

Action-Observation Training

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What is Action-Observation Training?

Action-Observation Training (AOT) is a rehabilitative approach in which a participant is first asked to observe a motor task and then performs the same task.¹ The observation may be “in-person” (i.e. the participant observes a therapist or caregiver perform the task) or via a video.¹ This seemingly simplistic approach is grounded in research findings regarding mirror neuron cortical networks and has been utilized in rehabilitative studies across a wide range of neurologic patient populations.¹⁻⁵

For an example of AOT take a look at the following video. This video demonstrates an activity which is more in the OT scope, but is still worth a look!

<https://www.youtube.com/watch?v=2ixhWsMStPw>⁶

Theoretical Background of AOT

Findings from both animal and human studies indicate that mirror neuron networks activate both when a subject performs a motor task and when they observe that same task being performed.¹ Through functional MRI (fMRI) and electroencephalography (EEG) studies of humans ranging from infancy to adulthood, researchers have been able to describe the way in which mirror neurons allow for the “activation of cortical motor areas by action observation alone.”^{1,2,7,8} The AOT approach is built upon the theory that, for patients with motor dysfunction resulting from CNS damage, activation of mirror neuron cortical networks will facilitate neuroplasticity adaptation and thus motor recovery.^{1,9}

Who Benefits from AOT?

Much of the current literature regarding AOT centers on three main patient groups: children with cerebral palsy (CP), survivors of stroke with resulting motor impairment, and individuals with Parkinson’s disease.^{1,2,4,8-11} Research involving the efficacy of AOT interventions in infant patient populations is still evolving, though evidence does support the same sort of mirror neuron cortical network activation during action-observation activities that are seen in adult populations.⁷

Potential Benefits of AOT

Cerebral Palsy

Randomized control trials of AOT in children with unilateral CP by Sgandurra et al and Kirkpatrick et al support the efficacy of this approach in improving UE motor function.^{4,10} Kirkpatrick et al’s study utilized parents as the action “performers” during the child’s observation period- which opens up the possible utility of AOT as a component of a child’s home exercise program.¹⁰ While these studies findings are promising, no systematic reviews or meta-analyses are currently available which directly address the use of AOT in this population. A 2014 meta-analysis of UE therapies for unilateral CP states that AOT “should be viewed as experimental” in this population until further research has been conducted.¹²

Stroke

A number of studies have identified positive outcomes - including ROM, power, control, and

dexterity - in UE function for patients following stroke who undergo a program of AOT rehabilitation versus traditional rehabilitation.^{2,9}

Some of the most definitive work regarding AOT as a rehabilitative technique comes from studies of gait rehabilitation in patients following stroke.¹³ A 2015 systematic review by Sarasso et al supports the use of AOT as a rehabilitative gait training approach in patients following stroke, noting improvements in “gait kinematics” as well as gait speed.¹ A 2017 review by Patel et al notes “highly positive results” including improvements on a number of functional gait outcome measures, decreased cadence, increased single leg support time, and improved gait velocity, in participants who underwent AOT versus traditional stroke rehabilitation programs.¹³

Parkinson’s

A number of studies have linked a reduction in incidences of freezing of gait in participants with Parkinson’s disease who participate in an AOT versus traditional gait training program.^{8,13}

Recent work by Agosta et al utilized fMRI imaging to identify neuroplasticity adaptations resulting from an AOT gait training program in a group of participants with Parkinson’s which may explain this reduction in freezing of gait occurrences.⁸

Infants with asymmetric brain lesions

The ongoing UP-BEAT (Upper Limb Baby Early Action-observation Training) study is exploring whether functional motor gains observed with the use of AOT in adult patients with hemiplegia following stroke will carry over into infants with asymmetric cortical lesion’s performance of reaching and grasping tasks.^{11,14} Additionally, recent work by Burzi et al explores the hypothesis that, in very young infants with asymmetrical brain lesions, AOT supports ongoing development of the corticospinal tract in addition to activating mirror neuron networks.¹⁵ While Burzi et al’s work is ongoing, it has interesting implications as to whether or not AOT should be utilized in much younger patients than is currently the norm.¹⁵

Indications and Contraindications

Based on current evidence, AOT may be indicated as an “adjunctive” approach in addition to other rehabilitative interventions across a wide spectrum of patient populations because the neuroplasticity mechanism at play (i.e. the activation of mirror neuron cortical networks) is not limited to one sort of patient.^{1,9,13}

Due to the highly adaptable nature of AOT, contradictions to this intervention approach will be based on individual patient presentation and their ability to safely perform whatever action is being modeled. In general, Patel et al state that AOT is a “safe” approach to therapy.¹³

Resources required (equipment, training, costs, etc)

No special training or equipment (beyond whatever equipment a therapist chooses to utilize for a given task) is required in order to integrate AOT into clinical practice.

Reimbursement for intervention as PT

Given that an AOT approach can be utilized across a wide spectrum of activities, it is likely that PTs would bill for the task performed as opposed to the technique itself. Examples of this might include:

- Therapeutic Activity

- Therapeutic Exercise
- Neuromuscular Reeducation

Translation to practice

As researchers continue to explore AOT as a rehabilitative approach a number of questions will need to be addressed before formal practice protocols can be put into place. Among these are:

- From what perspective should AOT tasks be demonstrated (first or second-person?)^{1,10,11}
- Should demonstrations involve the “correct” way to perform a motor task or “incorrect” task performance to encourage problem solving?
- How do cognitive or sensory impairments effect the utility of AOT?³
- Is observation of a video as effective as in-person observation? Research by Shimada et al indicates that infant’s brains respond differently to in-person versus televised demonstrations- is this true in other age groups/patient populations?¹⁶

Efficacy, Effectiveness, and Utility of AOT

The efficacy of an intervention speaks to how it plays out under “ideal and controlled circumstances” while its effectiveness speaks to how the intervention functions outside of the controlled research setting, under “real-world” conditions.¹⁷

Randomized control trials across a variety of patient populations have demonstrated AOT’s efficacy in addressing issues of motor function and control within a controlled research setting.^{2,8-10,13} That said, there may not be enough of an evidence base regarding the use of AOT in specific patient populations to determine whether the efficacy seen in specific RCTs carries out on a larger scale.¹²

Given the highly adaptable nature of the AOT rehabilitation approach, it seems likely that AOT would prove effective in real-world clinical practice. PTs may see great utility in this intervention given the relative ease of integrating AOT into commonly utilized clinical interventions- for example having a patient observe the PT performing a gait task before performing it themselves. The potential to utilize video or caregiver task performance for the demonstration component of these interventions means that patients could benefit from AOT interventions outside of the clinical environment.^{2,10} Speaking to this, Patel et al note “Given the ease with which action observation training can be applied in the home, it offers a promising, safe and economical approach.”¹³

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