Systematic Review of Apraxia Treatments to Improve Occupational Performance Outcomes

Article *in* OTJR Occupation Participation Health · October 2014

Impact Factor: 0.8 · DOI: 10.3928/15394492-20141006-02 · Source: PubMed

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Systematic Review of Apraxia Treatments to Improve Occupational Performance Outcomes

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keywords: apraxia, systematic review, treatment

ABSTRACT

The objective was to assess effectiveness of apraxia treatments using a systematic review. In contrast to previous reviews, each study was rated as to its applicability to occupational therapy practice and its focus on occupational performance using the FAME rating system (defined by four categories: Feasibility, Appropriateness, Meaningfulness, Effectiveness). This systematic review included eight studies: four randomized controlled trials (level 1 evidence) and four pre-post designs (level 3 evidence). Three treatment approaches were reported: errorless learning with training of details; gesture training; and strategy training. FAME scores ranged from A to C. All studies reported significant treatment effects, but only one demonstrated an impact on observed occupational performance that transferred from clinic to home. [OTJR: Occupation, Participation and Health. 2014; 34(4):183-192.]

Apraxia is a disorder of skilled purposeful movement that cannot be attributed to comprehension deficits or sensorimotor dysfunction (Heilman & Gonzalez Rothi, 2003). Apraxia may affect a person's ability to conceptualize the selection of a goal, initiate and execute a movement, and anticipate its results (Hansen, Steultjens, & Satink, 2009). The praxis system operates to store motor information for future use so motor planning is not required every time an activity is initiated (Maher & Ochipa, 1997). Functionally, the praxis system facilitates skilled interaction with the environment (Maher & Ochipa, 1997).

Apraxia, commonly associated with left hemisphere stroke, Alzheimer's disease, or corticobasal degeneration, has a marked impact on functional performance of activities (Buxbaum et al., 2008).

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Submitted: March 18, 2013; Accepted: August 4, 2014; Posted online: October 20, 2014

The authors have no financial or proprietary interest in the materials presented herein.

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doi:10.3928/15394492-20141006-02

Estimates of the prevalence of apraxia in people with left hemisphere stroke range from 28% to 51% (Donkervoort, Dekker, van den Ende, Stehmann-Saris, & Deelman, 2000; Zwinkels, Geusgens, van de Sande, & van Heugten, 2004). For the purposes of this review, two types of limb apraxia were included: ideational and ideomotor apraxia. Ideational apraxia occurs due to a breakdown of the knowledge required to perform a task. This manifests behaviorally as inability to correctly sequence steps of an activity or lack of knowledge regarding tool use (i.e., not performing an appropriate action with a familiar object such as a toothbrush) (Árnadóttir, 1990, 2004). Ideomotor apraxia is the inability to program, plan, or produce movements required to complete a task, despite intact sensory and motor skills (Gillen, 2009). In contrast to ideational apraxia, people with ideomotor apraxia have intact conceptual information about action; they cannot, however, execute performance of tasks due to loss of access to previously stored kinesthetic knowledge (Árnadóttir, 2004).

In people with apraxia, performance of basic and instrumental activities of daily living (ADLs/IADLs) are often affected (Landry & Spaulding, 1999). Hanna-Pladdy et al. (2003) found that people with ideomotor apraxia are significantly more dependent in performing ADLs, such as bathing, grooming, and toileting. Additionally, apraxia is resistant to current treatment approaches; Donkervoort et al. (2006) reported that 88% of patients were still apraxic at a 20-week follow up. Further, apraxia is associated with increased caregiver burden (e.g., Hanna-Pladdy et al., 2003).

Previous Systematic Reviews of Treatment for Apraxia

Although there have been six reviews of the apraxia intervention literature since 1990 (Buxbaum et al., 2008; Cicerone et al., 2005; Dovern, Fink, & Weiss, 2012; Landry & Spaulding, 1999; van Heugten, 2001; West, Bowen, Hesketh, & Vail, 2008), several factors warrant a new examination of apraxia interventions from the perspective of occupational performance, particularly for occupational therapy practitioners who treat clients with apraxia in a clinical environment. Apraxia reviews to date have generally not focused on occupational performance outcomes in evaluating effectiveness of treatment (Buxbaum et al., 2008; Dovern, Fink, & Weiss, 2012; van Heugten, 2001), or have only included randomized controlled trials. These approaches have limited the review to only two (Cicerone et al., 2005) or three (West et al., 2008) studies. Alternatively, the reviews have focused on theoretical models of apraxia and only briefly addressed how the intervention approaches improved occupational outcomes (Landry & Spaulding, 1999), thereby limiting applicability of the review to answering questions about efficacy determined in a well-controlled experimental setting, rather than effectiveness of intervention in a standard clinical environment (Robey & Schultz, 1998). Although these earlier reviews may not speak directly to the effectiveness of intervention approaches for occupations in everyday life, each concluded that apraxia treatment was effective, but that much was still unknown regarding the best treatment approach.

