionals in both standardized and non-standardized assessments with clients post-stroke. In particular, assessments within occupational therapy frequently are dominated by observation-based information gathering. While research continues to be generated around the psychometric properties of validity and reliability for these occupation based assessments (e.g., Brentnall & Bundy, 2009), what has not been probed is the actual eye movement behaviour underlying the observation abilities of the observer. Studies investigating psychometric properties have acknowledged that the observer presents a limiting factor to the assessment (e.g., Merritt, 2011), but further investigation into the observer's eye behaviour while gathering information has not been previously reported. The studies presented in this thesis serve as the foundation for a new area of research investigating observational behaviour of occupational therapists in particular, but the methodology could be adapted for general use with other healthcare professionals.

The purpose of this work was to begin building a theoretical account of skilled observation in occupational therapy, with a longer-term goal of informing our educational and practice frameworks. In order to dissect the puzzle of how observation contributes to decision-making, the first step chosen was to design a series of experiments in which the eye movements of occupational therapists and non-healthcare matched subjects were tracked under varying viewing conditions. The differences in viewing conditions and instructions allowed for the exploration to detect if there were indeed differences in eye movements between these two groups, and furthermore if differences were related to domain-specific knowledge. The intuitive hypothesis for developing these studies was

that clear differences of eye movement would be found between the occupational therapists and the matched participants with regard to domain-specific images or information. The careful matching process allowed for distinct differences between groups for: knowledge about body structure and function, knowledge about occupational therapy theory and practice, experiences with observing for assessment, and interest for contributing to practice related research. Given the purposeful difference in delineating the experimental groups in terms of domain-specific knowledge and experience, it was anticipated that the OT group would demonstrate differences in eye measures while viewing stroke images when compared to the NonOT group. However, there was no expectation that the groups would differ in eye measures during naturalistic or everyday activity participation with non-stroke image content.

Each study was designed to probe potential differences of eye movements under different experimental conditions in order to build an understanding of the observation behaviour of OT while observing occupational performance. Manipulation of task instructions to evoke top-down influences on eye movement and decision-making was also part of the experimental design.

The hypotheses included (re-stated here from Chapter 1):

1. Differences would be found in eye movement patterns between the OT and NonOT observers while viewing static images portraying a simulated client post-stroke (domain-specific content), while differences would not be found for domain-neutral content (Study 1: Chapters 2 and 3; Study 3: Chapter 6 and 7).
2. Differences would be found in eye movement patterns between the OT and NonOT observers while viewing dynamic images (videos) portraying a simulated client post-stroke (domain-specific content) (Study 2: Chapters 4 and 5).
3. Differences would be found between the OT and NonOT with respect to decision-making about safety subsequent to viewing static images of simulated client post-stroke (domain-specific content), while differences would not be found

for domain-neutral content. Differences would also be found for varying duration exposures (including short 150 ms ‘gist’ duration, a 1,000 ms duration and a 3,000 ms duration) (Study 3: Chapters 6 and 7).

These broad hypotheses were based upon the intuitive assumptions (and ones which may be common amongst practitioners and educators) that eye movement to features within an image represented what the observer found interesting (top-down influence), or which features were visually salient to all observers (bottom-up influence). It was also assumed that the groups would have different knowledge for the images portraying simulated clients post-stroke and that this top-down knowledge would influence eye movements. It was therefore reasonable to predict that there would be differences between eye movements for the OT and NonOT observers for the domain-specific content. It was also assumed that top-down knowledge and experience for the OT group would influence their decision-making process as measured by the image safety ratings in the scene perception study. However, our results indicate that this intuitive assumption only really scratches the surface of a very complex interaction within the observer.

