Changing patients’ focus of attention to enhance motor performance and learning

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Motor skills need to be learned in a variety of situations. Typically instructions are directed at the coordination of body movements.

“Concentrate on your diaphragm”
“Contract your biceps”
“Bend your knees more”
“Move your shoulders back”
“Squeeze that muscle”
INTERNAL FOCUS
Concentration on *body movements*

EXTERNAL FOCUS
Concentration on *effect of movements* (e.g., surfboard, cup, sound, skis, golf club, beanbag)

"Turn the board"

"Focus on the cup"

"Put pressure on the skis"

"Move the club back"

"Concentrate on the sound"

"Squeeze the beanbag"

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Changing patients' focus of attention to enhance motor performance and learning

**Objectives**

1. Describe how motor performance and learning are affected by an internal versus external focus of attention
2. Give examples of how attentional focus instructions affect performance in people with movement disabilities
3. Understand the effects of attentional focus on motor control and explain why an external focus is effective
4. Explain how movement efficiency is influenced by the performer's focus of attention
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Internal focus
"Exert force with your outer foot"

External focus
"Exert force on the outer wheels"

Control
No focus instructions

![Graph showing practice and retention of oscillation amplitude over three days with different focus instructions.](image-url)
Internal focus
"Keep your feet horizontal"

External focus
"Keep the markers horizontal"

Control


Groups
- Near (External)
- Far-outside (External)
- Far-inside (External)
- Internal

![Diagram showing different groups and their locations](image)

**Groups**

- **Near (External)**
- **Far-outside (External)**
- **Far-inside (External)**
- **Internal**

**Deviation from horizontal (deg.)**

**Practice**

- Near
- Far-outside
- Far-inside
- Internal

**Retention**

“Distance” effect

![Graph showing deviation over trials](image)
Does the attentional focus on a *supra-postural* task affect the learning of a postural (balance) task?


**Groups**
- **External focus**: Keep box still
- **Internal focus**: Keep hands still

[Image of a person standing on a box with a table tennis ball next to it]

[Graph showing practice, retention, and transfer with deviations and errors over trials]
External focus advantages have been found for …

**Tasks**
- Balance
- Golf (long-iron shots, pitch shots, putting)
- Soccer kicks
- Football kicks
- Volleyball serves
- Dart throwing
- Tennis
- Basketball free-throws
- Rowing
- Kayaking
- Swimming
- Riding a Pedalo
- Agility
- Sprint
- Weight lifting
- Force production
- Vertical jump
- Long jump
- Playing musical instruments
- …

**Levels of expertise**
- Novices
- Experts

**Age groups**
- Children
- Young adults
- Older people

**Disabilities**
- Parkinson’s disease
- Stroke
- Intellectual disability
- ADHD
- Injuries (ankle sprain)
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Participants

10 persons with Parkinson’s disease (Hoehn and Yahr Stage II or III)
Age: 61 to 86

- Sway-referenced condition (Walls and platform move)
Control
“Stand quietly”

Internal focus
“… and concentrate on putting an equal amount of pressure on your feet”

External focus
“… and concentrate on putting an equal amount of pressure on the rectangles”


“Falls”

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th>External</th>
<th>Internal</th>
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</thead>
<tbody>
<tr>
<td>Equilibrium score</td>
<td>4</td>
<td>0</td>
<td>3</td>
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</table>
Persons with Parkinson’s Disease
(Hoehn and Yahr Stage II or III)
Age: 52 to 80 years

Tasks
• Taking an apple off a shelf and putting it into a basket
• Moving an empty coffee mug from a table onto a saucer
• Removing a can from a shelf and placing it on a table

Persons after stroke
Age: 32-79 years

Persons after stroke
Age: 32-79 years

Tasks
- Taking an apple off a shelf and putting it into a basket
- Moving an empty coffee mug from a table onto a saucer
- Removing a can from a shelf and placing it on a table

**External focus:**
"Pay attention to the can: Think about where it is on the shelf and how big or heavy it is."

**Internal focus:**
"Pay attention to your arm: Think about how much you straighten your elbow and how your wrist and fingers move."