The objective of this analysis of the literature was to assess effectiveness of apraxia treatments using a systematic review. Assessment of evidence was undertaken from an occupational therapy perspective. Specifically, this systematic review focuses on treatment of apraxia with levels 1, 2, and 3 of evidence: randomized controlled trials, group comparisons, and pre-post comparisons. In contrast to previous reviews, each study included was rated as to its applicability to occupational therapy practice and its focus on occupational performance using the FAME (Feasibility, Appropriateness, Meaningfulness, Effectiveness) rating system as suggested by Pearson (1999, 2004). Single case reports, while valuable for developing new approaches to intervention, were not included in this review as the FAME rating cannot be systematically applied to case studies, and they have not yet been widely tested. Moreover, the systematic review focused on intervention studies, rather than assessments, as Dovern, Fink, and Weiss (2012) recently provided a review of the assessment tools available for evaluating apraxia.

Method

To search and analyze the literature, we adopted the approach to systematic review recommended by Murphy, Robinson, and Lin (2009) to ensure that results of the systematic review are relevant to occupational therapy practice. This approach included selecting an occupational therapy-relevant research question, conducting a thorough literature search, appraising the literature, abstracting data from articles meeting inclusion criteria, analyzing evidence, and rating applicability to occupational therapy practice using a published rating system (Pearson et al., 2007).

Search Strategy

A wide range of sources were searched to obtain evidence on apraxia treatment. We completed

searches with AMED, OT Seeker, CINAHL, MEDLINE, PsycInfo, OVID, and Google Scholar, in addition to manual searches of main articles and authors in the area of apraxia. Key words used to search the databases were *apraxia* and *treatment*, or *intervention*, or *rehabilitation*.

Inclusion and Exclusion Criteria

Three of the authors (K.L.-M., N.W.W., H.-Y.W.) determined and applied inclusion and exclusion criteria. Articles published in peer-reviewed journals between 1990 and 2012 describing intervention studies were included. Randomized controlled trials, group comparisons, and pre-post comparison designs were included. Gray literature, book sections, and research articles describing pediatric interventions were excluded. Single subject, narrative, and single case study designs evidence were excluded, as were non-English publications.

The **Figure** depicts the decision tree of included and excluded articles. Twenty-four articles were selected for possible review. We eliminated 16 articles that did not meet inclusion criteria and retained eight articles that met all inclusion criteria. Of the eliminated articles, four were intervention case studies (Butler, 1997; Maher, Rothi, & Greenwald, 1991; Pilgrim & Humphreys, 1994; Wu, Radel, & Hanna-Pladdy, 2011), two were assessments of apraxia (Goldenberg, Daumüller, & Hagmann, 2001; Hanna-Pladdy, Heilman, & Foundas, 2003), one was a book chapter (Maher & Ochipa, 1997), one was not published in English (Chen, Huang, Ding, Jiang, & Liu, 2004), six were reviews (Buxbaum et al., 2008; Cicerone et al., 2005; Dovern, Fink, & Weiss, 2012; Landry & Spaulding, 1999; van Heugten, 2001; West et al., 2008), two were published prior to 1990 (De Renzi, Motti, & Nichelli, 1980; Wilson, 1988), and one reported guidelines for intervention (Jackson, 1999).

Ratings

Murphy, Robinson, and Lin (2009) suggested that traditional approaches to conducting a systematic review, weighted toward research quality and the hierarchy of levels of evidence, may be one dimensional in representing complex therapeutic interventions. This approach hinders application to practice. As a solution to this problem, Pearson (1999, 2004) advocated for a multidimensional qualitative approach to evaluating evidence for clinical practice, called the Qualitative Assessment and Review Instrument (QARI). QARI assists health care professionals in incorporating into systematic reviews the ability of a clinical intervention to be translated into practice. QARI includes the areas of feasibility (F), appropriateness (A), meaningfulness (M), and effectiveness (E), or FAME, to evaluate interventions (Pearson, 2004, 2007). The FAME table has been reprinted in Murphy et al. (2009).