The results from the static image studies (free viewing Chapter 3 and scene perception Chapter 7) and the dynamic image study (Chapter 5) did not consistently support the first and second broad hypotheses anticipating that differences would be found in eye movement patterns between the OT and NonOT while viewing domain-specific stimuli (simulated client post-stroke). Additionally, it was anticipated that no differences would be found between groups for the domain-neutral images (free viewing and scene perception studies). Specifically, the free viewing studies found the OTs were significantly different than NonOTs for both domain-specific as well as domain neutral images for fixation count, fixation duration and saccade count. In the other static image study, scene perception, the only significant difference occurred for saccade amplitude within an interaction with Group, Image Type (stroke or non-stroke) and Image Safety (safe or not safe). Finally, in the dynamic image study, there was only one video (toilet transfer) which evoked differences of eye movement between groups. While all three videos contained a simulated client post-stroke, two of the three videos contained

activities that would be commonplace for observers of all backgrounds and experiences (e.g., working in the kitchen, mowing the grass) whereas only the video of the toilet transfer likely drew upon specific knowledge and experiences of the OT group as such, this may be the reason that group differences were only found for the toilet transfer video and not the others. Observing clients completing routine toilet transfers and hygiene is within the scope of routine occupational therapy practice, whereas social convention would suggest that NonOTs would not have this repertoire of observation experiences and may have found the toilet video awkward to view.

Given the careful matching process of occupational therapists (with at least five years of neurological practice experience) with non-healthcare participants in terms of age, gender, educational level and naturally occurring observation experience, it can be argued that any measured differences between groups could be attributed to ‘top-down’ influencing factors (i.e., domain specific training, knowledge, and/or experience). While the use of different image sets between studies may have introduced some systemic variability in the use of top-down influences, it is not suspected to make the results unreliable due to the careful manipulation of task instructions associated with each study and the associated image contents. Therefore, even if differences of eye movement were not found consistently across all images or videos, it remains reasonable to consider that eye behaviour in each study was influenced by the groups’ differences in top-down knowledge or experiences. For example, it is plausible that the OTs’ response to the condition of image exploration in anticipation of the ‘memory’ test in the first static free viewing study (Chapter 3) may have evoked a learned visual scanning pattern associated with information gathering and reporting that is common in their practice. Whereas, the static scene perception study (Chapter 7) required participants to provide an overall safety rating of each image’s content with varying time exposures. The change in task instructions and varying exposure times to explore the images with eye movement may have driven participants to use different viewing patterns, perhaps employing covert attention. Attention is not only overt (fixating on a feature), but can be deployed covertly (no eye movement). The absence of consistent differences in eye movements between groups across all tasks suggests that studying eye movements alone is insufficient to

capture observation behaviour and decision-making. Careful attention must be directed toward how the observer is gathering information (i.e., overt and covert attention) as well as the impact of instructions for engaging top-down influences and interpretations for decision-making. The one factor that differed between studies was the task instruction, so this may have elicited different observational strategies. Perhaps it was actually the importance of task instructions for the comparison group (Non OT) that was more important. In the first study there were no instructions given, yet there were significant group differences - perhaps the OTs were 'inventing' their own task instruction to motivate them whereas nonOT were happy to do 'nothing particular'. Maybe the third study caused the NonOTs to now start being more systematic because of the instructions, so they were brought up to the level of the OTs.

The third broad hypothesis stated above, anticipating that differences would be found between the OT and NonOT with respect to decision-making about safety, was supported by the third study's results. Indeed the OT group made more pronounced safety decisions than their untrained counterparts for the domain-specific images of clients post-stroke. These more pronounced ratings may be linked to their domain specificity of content knowledge for person based factors (e.g., physical limitations demonstrated in the image), perhaps anticipating what may happen based upon knowledge or experience with individuals post-stroke, and/or familiarity with the use of a rating scale for documentation of assessment findings. However, these safety decisions were not associated with any significant difference between the groups for most of the eye movement measures. The fact that there were group differences in safety rating in the absence of obvious evidence of eye movement differences leads one to believe that: (1) top-down factors influencing decision-making may be more influential than specific information gained through observation; or, (2) overt eye movements do not provide a complete assessment of how information is obtained during observation. These findings provide reason to suspect that it might be necessary to measure covert attention during decision-making tasks. Studies on expert decision-making have found experts make better decisions because of effective attention allocation strategies (Schriver, Morrow, Wickens, & Talleur, 2008). Decision-making is an interactive process which requires sensory information (e.g. visual input) to

be perceived in the context of the observer's knowledge and experience (working and long-term memory) prior to responding (Wickens & McCarley, 2008).

