# Improving the Mental Representation of Action to Decrease Phantom Limb Pain

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Psy.D. Thesis project

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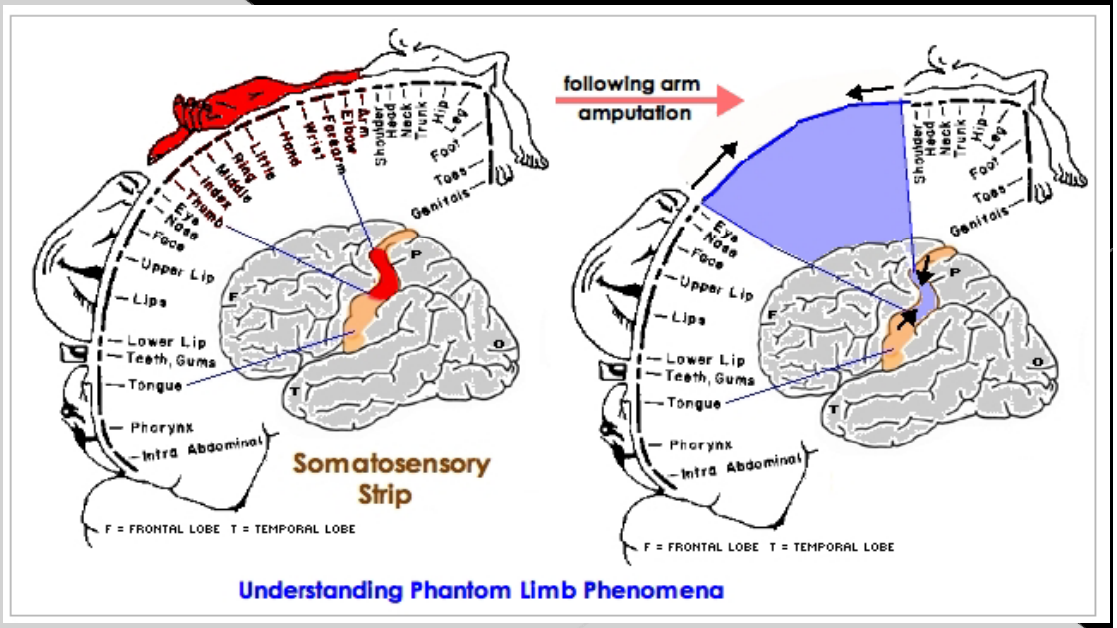
# Introduction

- Phantom limb pain (PLP) affects 60 to 80 % of amputees (Nikolajsen & Jensen, 2001) and is recognized as one of the most complex kind of pain and most difficult to treat (Flor, 2002).
- A discomfort is also associated to the phantom limb position and their difficulty to move it (Flor, 2002).

**Possible cause of PLP:**

The representation of the body parts adjacent to the hand in the cortical somatotopy expands in sensorimotor cortices

(Flor et al., 1995; Lotze et al., 2001)



# Introduction

- Ramachandran and Rogers-Ramchandran (1996) : intact upper limb inside a mirror box creates the impression that the missing limb is still there.
- The movements of the intact limb generate illusory movements of the missing limb, which appears to alleviate PLP in some patients.
- By providing illusory (visual and sensory) feedback can restore voluntary control over phantom movements (Giraux et Sirigu, 2003).

# Introduction

- The neuronal substrate which underlies the imagination, observation and execution of movements is thus thought to be similar (Jeannerod, 2001; Grezes J, Decety, 2001).
- For amputees, the voluntary re-evocation of motor representations of the amputated limb is associated with the activation of the cerebral systems implied in the real behavior (Lotze et al., 2001).
- This voluntary representation of the absent limb can be accessed with motor imagery, which evokes the visual aspect as well as the kinaesthetic aspects of a movement (Jeannerod, 1995).