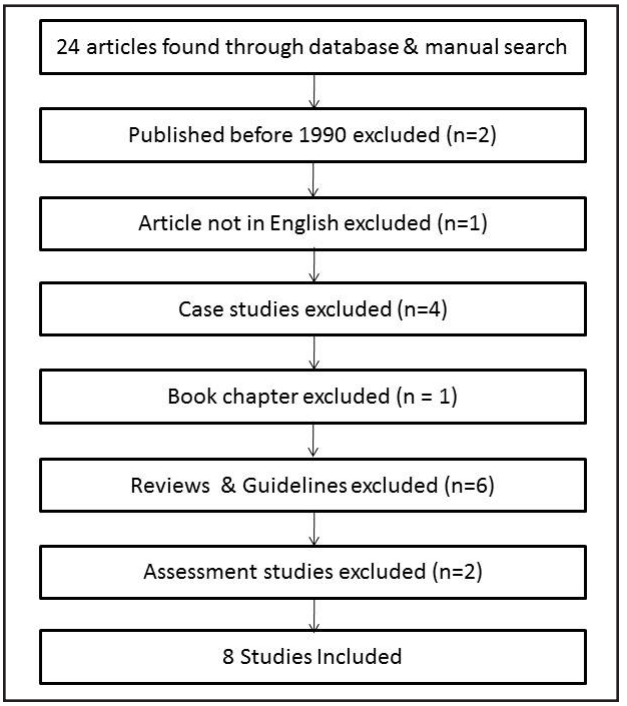

Figure. Decision tree of included and excluded apraxia treatment articles.

FAME scoring is based on each of the four dimensions. Feasibility is based on how reproducible the intervention is in the United States. Appropriateness is based on ethical concerns. Meaningfulness is based on whether the intervention is functional. Effectiveness is based on statistical parameters of the intervention, where *p* values and effect sizes are considered. FAME scores range from A to E on each dimension, with A being the highest score. In this study, three authors (K.L.-M., N.W.W., H.-Y.W.) independently evaluated each of the eight articles that met the inclusion criteria (see Table 1 in Murphy et al., 2009, for grading criteria). The three evaluators then met to compare and discuss FAME scores. Disagreements on ratings were documented and reasons for giving each component of the FAME score were discussed until consensus was obtained.

Results

In this review, FAME scores ranged from A to C (**Table**). Statistical significance and effect sizes, more traditionally part of systematic reviews, are reflected in the Effectiveness component of the FAME rating.

Table
Summary of Apraxia Intervention Studies Meeting Inclusion Criteria and FAME Ratings

Study	Study Design	Participants	Intervention	Results	Ratings: FAME
Donkervoort, Dekker, Stehmann-Saris, & Deelman (2001): Netherlands	Randomized, Single Blind, Control Trial	Treatment Group (n=56): age=67.6 ± 11.7, 52% male	Treatment Group: 8 weeks strategy training	Treatment group improved significantly (p=0.03) in ADL functioning when compared to the control group. At 5 mo follow up there was no difference between the groups in ADL functioning	F=C, A=A, M=C, E=B
		Control Group (n=57): age=63.3 ± 11.6, 61% male	Control Group: usual occupational therapy focused on sensory, motor, perceptual, & cognitive deficits		
Geusgens, van Heugten, Donkervoort, van den Ende, Jolles, & van den Heuvel (2006): Netherlands	Randomized, Single Blind, Control Trial	Treatment Group (n=56): age=67.6 ± 11.7, 52% male	Treatment Group: 8 weeks strategy training	Treatment (p=0.00) and control (p=0.05) groups improved significantly on non-trained task. The change of score in non-trained tasks was significantly larger (p=0.04) in the treatment group	F=C, A=A, M=B, E=B
		Control Group(n=57): age=63.3 ± 11.6, 61% male	Control Group: usual occupational therapy focused on sensory, motor, perceptual, & cognitive deficits		
Geusgens, van Heugten, Cooijmans, Jolles, & van den Heuvel (2007): Netherlands	Pre-Post Test	Treatment Group(n=29): >1mo & <2yrs post stroke, age=60.0 ± 9.1, 75.9% male	Treatment Group: 8 wks of ADL strategy training	Significant improvement on ADL performance was found both directly (p=0.00) after the intervention period and at 5mo follow-up. No significant difference between trained and untrained tasks performed in the home (p=0.84) and rehab centre (p=0.48) was found. Thus, demonstrating transfer of training effects.	F=C, A=A, M=A, E=A
Goldenberg & Hagmann (1998): Germany	Pre-Post Test	Treatment Group (n=15): mean time since stroke = 6.1wks, age=55.7, 80.0% male	Treatment Group: 2-5wks of errorless completion and training of details for 3 ADL activities (eating, dressing, and grooming)	Significant decrease in fatal errors occurred (p<0.01). The training effect did not generalize to other tasks. At follow-up, only in participants who practiced the trained ADL tasks post-treatment was the training preserved.	F=A, A=A, M=B, E=B

Table (continued)

Summary of Apraxia Intervention Studies Meeting Inclusion Criteria and FAME Ratings