The human visual system integrates many sources of information to guide eye movements when exploring scenes (Malcolm & Henderson, 2010). While tracking eye movement provides some insight into what the observer found interesting (overt attention), or how the observer directed the eyes to task-relevant stimuli in the environment (Duchowski, 2007; Castelhana, Mack, Henderson, 2009), it is not effective in capturing other cognitive processing that may be occurring via covert attention. Eye tracking is still a useful technique to study observation skill via overt attention methodology, but future studies should be designed more precisely to tease out the role or influence of overt and covert attention on gathering visual information that interacts with knowledge and experience of the observer during the decision-making process.

Overall, the results of these studies lead to continued questions with respect to how an observer filters visual information within the context of their knowledge and experience. The inconsistency of locations of fixated by the OT group compared to the region indicated by the expert for domain-specific content, even when in agreement for safety rating, is problematic for assessment training and consistency. These differences lead to questioning the methodology underlying the current educational strategies (e.g., expert points out what you should attend to on pictures and videos) as observation based assessment instruments. The interaction of top-down influences with the instrument task instruction can lead to a shift in observation behaviour and/or affect how information is processed. Ultimately the decision-making process leads to recommendations and intervention plans, so it is critical that there is more awareness of the observer's visual attention capacity. The work presented points to the need for more sophistication in addressing observer limitations, and how they may potentially introduce bias to the information gathering process during observation-based assessments.

8.1 IMPLICATIONS FOR PRACTICE

This is the first work to probe potential differences of eye movements under different experimental conditions in order to build an understanding of the behaviour of OT while observing occupational performance. As such, it introduces new information regarding how observers' eye movements are affected by bottom-up and top-down influences. Many assessments completed by healthcare professionals in general, and specifically occupational therapy, are based upon observation of clients. Within occupational therapy, the theoretical development and emphasis on studying and measuring 'occupation' has shifted the observer's lens away from the domain of routinely observing body structures and functions to activity and participation (e.g., Coster, 2008). Practice has become more inclusive of the client and assessments have been challenged to become more ecologically valid and focused on activity and the client's ability to participate. As an example, determining if a client is safe to make a meal using a stove cannot be determined from a paper-pencil task, but observing the client in a kitchen environment provides the client with task context congruency allowing an opportunity for more relevant assessment data for the evaluation of performance. However, the question remains as to what data are we attending? If we only attend to the completion of the task or occupation, our attention may be drawn to the environment, or to whether the task was done or not, at the expense of noting other important features of the client's performance. The observer may not attend to key limiting factors, or to how the factors are combining (e.g., limitations in more than one system – motor, cognitive, perceptual, visual) to prevent a client from performance completion. While the assessment lens being focused on occupation is central to occupation based practice, only focusing on the outcome may limit the observer's ability to notice the process and/or key underlying performance components. Likewise, only focusing on the process or component parts may also limit the observer's ability to perceive the more global overall ability of the client to participate in the desired occupations. The message for the observer is that observation is complex, whether it is observing people or environments, and we simply need to understand it better because some fairly obvious, intuitive predictions turned out not to be correct.