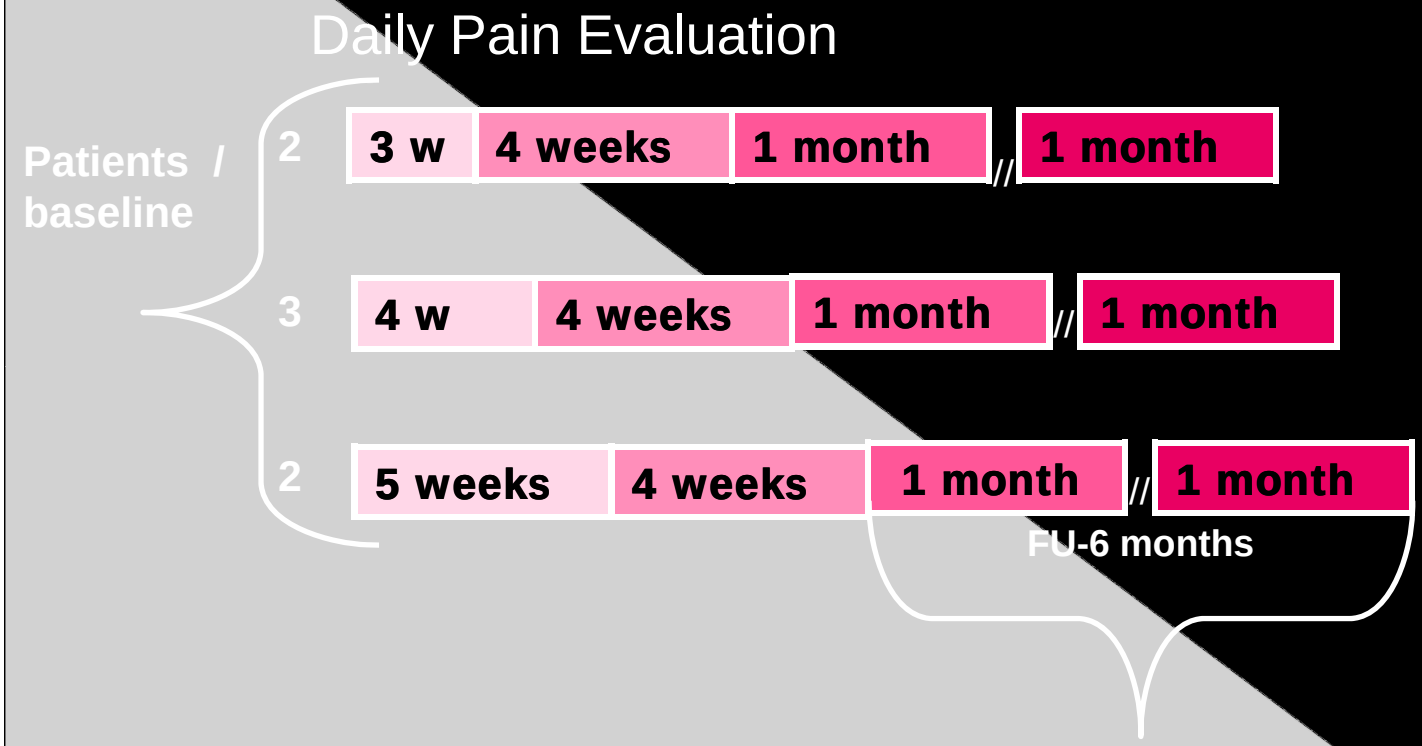
# Aim of the study

- To verify if a new intervention combining the observation and the imagination of movements corresponding to the amputated limb:
  - can reduce resistant PLP,
  - can improve motor control (improve rapidity and ease of motor imagery),
  - can be more suitable for patients with some individual characteristics.

# Participants

- 7 men;
- age range 32–65 years;
- Traumatic unilateral amputation of upper (above wrist), or lower (above ankle) limb;
- PLP daily for at least six months;
- All participants tried other treatments without significant effect;
- 5/7 regular medication to control pain;
- Medication was stable for at least one month before the baseline;
- All changes were documented.

# A single-case multiple baseline design




**Baseline**

**Intervention-1**

**Intervention-2**

**FU-6 months**

**Daily Pain Evaluation:**
A 100 mm VAS from « No pain »
to « Worst pain imaginable »

# A single-case multiple baseline design

- **Intervention-1:**
  - 4 weeks (2 days in laboratory and 3 days at home).
  - First week: 4 movements + 2 movements /week.
  - For each movement:
    - **Observe** while simultaneously **follow with** their **phantom** limb (2X).
    - **Imagine** the same movement with the eyes closed (10x).
    - 5-min pause + same procedure repeated.
- **Intervention-2**
  - Same procedure, home only, 5 days a week for one month.