Study	Study Design	Participants	Intervention	Results	Ratings: FAME
Smania, Girardi, Domenicali, Lora, & Aglioti (2000): Italy	Randomized Control Trial	Treatment Group (n=6): >2mo post injury, age=69.3, 83% male	Treatment Group: transitive, intransitive-symbolic, & intransitive-nonsymbolic gestures training	Treatment group had significant improvement and reduction in errors in ideational (p=0.04, p=0.00) and ideomotor (p=0.04, p<0.00) tests of apraxia	F=B, A=A, M=C, E=B
		Control Group (n=7): >2mo post injury, age=62.1, 71% male	Control Group: conventional treatment for aphasia		
			Both groups had 35 50-minute treatment sessions		
Smania, Aglioti, Girardi, Tinazzi, Fiaschi, Cosentino, & Corato (2006): Italy	Randomized Control Trial	Treatment Group (n= 18): >2mo post injury, age=65.67 ± 9.83, 67% male	Treatment Group: transitive, intransitive-symbolic, & intransitive-nonsymbolic gestures training; 30 50-minute treatment sessions	Treatment group had significant improvement in ideational (p<0.01), ideomotor(p=0.02), & gesture comprehension test (p=0.02) & in the ADL questionnaire (p<0.01). 2 mo follow up did not show any significant decline when compared to post-treatment results	F=C, A=A, M=C, E=B
		Control Group (n=15): >2mo post injury, age=65.73 ± 8.78, 73% male	Control Group: conventional treatment for aphasia		
van Heugten, Dekker, Deelman, van Dijk, & Stehmann-Saris (1998): Netherlands	Pre-Post Test	Treatment Group (n=33): age=70.1, 54.5% male	Treatment Group: 12wks of ADL strategy training	Significant reduction of ADL (p<0.00), motor (p<0.05), & apraxia (p<0.01) difficulties were found	F=C, A=A, M=A, E=A
van Heugten, Dekker, Deelman, Stehmann-Saris, & Kinebanian (2000): Netherlands	Pre-Post Test	Treatment Group (n=33): acute diagnosis of apraxia, age=70.1, 54.5% male	Treatment Group: 12wks of ADL strategy training	For the treatment group, ADL observation scores improved significantly; apraxia and motor function scores also improved significantly	F=C, A=A, M=A, E=A
		Control Group (n=36): no acute diagnosis of apraxia, age=59.9, 39% male	Control Group: No treatment		

Note. FAME = Feasibility, Appropriateness, Meaningfulness, Effectiveness (FAME scores range from A to E on each dimension, with A being the highest score); mo = month; ADL = activities of daily living; yrs = years; wks = weeks; rehab = rehabilitation.

Overall, all studies reported statistically significant improvements for the treatment approaches investigated. Therefore, all Effectiveness ratings were deemed A or B. The primary difference between studies rated as A and B in effectiveness was long-term maintenance of treatment gains and generalization to non-trained occupations. All studies were deemed to be ethically sound, rating an A on the Appropriateness dimension. Feasibility scores, however, were mainly C due to training requirements, lack of available treatment manuals, and length of the intervention periods that generally exceeded current reimbursable services. Values on the Meaningfulness dimension ranged from A to C. Next, study results are grouped by intervention technique to evaluate whether the approach was a primary determiner of clinical effectiveness.

Errorless Learning Approach

Goldenberg and Hagmann (1998) combined errorless learning of a whole activity and training of task details in 15 patients with severe apraxia. To achieve errorless learning, therapists provided support or cueing at critical stages in training three ADLs. In addition, therapists trained on details of the ADL, such as practicing searching for an armhole before donning a shirt or directing attention to perceptual details of an object, such as the bristles on a toothbrush. Training lasted from 2 to 5 weeks, depending on when patients stopped experiencing fatal performance errors. Fatal errors in completing ADLs decreased significantly ($p < 0.01$) following treatment. Ten participants showed no fatal errors, and 3 participants showed one fatal error. The benefit of errorless learning with detail training was maintained from 6 to 30 months only in participants who continued to practice the activities at home. No generalization was found to non-trained ADLs.

Gesture Training

Two studies by Smania and colleagues (Smania, Girardi, Domenicali, Lora, & Aglioti, 2000; Smania et al., 2006) reported significant benefits of gesture training. In the first study (Smania et al., 2000), 13 patients with limb apraxia were randomized to experimental gesture training ($n = 6$) or to treatment for aphasia ($n = 7$), not specifically directed at performing actions. The study group received training in producing (a) transitive, (b) intransitive-symbolic, and (c) intransitive-nonsymbolic gestures. The study group significantly improved in ideational ($p = 0.039$) and ideomotor ($p = 0.043$) tests of apraxia. Gesture comprehension improved modestly in the study group but did not attain statistical significance ($p = 0.058$). The control group did not show significant improvement in any outcome measures.