The ability of the observer to attend to the many interacting factors of the person, occupation and environment is most likely affected by the visual stimuli in combination

with the observer's knowledge, training and experience. The use of the *ad hoc* expert panel to identify key safety locations, and the resultant findings related to the ROI they identified (i.e., no differences between OT and NonOT with respect to eye measures within these ROI, and the fact that there were ROIs which were not fixated by the OTs), challenges some very straightforward assumptions. Specifically, the results challenge the assumptions that: 1) experts *know* what should be looked at; (2) experts actually look at the features they *think* they look at; (3) our understanding of what it means to 'look at something' might not be so simple (e.g., you may not need to fixate your eyes on feature to pay attention to it); and, (4) the connection between looking at something that 'seems important' and reaching a correct decision has not been validated. In other words, every commonplace assumption about 'how to observe', and what the link is between observing and assessing, needs to be studied and validated before continuing our observation practices *as usual*.

The potential for discord between what is thought to be looked at, and what is actually looked at raises concern for our current education methodology involving observation skill development. Even if the observation skill is taught within the structure of a specific assessment, the instructor can still introduce bias or suggest incorrect targets for observation. Additionally, given the differences between eye movement behaviours of OT and NonOT between static and dynamic images, it is not clear that targeted features for static images (e.g., textbook images) transfer directly to features that should be attended during dynamic observation (e.g., in practice). Further, the observers in training may be influenced by bottom-up features given they do not yet have the top-down knowledge to override the salient features. Given the results of this study, questions of how learners are gathering their knowledge and experience regarding the 'where and when to look' and 'how to make sense' of the observations should be reviewed. Observers should also be made aware of the fallibility of the visual system.

Increasing the awareness of the observers to potential influences on their observation capacity should be explored (i.e., bottom-up features, joint attention or top-down knowledge bias). The results of the work presented here points to the need for advanced

study to further our understanding of the influences on the observer and the effect upon their decision-making ability. While specific recommendations or approaches to training observation skills cannot be provided when it is not clear exactly how observation taking place, these results challenge commonplace assumptions and beliefs that may be held as *obvious* and not worthy of study by educators, practitioners and experts. Future work is warranted, with the lens of looking at how overt and covert attention influence decision-making for assessments. This work on its own only serves to increase awareness of observer fallibility to the field, and highlights the need for further investigation with the eventual goal to improve practice.

8.2 LIMITATIONS

There are several limitations listed below, as will exist with any study – but none of the limitations identified are fatal to the validity of the work, or the ability to transfer the concepts implied by the results (e.g., influence of top-down knowledge) to other areas of occupational therapy or healthcare practice.

The overall findings of these studies may not be representative of the larger population due to small sample sizes. Additionally, the domain-specific visual stimuli may not have expressed all the potential iterations of a client post-stroke, but the key observable features were represented. There may also be inherent differences within each observer's ability, acquired knowledge or experience and practice which were not captured within the matching process, and which might have contributed to their respective study performances. However, given the careful matching of personal attributes (e.g., age, gender, education) together with the naturally occurring observation experiences, the impact of personal differences is likely to be minimal or perhaps a source of error for statistical power. While oculomotor control is under reflexive control and might therefore be the least amenable part of the system to expert level changes, it is known that eye movements can be changed by top-down instructions (e.g., Yarbus, 1967). The use, or lack, of task demands was purposeful in each study to elicit top-down influences on participants' eye movements and/or decision-making skills. However, the instructions may not have been specific enough to the occupational therapy domain of practice and as

a result may have affected how the study commands triggered the use of top-down knowledge and experience. It also is important to recognize that eye tracking methodology can determine what a person is looking at but not necessarily to what they are paying attention (Duchowski, 2007). It is recognized that attention is not only overt (fixating on a feature), but can be deployed covertly (no eye movement). These studies did not have measures in place to track or evaluate the influence of covert attention within each study's methodology.

