**External VS Internal attention focus**

As we all know exercise is one of the fundamental tools in the rehab process and many times patients are required to do something at home to maintain/improve their condition.

How many times does patients tell us “I’m not sure if I did the exercise in the correct way …” “When I got home I couldn’t remember the exercise” “I’m not sure if I’m activating the right muscle” etc.? Most of the times it’s not patient’s fault because performing homework exercises can be challenging and if a patient is uncertain of the correctness of the exercise his/her compliance decreases dramatically.

For this reason, some of the questions which frequently arises during my clinical activity are: How can I facilitate homework exercises so that my patients are ready to perform them regularly without hesitation and uncertainty? how can I assure the fact that homework exercises are actually well performed?

By talking to another physio (sincere thanks to Jim Rivard) some ideas were raised and I would like to share them with you and, of course, hear what you think!

In particular, what caught my attention was the concept of internal and external attention focus.

*Internal attention focus* (IF) refers to the attention during exercise that is geared internally in the body, thinking about range of motion, flexibility, specific muscle recruitment, strength performance and endurance.

In contrast we practice “*external attention focus*” (EF) when our attention is directed toward the effects of movements on the environment or on an apparatus. (*Wulf et al 2013*)

Just to give an easy example let’s think about the elbow flexion movement:

* An internal focus instruction would be “keep the bar in your hand and bend your elbow as much as you can. Feel your biceps contract and squeeze!”
* For an external focus instruction we would say “move the weight (bar) in your hand towards your mouth!”

Here is another example about dart throwing…

* An IF wording would be “control the position of the body, the alignment of the elbow and let the wrist go when throwing”
* In contrast an EF instruction would be “cause the dart to make a parabola while flying to the bulls eye”

I would say…. What a difference!

I had never realized how much literature existed about this topic. More than 80 studies actually support the use of an external attention focus instead of an internal one to optimize exercise.

Interestingly it looks like external attention focus results in:

* **Enhanced motor learning and performance**.

This effect is sometime seen almost immediately as well in more long-term effects (obviously favoured by repetitions). There is evidence that performance in terms of efficiency and effectiveness with EF is enhanced compared to activities driven by IF instructions and to the control group (C). (*Wulf, G., 2014*)

* **Efficiency within muscles**

Converging evidence suggests that the same exercise executed with an external attention focus seems to activate only the strictly needed motor unit (lower EMG activity) compared to internal attention focus where superfluous and larger units are involved. A more efficient coordination between muscle groups is shown by a reduced amount of co-contraction between agonist and antagonist muscles compare to C and IF group. (*Wulf et al 2012*)

For this reason…

* **Cardiovascular response and oxygen consumption** are **lowered**

This happens because the same movement is achieved with less muscular activity. This hypothesis has been confirmed by two studies showing how activities such as running and sit-ups showed reduced oxygen consumption and heart rate by focusing on the external environment (EF) rather than running technique or breathing (IF). (*Wulf G. et al 2013, Lhose KL et al 2015*)

* **Speed increase**

Observed in reaching activities with stroke patients (*Fasoli et al 2002*), with healthy people during “Pedalo” locomotion tasks (*Chen et al 2005*) and during swimming (*Freudenheim, A.M., et al 2010*)

* **Fatigue** is **reduced**

Performers are able to execute more repetitions with the same weight with EF as compared with IF and the Control group.

* **Greater maximal** **force** is **produced**

Showed by biceps contraction on a dynamometer, vertical and long jumps and in complex task such as disc throwing.

An intriguing finding is the so-called **distance effect**. Some studies have compared the effectiveness of external foci that differed with respect to the distance of the intended movement effect from the body. Taking balance tasks as an example, it seems that focus on a mark located far away (long distance EF) while standing on one foot results in a better outcome then focus on a near located mark (short distance EF) or focus on the stability of the foot (IF). The same thing happens with a wire walker holding a bar in his hands: tell him to “focus on keeping the extremities of the bar parallel to the soil” (long distance EF) results in a better outcome than telling him to “focus on keeping the markers located mid-bar parallel to the soil” (short distance EF) or to “focus on keeping the hands parallel to the soil” (IF).

The hypothesis behind the mechanisms underlying the attentional focus effect has been called “the constrained action hypothesis “ (*Wulf, McNevin, & Shea, 2001; Wulf, Shea, & Park, 2001*). According to this view, an internal focus induces a conscious type of control, causing individuals to constrain their motor system by interfering with automatic control processes. (*Wulf G et al 2001*). An internal focus results in an increase of co-contraction of agonists and antagonists, which in turn may cause ‘freezing’ by limiting the degrees of freedom of movements, and in the recruitment of unnecessary motor units within muscles, which adds ‘noise’ to the motor system (*Lohse KR et al 2012*).

In contrast, an external focus promotes a more automatic mode of control by utilizing unconscious, fast, and reflexive control processes.

We realize then how a simple change in the wording of instructions or feedback can have dramatic effects on motor performance and learning.

This strategy has been tested in a number of sports such as basketball (concentrate on the rear of the basketball hoop rather than on snapping the wrist during the follow through - *Zachry et al 2005*), golf (focus on the head of the golf club rather than the swing of the arms - *Wulf et al. 1999*), tennis (focus on the trajectory of the ball leaving the racket rather than your position when the ball is coming toward you - *Wulf et al 2000*) and skiing (exert a force with the right foot when the platform moves to the right VS Exert force on wheels under the platform when it moves to the right - *Wulf et al 1998*).

In all these studies the groups with external attention focus task were more accurate, effective and in general performed better than the internal attention focus and control group.

Clearly all these sportsmen were healthy but what happens if we try to apply this motor learning strategy with patients?

Some research has been done in this direction but mainly with neuro-patients (e.g. post stroke, Parkinson’s disease, etc.) and it lead to the same conclusion.

Interestingly, an analysis of feedback statements used by physical therapists in their treatment of people after stroke, pointed out that 95.5% of feedback statements were related to the patient’s body movements (IF) (*Durham et al 2009*).

There is little literature about this strategy applied to orthopaedic patients. One study titled “Acquisition and Retention of Postural Control Following Ankle Sprain” (*Laufer et al 2007*) and another one concerning the acquisition of complex tasks such as jumping and landing after ACL reconstruction (*Gokeler et al 2015*), also confirmed these results.

In my opinion it would be interesting to start to approach exercises in this way and see what happens!

For example, what if we approach an altered knee extension during gait pattern after ACLR by asking to “kick a ball” instead of “extend the knee more” during the swing phase?

What if we ask the patient to reach an object situated on the right or to “push the ground as you were turning while skiing” rather than “feel the weight increasing in your right foot” while trying to increase his lower limb load?

These may be small things that could make a difference!

I would add one more thing. Focusing on the effect of the movement in the environment (the goal of the exercise) may provide patients with a good way to have immediate feedback, reducing the need for the physio presence to a minimum. This means that patients would be able to do and correct exercises autonomously at home, hopefully increasing their compliance.

Here the hard task for physio come. We should be able to construct the best exercise for the patient (avoiding compensations) keeping his attention externally focused! This action will require some effort but what we could gain from this may worth be it.

At the bottom you can find some literature about the topic. For a more comprehensive background I would suggest starting with the following review from which much of the content of this blog was inspired.

*Wulf G. Attentional focus and motor learning: a review of 15 years. Int Rev Sport Exerc Psychol. 2013;6(1):77–104.*

P.S Sincere thanks to Mrs. Wulf G. for sharing with me all her publications on these topics.

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