In the second study (Smania et al., 2006), 18 patients were randomized to gesture training, and 15 patients were randomized to aphasia treatment. Participants in both groups were dose-matched, receiving 30 50-minute sessions. Participants in the gesture training group had significant improvement on tests of ideational and ideomotor apraxia, gesture comprehension tests, and an ADL independence questionnaire. ADL performance was not assessed. Participants in the aphasia treatment group improved significantly on intelligence and verbal comprehension but did not significantly improve on any other measure. At a 2-month follow up, there was no significant decline in limb praxis and ADL questionnaire scores in the gesture training group.

Strategy Training

First described by van Heugten et al. (1998), the strategy training approach is designed to compensate for ADL deficits (Donkervoort, Dekker, Stehmann-Saris, & Deelman, 2001; van Heugten et al., 1998). Occupational therapists observed clients performing ADLs and assessed their difficulties in ADL initiation, execution, and control. Interventions were focused on teaching clients intrinsic or providing extrinsic strategies, such as providing instruction, assistance, and feedback, to compensate for deficits in ADL performance.

Five studies reported using strategy training (Donkervoort et al., 2001; Geusgens et al., 2006, 2007; van Heugten et al., 1998, 2000). Two of these studies reported on different outcome measures from a 12-week treatment program for the same research participants (van Heugten et al., 1998, 2000). Two other studies reported on different outcome measures from an 8-week program for the same research participants (Donkervoort et al., 2001; Geusgens et al., 2006). It is unclear whether results from Geusgens et al. (2007) are derived from a subset of the data reported for the 8-week program or from a new sample of research participants undergoing an 8-week program, a point also noted by Buxbaum et al. (2008). Treatment intensity, activities, and strategies used varied among the studies. In all studies, improvements in ADL performance or self-report were obtained. Effect sizes ranged from 0.37 in observed ADL tasks reported by Donkervoort et al. (2001) to 1.06 in ADL questionnaire reported by van Heugten et al. (1998). Geusgens et al. (2006, 2007) reported transfer of training effects to other untrained ADLs (in 2006, $p < 0.001$; in 2007, $p = 0.01$). Addition-

ally, size of transfer effects was no different whether measured in the rehabilitation setting or in the clients' homes.

Discussion

This systematic review included eight studies: four randomized controlled trials (level 1 evidence) and four pre-post designs (level 3 evidence). Three different treatment approaches were reported: errorless learning with training of details, gesture training, and strategy training. Ratings did not reveal an unequivocal best treatment approach, as studies varied in their strengths and weaknesses on the four FAME dimensions.

All studies reported earned either an A or B on the Effectiveness dimension, with statistically significant treatment effects and clinically meaningful effect sizes. What differentiated the studies earning an A on Effectiveness (Geusgens et al., 2007; van Heugten et al., 1998, 2000) were maintenance of the treatment effect over time and transfer from clinic to home. Other studies were unable to demonstrate long-term maintenance or transfer to home, or did not objectively measure either (Smania et al., 2000, 2006). Thus, studies from the Dutch research team (Donkervoort et al., 2001; Geusgens, et al., 2006, 2007; van Heugten et al., 1998, 2000) have demonstrated a beginning level of effectiveness in real-world environments for the strategy training approach.

Feasibility was rated as a C for all but two studies, one earning a B (Smania et al., 2000) and one earning an A (Goldenberg & Hagmann, 1998). The primary issue in rating feasibility of an intervention was the ability to apply the treatment program in the United States, as described in the papers reporting these studies. All of the studies scoring C lacked a manual readily available in English that provided details of the treatment program sufficient to implement it as described. For example, although a free treatment manual is available in Dutch from the authors of the strategy training approach (Donkervoort et al., 2001; Geusgens et al., 2006, 2007; van Heugten et al., 1998, 2000), the manual is not readily available, and it remains uncertain whether details are sufficient to implement the program "out of the box." Each study described general treatment approaches that are within occupational therapists' skill set, but without details, it is unclear how these interventions differ from standard approaches. If occupational therapists are to practice from a more evidence-based framework, obtaining a manual to ensure similar practice among treating therapists seems preferable. Additionally, time to conduct treatment was a limitation in several studies. Although the current research protocols were designed to evaluate efficacy (effect size under ideal conditions), rather than effectiveness in everyday practice, the constraints of current outpatient and inpatient therapy need to be a addressed when considering implementation in a traditional U.S. clinic. The strategy training intervention is a 12-week program, and the gesture training intervention consisted of 30 to 35 50-minute treatment sessions. Realistically, restrictions such as insurance coverage and patients' motivation or willingness need to be acknowledged with the current protocols. We recognize that these studies were undertaken to demonstrate that outcomes improve after clients undergo these interventions as described. Further work will need to be done to scale these treatment programs to a typical clinical setting and time frame and to determine whether that approach is effective.