The purpose of the three studies was to gather a baseline of observation behaviour and investigate whether occupational therapists were different than a matched group of individuals. The overall interest was in global eye measurement and not in specific location analysis. As a result, there were no *a priori* specific locations identified, and so there were no post-hoc analyses carried out on comparisons if they were not significant. The same individuals participated in all three studies. This presents both a strength and limitation to the experimental design. The strength of using the same participants for all three studies allowed for familiarity of wearing the eye tracking equipment, yet no concern regarding a learning effect was present due to the fact that all three experiments were distinct tasks. The groups were purposefully matched, so there was already bias introduced to purposefully make the groups distinct by their level of occupational therapy (or healthcare) education. The limitation is that there may have been participant fatigue over the three studies as well influence on decision-making based upon the viewing experience or the task instructions.

Finally, the visual stimuli themselves, whether static or dynamic, may have unintentionally affected the participants' eye movements. The images were selected to represent the viewing angle afforded within a practice setting or within a typically occurring natural setting. However, inherent to providing this vantage point is the introduction of a photographer's central bias (Tseng, Carmi, Cameron, Munoz, & Itti, 2009). This bias may unwittingly have directed the participants' attention to areas that the photographer found interesting, instead of exploring other areas of interest. In the last study, the sudden onset and offset of images may also have influenced typical eye

movement behaviour by the element of surprise (not knowing how long the participants would have to inspect the image) (Tatler, Hayhoe, Land & Ballard, 2011). Since static image studies do not contain depth or motions cues (Tatler, 2005) caution should be used when generalizing the results from the free viewing and scene perception studies to the observation of dynamic stimuli.

8.3 FUTURE WORK

There are many potential follow-up studies which could extend the initial work documented in this thesis. However, the results from these initial results do lead to more specific questions and possible methods to seek further understanding of how overt and covert attention influences dynamic observation for interaction with, or deployment of, top-down knowledge during observation and decision-making.

8.3.1 Do you look where you say you look?

Expert regions of interest were gathered from think-aloud techniques in the absence of collecting their eye movement data. What the panel described as important areas to fixate may not actually be what they would have looked at to gather their own information. The lack of difference between the OT and NonOT fixations within the panel's ROI, and the fact that many of the ROIs identified by the expert panel were not even fixated within by the OTs, suggests that there may be an awareness disconnect between what a person (e.g., the expert panel) says they look at (or should look at) and what they actually might look at (covert attention). Further investigation into the awareness component of the observer is warranted. 'Think-aloud' techniques have been used to explore how highly experienced clinicians reason to plan and make decisions (Fossum, et al., 2011). Utilizing this technique in combination with eye tracking methodology (with the already developed stimuli set) would serve to look for similarities between thought and eye movement (overt attention), or differences suggesting more influence from the covert attention system.

8.3.2 Close enough for gist?

Emerging from the scene perception study, as well as this stated lack of fixations within the regions of interest for images with safety ratings all in agreement, is the idea that

perhaps one does not need to fixate directly on an object to glean the information required for a decision. How close to an object, or area of interest, does one need to fixate in order to get enough 'gist' to inform the decision-making process? As an example (giving a specific reference for what was mentioned above), in one of the images where the OT and expert OT were in agreement with their safety score, the OT group did not fixate in the two regions of interest identified to be necessary to determine the safety level. This leads to the question: Do specific items need to be fixated directly – or can the fixations just be close enough to get the gist? Task commands should be manipulated for a study of this type to gain a sense if eye behaviour is different for a global assessment (e.g., is the person safe making a meal) versus gaining specific knowledge from the same observation (e.g., can they also identify issues with fine motor control).

8.3.3 Joint attention or anticipation?

The video viewing study with many fixations on the environment suggests that the observer may be drawn to locations by the observer's attention to external objects, or perhaps the observer is anticipating movement or interaction with the environment. It could be speculated that perhaps it is important to gain information on what the client is attending to, yet perhaps the trained observer is able to have a covert sense of the client's attended interest while attending simultaneously to the client's ability. It is not known if this is actually what occurs in practice, and, if it changes over time from novice to expert practitioners. A video study could be created to measure the observer's eye movements to targets of joint attention, as well as targets of areas where information would be important to note for decision-making.