<table>
<thead>
<tr>
<th>Task</th>
<th>External focus</th>
<th>Internal focus</th>
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</thead>
<tbody>
<tr>
<td>Movement time (s)</td>
<td>1.9</td>
<td>2.2</td>
</tr>
<tr>
<td>Peak velocity (mm/s)</td>
<td>594</td>
<td>534</td>
</tr>
<tr>
<td>No. of movement units</td>
<td>4.1</td>
<td>4.5</td>
</tr>
</tbody>
</table>
Participant
52-year-old female after stroke with stiff-legged gait

- **External**: “Focus on bending the sticks together”
- **Internal**: “Focus on bending your knee”

Children with intellectual disabilities

12-year olds
IQ: 51-69

![Graph showing the effect of internal versus external focus on accuracy score over practice, retention, and transfer trials.](image1)

<table>
<thead>
<tr>
<th>Blocks of 8 (practice) and 10 (retention, transfer) trials</th>
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<tbody>
<tr>
<td>Practice</td>
</tr>
<tr>
<td>Accuracy score</td>
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<tr>
<td>30</td>
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</table>

- **Internal focus**: "Focus on your hand"
- **External focus**: "Focus on the beanbag"


Children with ADHD

10.1 years (SD = 0.85)
Throwing tennis ball at a target

![Graph showing the effect of internal versus external focus on accuracy score over trials.](image2)

<table>
<thead>
<tr>
<th>Blocks of 30 (practice) or 10 (retention) trials</th>
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</thead>
<tbody>
<tr>
<td>Practice</td>
</tr>
<tr>
<td>Accuracy score</td>
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<td>2</td>
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</table>

- **Internal focus**: "Focus on your hand"
- **External focus**: "Focus on the ball"
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to enhance motor performance and learning

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Constrained action hypothesis

- Trying to consciously control one’s movements (internal focus) constrains the motor system by interfering with automatic control processes.
- Focusing on the movement effect (external focus) promotes the utilization of automatic control processes.

Evidence …?
Platform deviations from horizontal

Shorter reaction times with external focus:
Reduced attentional demands (i.e., greater automaticity)

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Probe reaction times

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Faster movement adjustments with external focus:
Utilization of reflexive (automatic) control mechanisms

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Cyclic one-leg extension-flexion task:
Alternately flex and extend the leg at a comfortable pace for 60 s

- **Motor performance**
  - Cycle duration

- **Automaticity**
  - Dual task cost
    (Letter fluency task: Name words starting with certain letters)
  - Fluency of movement
  - Movement regularity


Motor performance
(Cycle duration)

Automaticity
(Dual-task cost)
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Pressure generation to a target level of 20% of maximal strength

Internal focus
“Focus on your tongue/hand”

External focus
“Focus on the bulb”

Iowa Oral Performance Instrument (IOPI)


**Isometric force production:**
30% of max. force

**Internal focus:** Calf muscle

**External focus:** Platform
Isometric force production
30% of max. force

Internal focus: Calf muscle
External focus: Platform

Errors (deviation from 30%)

Subject: 015

<table>
<thead>
<tr>
<th>External Phase</th>
<th>Internal Phase</th>
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<tbody>
<tr>
<td>Soleus (V)</td>
<td></td>
</tr>
<tr>
<td>Tib Ant (V)</td>
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<tr>
<td>Force (lbs)</td>
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Subject: 020

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<td>Tib Ant (V)</td>
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<tr>
<td>Force (lbs)</td>
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Subject: 016

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An internal focus of attention degrades accuracy (“noise”) because

- it reduces movement efficiency at the **inter-muscular level**
  (i.e., co-contractions between the agonists and antagonists)

- and it reduces efficiency at the **intra-muscular level**
  because it leads to increased motor unit recruitment
  (i.e., larger motor units with faster conduction times)


**Tasks**

- Assisted bench press (Smith machine) – 75% 1 RM
- Free bench press – 75% 1 RM
- Free squats – 75% 1 RM

**Conditions** (on different days)

- Control
- Internal focus (arms/legs)
- **External focus** (barbell)

**Dependent variable**

Repetitions to failure
% change in repetitions to failure relative to control condition ....

![Graph showing internal and external focus](chart1.png)

**Assisted bench press**

**Free bench press**

**Free squats**


**Control**
No focus instruction

**Internal focus**
“Focus on your finger”

**External focus**
“Focus on the rung”

![Bar chart showing jump height](chart2.png)

**Jump-and-reach task**

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AT = m. tibialis anterior  
BF = m. biceps femoris  
VL = m. vastus lateralis  
RF = m. rectus femoris  
LG = m. gastrocnemius (lateral)

Remember: The focus is on the finger …


This kid’s got game …  
and this game’s got kid!
Summary and Conclusions

Movement instructions or feedback promoting an external relative to an internal focus of attention lead to …

- more effective motor performance and learning, for example
  - balance
  - movement accuracy (including force production)
  - supra-postural and postural task performance

- greater movement automaticity
  - reduced attentional demands
  - improved multi-tasking
  - greater fluidity
  - enhanced performance in stressful situations

- more efficient movement patterns
  - reduced muscular activity
  - greater maximum force production
  - reduced fatigue, greater endurance (lower HR, reduced oxygen consumption, etc.)