Meaningfulness captures the degree to which the study provides a strong rationale for practice change. Because we were rating studies from an occupational therapy perspective, we interpreted this dimension to mean the extent to which the intervention focused on outcomes that were relevant to the clients' performance of everyday occupations. We deemed training gestures as less meaningful than training occupations themselves. Although gesture training produced improvement in measures of apraxia and caregiver report of ADL performance (Smania et al., 2000, 2006), actual observation of performance of ADLs/IADLs was not assessed in the studies themselves. Further research is needed to determine whether training gestures improves performance in ADLs and IADLs. Only one study (Geusgens et al., 2007) reported outcomes within the natural context by assessing ADL performance in the participants' homes. We found this to be a limitation of the other studies, considering the importance of being able to function outside the structured environment of a rehabilitation facility.

Limitations

This review is limited in that we excluded studies not written in English, book chapters, single case studies, papers published before 1990, and studies that have been completed but are not yet published that may contribute to knowledge of the treatment of apraxia. A second limitation of this study lies in the application of FAME ratings. FAME ratings are qualitative, and therefore, were subject to interpretation by the reviewers of these studies. For the most part, agreement among raters was achieved. There were, however, several cases where discrepancies

were resolved via discussion, primarily with regard to the Feasibility dimension. Future work may need to be done to further explicate critical elements in determining feasibility of disseminating treatments from the research literature into clinical practice.

A final set of limitations relates to the apraxia treatment literature itself. There were only eight studies that met the criteria for review; only four were randomized controlled trials. It is a positive development that occupation-based outcome variables are being reported for clinical trials. Clearly, more studies are warranted for apraxia treatment. As it stands today, there are only three treatment approaches with level 1, 2, or 3 evidence in support of them.

Summary and Future Directions

Considering all dimensions of the FAME ratings reported in this systematic review, the best practice for treatment of apraxia appears to be task-specific strategy training (Donkervoort et al., 2001; Geusgens et al., 2006, 2007; van Heugten et al., 1998, 2000). This approach showed transfer of training effects to the performance of ADL in the home in one study (Geusgens et al., 2007) and had long-term effects at follow up in two studies (Geusgens et al., 2006, 2007). Gesture training also appears to be a promising avenue for treatment of apraxia, although future work will need to determine whether the performance of functional tasks improves with this intervention (Smania et al., 2000, 2006).

Applying FAME ratings to the studies did focus our attention on dimensions other than statistical significance and size of treatment effects (as recommended by Murphy et al., 2009), thereby broadening the clinical applicability of this review in our estimation. We discovered, most likely due to the rigor of the peer review process, that all studies were ethically sound. This dimension of the FAME ratings did not add to our understanding of the utility of the studies included in the systematic review. Development of elaborated criteria for determining the feasibility grade to assign studies for their clinical application may be necessary. In our experience, nearly all of the discrepancies among raters in initial scores arose in the feasibility dimension.

As for the future development of apraxia treatment approaches, we suggest treatment protocols be widely disseminated through postings on websites so clinicians may adopt promising treatments without delay. Further, we suggest that descriptions of research participants enrolled in treatment studies be more clear so clinicians are able to determine who may benefit from a treatment approach, as has been recently recommended in reporting guidelines soon to be adopted by 29 rehabilitation journals (Chan, Heinemann, & Roberts, 2014). To validate long-held tenets of occupational therapy, we hope that future investigations of apraxia treatment include outcomes that are occupation focused, are performance based, and include measures of transfer to daily life. The focus on occupational performance enables clients to see purposefulness and meaningfulness, which in turn, provides clients with the ability to organize time, set goals, and motivate participation in life (Trombly, 1995).

Finally, this review points to the need for new treatment approaches to be developed for rehabilitation of those with apraxia. Although it was not included in this review because it was a case study, Wu, Radel, and Hanna-Pladdy (2011) used a novel treatment approach of mental and physical practice of ADLs. The intervention consisted of 30 minutes of practicing an activity followed by 30 minutes of guided mental practice. After 6 weeks of practice, 3 days per week, the patient demonstrated improvement in both functional performance and self-perception of performance, despite persistent ideomotor apraxia. Moreover, the patient continued to improve 4 weeks post intervention. The results of this preliminary study merit further investigation of this intervention approach.

Systematic reviews allow occupational therapists to guide research and practice to advance the profession. To our knowledge there has not been a systematic review regarding treatment of apraxia from an occupational therapy perspective. The promising effects of treatment described in this review can be considered in planning treatment for people with limb apraxia to enhance functional performance in everyday life. However, there is an outstanding need for more evidence to validate current treatment approaches. Larger scale randomized controlled trials, with adequate characterization of participants and measurement of long-term outcomes in naturalistic settings, are warranted.