8.3.4 Do eye movements and/or interpretation change after formal standardized assessment training?

There are several performance based assessments currently used in practice. The training methodology involves the use of video tapes for training participants about the assessment and respective rating scale. Of interest is whether there is a difference in an observer's eye movement behaviour pre- to post-training, or if the eye movement stays the same and it is the interpretation of what is 'seen' that changes during the viewing of

the same material. What can potentially be looked at by an observer, and what is actually perceived and seen by the observer presents opportunity for measurement error in both practice and research.

All of the above potential options for future directions of study could be pursued on a novice to expert population. The continuum for defining novice to expert is quite broad. Novice could be defined as an incoming entry-to-practice master's student through to an experienced practitioner learning a new assessment. There are many avenues to pursue with such observation studies. Given the importance of occupational performance evaluations for determining intervention and level of care recommendations, this line of research inquiry should be pursued from the perspective of the practice and educational applications informing decision-making.

8.4 FINAL THOUGHTS

At the core of occupational therapy practice is the use of occupation-based assessments. These ecologically valid assessments require an observer to not only evaluate the client's outcome, but to take note of process for how the outcome was achieved. The gap in current practice and research is the investigation of the observer and how to improve observation practice; commonplace assumptions about observation and the connection to decision-making need to be challenged. The take-home messages for observers/practitioners, educators, and researchers are (1) skill development and education need to move beyond current assumptions about observation or *routine practice*; and (2) further work needs to be done to develop evidence-informed observation education and practice guidelines.

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APPENDIX A Participant Survey Questions

Participant code: _____

1. Gender

- Male
- Female
- Other

2. Which of the following best describes your age?

- 25 – 29
- 30 – 34
- 35 – 39
- 40 – 44
- 45 – 49
- 50 – 54
- 55 – 59
- 60 – 64
- 65 or older

3. Which of the following best describes the highest level of education you have completed?

- BA
- BSc
- MA
- MSc
- PhD

The following questions are to gather a profile of your observation experience with the naturally occurring events in your life.

4. Have you ever been actively involved with parenting a child?

- No
- Yes

5. On average, how often are you the driver of a motor vehicle?

- Never, I walk or take the bus
- Less than 4 hours per week
- 4 – 8 hours per week
- More than 8 hours per week

6. On average, how many hours of television or movies do you watch per week?

- None
- Less than 2 hours per week
- 2 – 5 hours per week
- More than 5 hours per week

7. Have you ever been a participant in an organized competitive sport?
- No
 - Yes
8. On average, how often do you do participate in a sporting or fitness event?
- None
 - Less than 2 hours per week
 - 2 – 5 hours per week
 - More than 5 hours per week
9. On average, how often have you coached a sporting team or event?
- Never
 - Less than 2 hours per week
 - 2 – 5 hours per week
 - More than 5 hours per week
10. On average, how often do you watch a sporting event?
- Never
 - Less than 2 hours per week
 - 2 – 5 hours per week
 - More than 5 hours per week
11. On average, how often do you spend watching friends or family members in a sporting event?
- Never
 - Less than 2 hours per week
 - 2 – 5 hours per week
 - More than 5 hours per week
12. Have you ever been a performing visual artist (e.g. dance, theatre, art)?
- No
 - Yes
13. On average, how often do you perform in an artistic dance or visual display event?
- Never
 - Less than 2 hours per week
 - 2 – 5 hours per week
 - More than 5 hours per week
14. On average, how often have you directed an artistic performance or event?
- Never
 - Less than 2 hours per week
 - 2 – 5 hours per week
 - More than 5 hours per week
15. On average, how often do you observe an artistic dance or visual display event?
- Never
 - Less than 2 hours per week
 - 2 – 5 hours per week
 - More than 5 hours per week