# Other measures

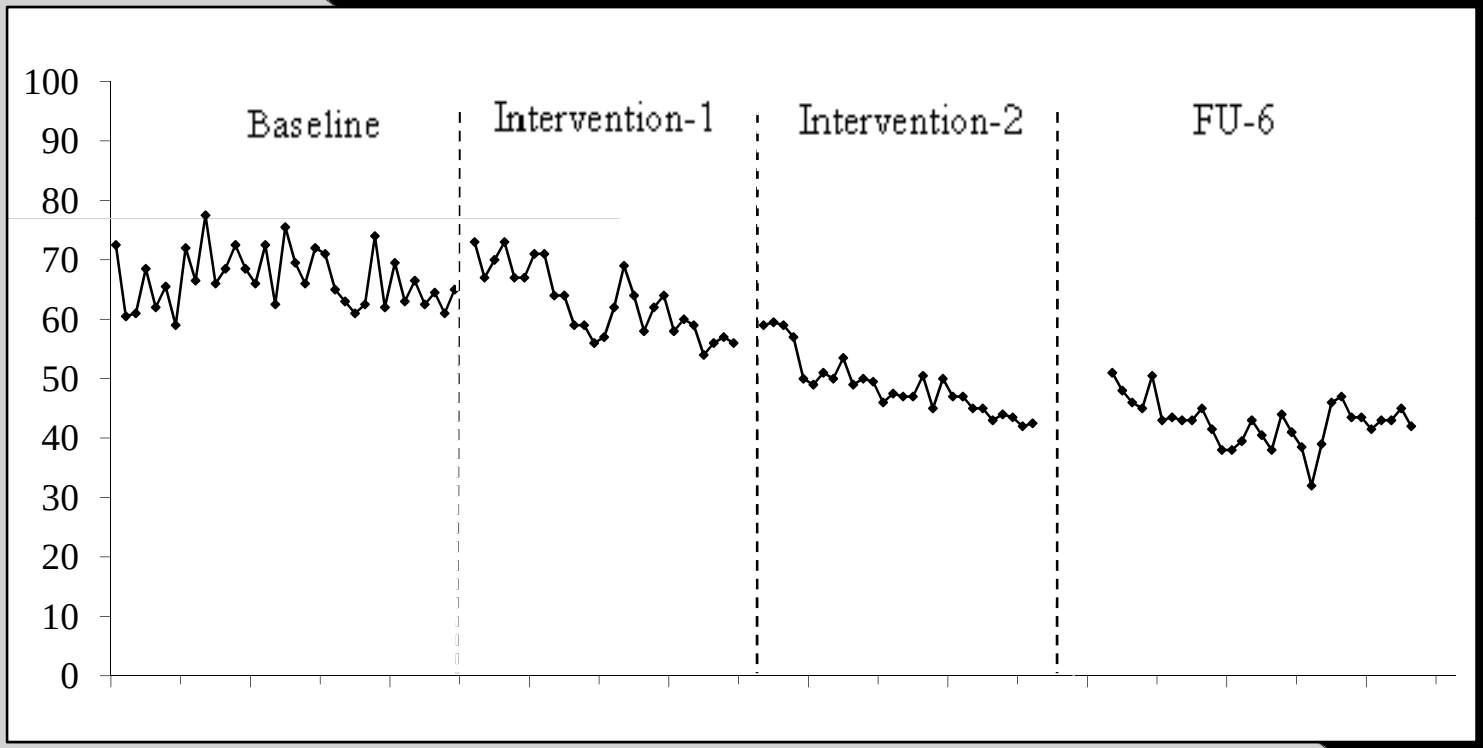
- **Chronometry:**
  - 1 proximal and 1 distal movements were timed during their imagination at 1st, 4th and 8th (last) sessions of Intervention-1.
- **Imagery performance:**
  - Before and after Intervention-1, all 48 videos of movements was viewed and rated on a numerical scale between 0 (unable to imagine) to 10 (I Imagine like if I was doing it).
- **Questionnaires:**
  - Pain (Self-efficacy, catastrophizing, support, etc) and imagery ability were assessed by questionnaires before the baseline.