References

* = Studies included in the systematic review.

Árnadóttir, G. (1990). *The brain and behavior: Assessing cortical dysfunction through activities of daily living.* St Louis: Mosby.

Árnadóttir, G. (2004). Impact of neurobehavioral deficits on activities of daily living. In G. Gillen & A. Burkhardt (Eds.), *Stroke rehabilitation: A function-based approach* (2nd ed., pp. 376-426). St. Louis: Elsevier/Mosby.

Butler, J. (1997). Intervention effectiveness: Evidence from a case study of ideomotor and ideational apraxia. *British Journal of Occupational Therapy, 60,* 491-496.

Buxbaum, L.J., Haaland, K.Y., Hallett, M., Wheaton, L., Heilman, K.M., Rodriguez, A., & Gonzalez Rothi, L.J. (2008). Treatment of limb apraxia: Moving forward to improved action. *American Journal of Physical Medicine & Rehabilitation, 87,* 149-161.

Chan, L., Heinemann, A.W., & Roberts, J. (2014). Evaluating the quality of disability and rehabilitation research: Mandatory use of the reporting guidelines. *American Journal of Occupational Therapy, 68,* 127-129.

Chen, S.Z., Huang, D.F., Ding, J.X., Jiang, Q., & Liu, P. (2004). Effect of cognitive training on equilibrium function in stroke patients. *Chinese Journal of Clinical Rehabilitation, 8*(1), 10-11.

Cicerone, K.D., Dahlberg, C., Malec, J.F., Langenbahn, D.M., Felicetti, T., Kneipp, S.,…Catanese, J. (2005). Evidence-based cognitive rehabilitation: Updated review of the literature from 1998 through 2002. *Archives of Physical Medicine & Rehabilitation, 86,* 1681-1692.

De Renzi, E., Motti, F., & Nichelli, P. (1980). Imitating gestures: A quantitative approach to ideomotor apraxia. *Archives of Neurology, 37,* 6-10.

Donkervoort, M., Dekker, J., & Deelman, B. (2006). The course of apraxia and ADL functioning in left hemisphere stroke patients treated in rehabilitation centres and nursing homes. *Clinical Rehabilitation, 20,* 1085-1093.

*Donkervoort, M., Dekker, J., Stehmann-Saris, F., & Deelman, B. (2001). Efficacy of strategy training in left hemisphere stroke patients with apraxia: A randomised clinical trial. *Neuropsychological Rehabilitation, 11,* 549-566.

Donkervoort, M., Dekker, J., van den Ende, E., Stehmann-Saris, F., & Deelman, B. (2000). Prevalence of apraxia among patients with a first left hemisphere stroke in rehabilitation centres and nursing homes. *Clinical Rehabilitation, 14,* 130-136.

Dovern, A., Fink, G.R., & Weiss, P.H. (2012). Diagnosis and treatment of upper limb apraxia. *Journal of Neurology, 259,* 1269-1283.

*Geusgens, C., van Heugten, C., Donkervoort, M., van den Ende, E., Jolles, J., & van den Heuvel, W. (2006). Transfer of training effects in stroke patients with apraxia: An exploratory study. *Neuropsychological Rehabilitation, 16,* 213-229.

*Geusgens, C.A.V., van Heugten, C.M., Cooijmans, J.P.J., Jolles, J., & van den Heuvel, W.J.A. (2007). Transfer effects of a cognitive strategy training for stroke patients with apraxia. *Journal of Clinical and Experimental Neuropsychology, 29,* 831-841.

Gillen, G. (2009). Managing apraxia to optimize function. In G. Gillen (Ed.), *Cognitive and perceptual rehabilitation* (pp. 109-133). St. Louis: Elsevier/Mosby.

Goldenberg, G., Daumüller, M., & Hagmann, S. (2001). Assessment and therapy of complex activities of daily living in apraxia. *Neuropsychological Rehabilitation, 11,* 147-169.

*Goldenberg, G., & Hagmann, S. (1998). Therapy of activities of daily living in patients with apraxia. *Neuropsychological Rehabilitation, 8,* 123-141.

Hanna-Pladdy, B., Heilman, K.M., & Foundas, A.L. (2003). Ecological implications of ideomotor apraxia. *Neurology, 60,* 487-490.

Hansen, T., Steultjens, E., & Satink, T. (2009). Validation of a Danish translation of an occupational therapy guideline for interventions in apraxia: A pilot study. *Scandinavian Journal of Occupational Therapy, 16,* 205-215.