16. On average, how often do you spend watching friends or family members in an artistic event?
- Never
 - Less than 2 hours per week
 - 2 – 5 hours per week
 - More than 5 hours per week
17. Do you have any video gaming experience?
- No
 - Yes
18. Have you ever taught someone how to play a video game?
- No
 - Yes
19. On average, how often do you participate in playing video based games?
- Never
 - Less than 2 hours per week
 - 2 – 5 hours per week
 - More than 5 hours per week
20. On average, how often do you observe your friends or family playing video based games?
- Never
 - Less than 2 hours per week
 - 2 – 5 hours per week
 - More than 5 hours per week
21. Are you a practicing and licensed occupational therapist?
- No** **Thank you for completing this survey**
 - Yes Please continue with questions 22 through 26
-
22. How many years have you been a practicing therapist since graduation?
- 0 – 5 years
 - 6 – 10 years
 - 11 – 15 years
 - greater than 15 years
23. Which best describes your current practice setting?
- Acute Care
 - Rehabilitation
 - Home Care
 - Long-Term Care
 - Private Practice
 - Combination of practice settings listed above

24. What age group best reflects your current caseload?

- Infancy - Childhood
- Adolescents – Young Adults
- Middle – Older Adulthood
- Combination of caseload descriptions listed above

25. Do you record and review client-consented video tapes as part of your regular practice?

- No
- Yes

26. Have you ever attended any post professional education events which incorporated observational training through video case or live demonstrations?

- No
- Yes



If yes, which of the following post professional education opportunities have you attended?

- ADL Profile
- Assessment of Motor and Process Skills
- Neurodevelopmental Treatment Certification
- Sensory Integration Certification
- Other _____

APPENDIX B OTJR Copyright Release and Restrictions

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APPENDIX C Video Viewing Detailed Feature Coding

Toilet Video Detailed Feature Coding*			
1. Head/Hair/Face	1	Head/hair	1.5 Front edge hair/face
	2	Face	
2. Neck & Body	3	neck/edge of top	3.1 Back mid scapula
	4	mid chest - center	4.2 L of midchest
	4.3	front mid chest to legs	4.4 R lateral mid chest
	4.1	R of mid chest	5 waist
	5.1	R lower shirt	5.2 L lower shirt
	11.1	R Pelvic brim	11.2 Sacrum area
	11.3	lumbar spine area	11.4 Center back area
	3. R UE and LE	6	R shoulder
6.2		R mid humerus	6.4 R scapula
6.3		R Edge of shirt above elbow	8 R elbow
8.1		R mid forearm	9 R wrist
9.1		R hand	11 R hip
13		R thigh - skin	13.2 R thigh pants
13.3		Center of thighs	15 R knee
15.1		R mid shin level	
4. L UE and LE	7	L Shoulder	7.1 L mid humerus
	10	L Hand	16 L knee
	16.1	L shin	16.2 L edge of pants
5. Feet	17	R foot/castor	18 L foot
	23	R wc castor	34 Floor by castor
	35	Floor by feet	24.1 R wc legrest rigging
6. R side WC	21	R wc armrest	21.1 R wc armrest stickers
	21.2	R mid armrest HAND	21.3 R mid arm rest/R HIP
	21.4	R wc armrest front bar	22 R wc wheel
	23.1	R front edge seat	24 R wc brake
	23.3	R back of wc/cane	
7. L side of WC	20	L wc armrest pad	20.1 L wc armrest front rig
	20.2	L wc armrest bar	20.3 L wc armrest cloth g
	22.1	L wc wheel	23.2 L front edge of seat
	23.4	L wc/cane handle	
8. Environment	25	wall bar	25.1 Mid bar – toilet holder
	25.2	Far bar – toilet holder	27 R toilet roll
	28	L toilet roll	28.1 Center toilet paper rolls
	29	inner/toilet seat	29.1 toilet tank
	29.2	front toilet seat	29.3 Back of toilet seat
	30	wall in front of wc	30.1 Wall b/t toilet & paper
	30.2	Wall above grab bar	30.3 Wall below toilet rolls
	32	Wall sanitary bin	