# Analyses

- **1** participant was excluded from all analyses for failing to meet inclusion criteria.
- Pain:
  - Times series analysis
  - Descriptive analysis (Change in pain %)
- Chronometry
  - Repeated measures Anova
- Imagery performance
  - T-Test
- Questionnaires
  - Sperman's correlations

# Pain results

- **Example: Daily pain intensity: Participant #5**



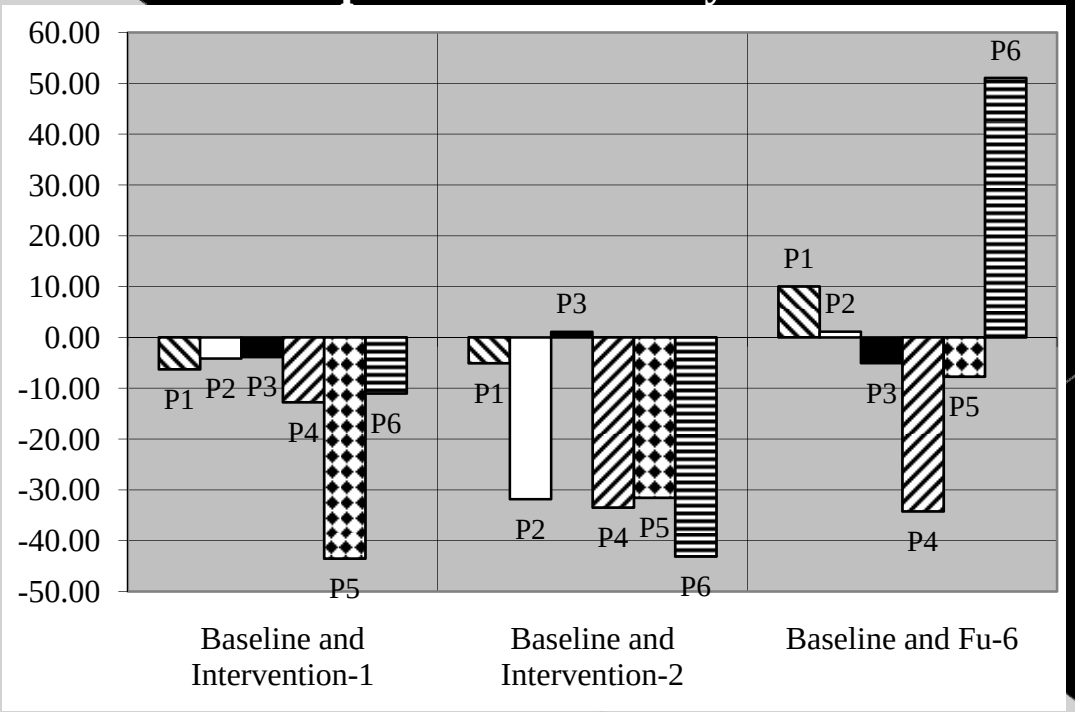

- **Times series analysis:**
  - 3 /6 participants rated that their **pain decreases gradually every week** (3.7 to 11.7 mm/ 100 mm) at Intervention-1.

# Pain results

**Change in pain:**
[(post-intervention pain – pre-intervention pain) / pre-intervention pain)] x 100%.

- More changes after 8 weeks than four weeks .
- Pain decreased between 32 to 43% for 4 participants after 8 weeks (Intervention-2).
- Only one participant maintain his gains at FU-6.

**Change in pain (%) between baseline and other phases of the study**



# Other measures

- **Chronometry:**
  - The results suggest that participants **did not imagine more rapidly throughout Intervention-1** with intact or phantom limb ($p<0.5$).
- **Imagery performance:**
  - 5/6 participants **improved their performance to imagine** not only practiced movements but all 48 movements ($p<0.05$).
- **Questionnaires:**
  - <u>West-Haven-Yale Multidimensional Pain Inventory:</u>
    - Participants that benefited from this intervention perceived:
      - **More control** on their life ($r = -0.99$ ; $p< 0.01$),
      - That they were more **supported** ($r = -0.97$ ; $p< 0.01$),
      - That they were more **functional** ($r = 0.83$ ; $p< 0.05$).
  - Pain Catastrophizing Scale, Pain Self-Efficacy Questionnaire, Kineasthetic and Visual Imagery Questionnaire did not correlate significantly with pain changes.

# Conclusion

- Most of participants (4/6) benefited moderately from this intervention but some (2/6) did not reported any effect effect on pain.
- All participants improved their ability to move their phantom limb.
- The findings suggest that this intervention should be practiced at least 8 weeks and regularly.
- It should be continued to maintain the gains.
- The observation before the imagination could:
  - Help maintain the visual image in memory,
  - Control the speed and accuracy of the movements between sessions (consistency and quality).
- Other studies are necessary to uncover the mechanisms and the participants' characteristics associated with potential changes in the level of pain.

# Thanks

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