Heilman, K.M., & Gonzalez Rothi, L.J. (2003). Apraxia. In K.M. Heilman & E. Valenstein (Eds.), *Clinical neuropsychology* (4th ed., pp. 215-235). New York: Oxford University Press.

Jackson, T. (1999). Dyspraxia: Guidelines for intervention. *British Journal of Occupational Therapy, 62,* 321-326.

Landry, J., & Spaulding, S. (1999). Assessment and intervention with clients with apraxia: Contributions from the literature. *Canadian Journal of Occupational Therapy, 66,* 52-61.

Maher, L.M., Rothi, L.J.G., & Greenwald, M.L. (1991). Treatment of gesture impairment: A single case. *American Speech and Hearing Association, 33,* 195.

Maher, L.M., & Ochipa, C. (1997). Management and treatment of limb apraxia. In L.J. Gonzalez-Rothi & K.M. Heilman (Eds.), *Apraxia: The neuropsychology of action* (pp. 75-91). Hove, UK: Psychology Press.

Murphy, S.L., Robinson, J.C., & Lin, S.H. (2009). Conducting systematic reviews to inform occupational therapy practice. *American Journal of Occupational Therapy, 63,* 363-368.

Pearson, A. (1999). Evidence-based nursing-quality through research. In R. Nay & S. Garratt (Eds.), *Nursing older people: Issues and innovation* (pp. 338-352). Sydney: Maclennan & Petty.

Pearson, A. (2004). Balancing the evidence: Incorporating the synthesis of qualitative data into systematic reviews. *JBI Reports, 2*(2), 45-64.

Pearson, A., Srivastava, R., Craig, D., Tucker, D., Grinspun, D., Bajnok, I.,…Gi, A.A. (2007). Systematic review on embracing cultural diversity for developing and sustaining a healthy work environment in healthcare. *International Journal of Evidence-Based Healthcare, 5,* 54-91. doi:10.1111/j.1479-6988.2007.00058.x

Pilgrim, E., & Humphreys, G.W. (1994). Rehabilitation of a case of ideomotor apraxia. In M.J. Riddoch & G.W. Humphreys, (Eds.), *Cognitive neuropsychology and cognitive rehabilitation* (pp. 271-284). Hillsdale, NJ: Erlbaum.

Robey, R., & Schultz, M.C.(1998). A model for conducting clinical-outcome research: An adaptation of the standard protocol for use in aphasiology. *Aphasiology, 12,* 787-810.

*Smania, N., Aglioti, S.M., Girardi, F., Tinazzi, M., Fiaschi, A., Cosentino, A., & Corato, E. (2006). Rehabilitation of limb apraxia improves daily life activities in patients with stroke. *Neurology, 67,* 2050- 2052.

*Smania, N., Girardi, F., Domenicali, C., Lora, E., & Aglioti, S. (2000). The rehabilitation of limb apraxia: A study in left-brain-damaged patients. *Archives of Physical Medicine & Rehabilitation, 81,* 379-388.

Trombly, C. (1995). Occupation: Purposefulness and meaningfulness as therapeutic mechanisms. *American Journal of Occupational Therapy, 49,* 960-972.

*van Heugten, C.M., Dekker, J., Deelman, B., van Dijk, A., & Stehmann-Saris, J. (1998). Outcome of strategy training in stroke patients with apraxia: A phase II study. *Clinical Rehabilitation, 12,* 294-303.

*van Heugten, C.M., Dekker, J., Deelman, B.G., Stehmann-Saris, J.C., & Kinebanian, A. (2000). Rehabilitation of stroke patients with apraxia: The role of additional cognitive and motor impairments. *Disability & Rehabilitation, 22,* 547-554.

van Heugten, C. (2001). Rehabilitation and management of apraxia after stroke. *Reviews in Clinical Gerontology, 11,* 177-184.

West, C., Bowen, A., Hesketh, A., & Vail, A. (2008). Interventions for motor apraxia following stroke (Article No. CD004132). Cochrane Database of Systematic Reviews, Issue 1.

doi:10.1002/14651858.CD004132.pub2

Wilson, B.S. (1988). Remediation of apraxia following an anaesthetic accident. In J. West & P. Spinks (Eds.), *Case studies in clinical psychology* (pp. 178-183). Bristol: John Wright.

Wu, A., Radel, J., & Hanna-Pladdy, B. (2011). Improved function after combined physical and mental practice after stroke: A case of hemiparesis and apraxia. *American Journal of Occupational Therapy, 65,* 161-168.

Zwinkels, A., Geusgens, C., van de Sande, P., & van Heugten, C. (2004). Assessment of apraxia: Inter-rater reliability of a new apraxia test, association between apraxia and other cognitive deficits and prevalence of apraxia in a rehabilitation setting. *Clinical Rehabilitation, 18,* 819-827.