***NOTE:** R and L on the mower and grass is its actual L and R (INVERTED from the viewing position of the video)

Kitchen Video Detailed Feature Coding**

1. Head/Hair/Face	1	Head/hair	1.5	Front edge hair/face
	2	face		
2. Neck & Body	3.1	Upper trunk/neck	3.2	R axilla
	4	Lower trunk		
3. R UE and LE	5	R shoulder	5.1	R humerus
	5.2	R humerus/FACE	7	R elbow
	7.1	R forearm	7.2	R forearm/L Counter
	8	R wrist	8.1	R hand
	8.2	R Hand/ CUP shelf	8.3	R Hand / Counter
	10	R hip	12	R thigh
	14	R knee	14.1	R mid shin level
4. L UE and LE	6	L Shoulder	9	L Hand/wrist
	9.1	L forearm/body edge	9.2	L hand/counter edge
	11	L hip	13	L thigh
	13.1	L thigh/EDGE of chair	13.2	Edge of thigh/hand
5. Feet	15	R foot/heel	15.1	R foot /Step
	16	L foot	16.1	Left foot/Step
	18.7	R front leg of chair	18.8	L front Leg of chair
	19.1	Floor under near step		
6. Environment	17	Tea towel on counter	17.1	dish rack
	17.2	Counter edge in front of sink	18.1	L bar Back of chair
	18.2	R bar Back of Chair	18.3	Chair Back Center
	18.4	Chair back Edge/Seat	18.5	R back Leg of chair
	18.6	L back Leg of chair	19	Cupboard b/t chair legs
	20.1	Open 1 st shelf/cup	20.2	Open 2nd shelf/cup
	20.3	Cabinet door L of cups	21.1	Sink/ edge of sink
	21.2	Backsplash	21.3	Bouncing cup
	21.4	Counter left of sink	21.5	Counter R of sink
	22.1	Tea kettle /L stuff	22.2	Walker
	22.3	Stove	22.4	Poster
	23	Window		

****NOTE:** R and L on the chair is its actual L and R (as seen from the camera position)

Grass Video Detailed Feature Coding***

1. Head/Hair/Face	1	Head/hair	2	Face
2. Neck & Body	3.1	Upper trunk/neck	3.2	Upper trunk/strap
	4	Lower trunk		
	4.1	Center crotch		
3. R UE and LE	5	R shoulder	5.1	R humerus
	7	R elbow cuff	7.1	R forearm
	8	R wrist cuff	8.1	R hand
	10	R hip	10.1	R thigh
	12	R knee	12.1	R mid shin level
4. L UE and LE	6	L Shoulder	6.1	L humerus
	9	L Hand/wrist	9.1	L forearm
	9.2	L elbow	11	L hip
	11.1	L thigh	13	L knee
	13.1	L mid shin level		
5. Feet	15	R foot/ankle	16	L foot/ankle
6. Environment	17	Top horz mower bar	17.1	Mid horz mower bar
	17.2	L upright mower bar	17.3	R upright mower bar
	17.4	L mower wheel	17.5	R mower wheel
	17.6	Mower blades	17.7	L lower bar
	17.8	R lower bar	18.1	Sidewalk L
	18.2	Sidewalk R	18.3	Sidewalk center
	19.1	R Lawn Grass	19.2	L Lawn Grass
	19.3	Center Lawn Grass	20.1	R Sidewalk Grass
	20.2	L Sidewalk Grass	20.3	Center Sidewalk Grass
	21.1	R Sidewalk	21.2	L Sidewalk
	21.3	Center Sidewalk	22.1	R Road
	22.2	L Road	23.1	R Neighbor Grass
	23.2	L Neighbor Grass	23.3	Center Neighbor Grass
	24	Garbage bag		

NOTE: R and L on the mower and grass is its actual L and R (INVERTED from the viewing position of the video)