

# Potential mechanisms underlying the efficacy of VR to reduce acute pain: A literature review.

*Stéphanie Dumoulin, B.A., Stéphane Bouchard, Ph.D. & Vicky Rivard, M.A.*

*Cyberpsychology Lab of University of Quebec in Outaouais (Hull, Qc, Canada)*

# Introduction

- Pain is now considered a complex subjective phenomenon that involves sensorial, motivational, cognitive and emotional dimensions.
- Few recent studies have shown that virtual reality (VR) can be used to control and reduce acute pain, probably because of its potential for distracting attention away from the pain.
- But many factors may influence the efficacy of VR to help manage pain.

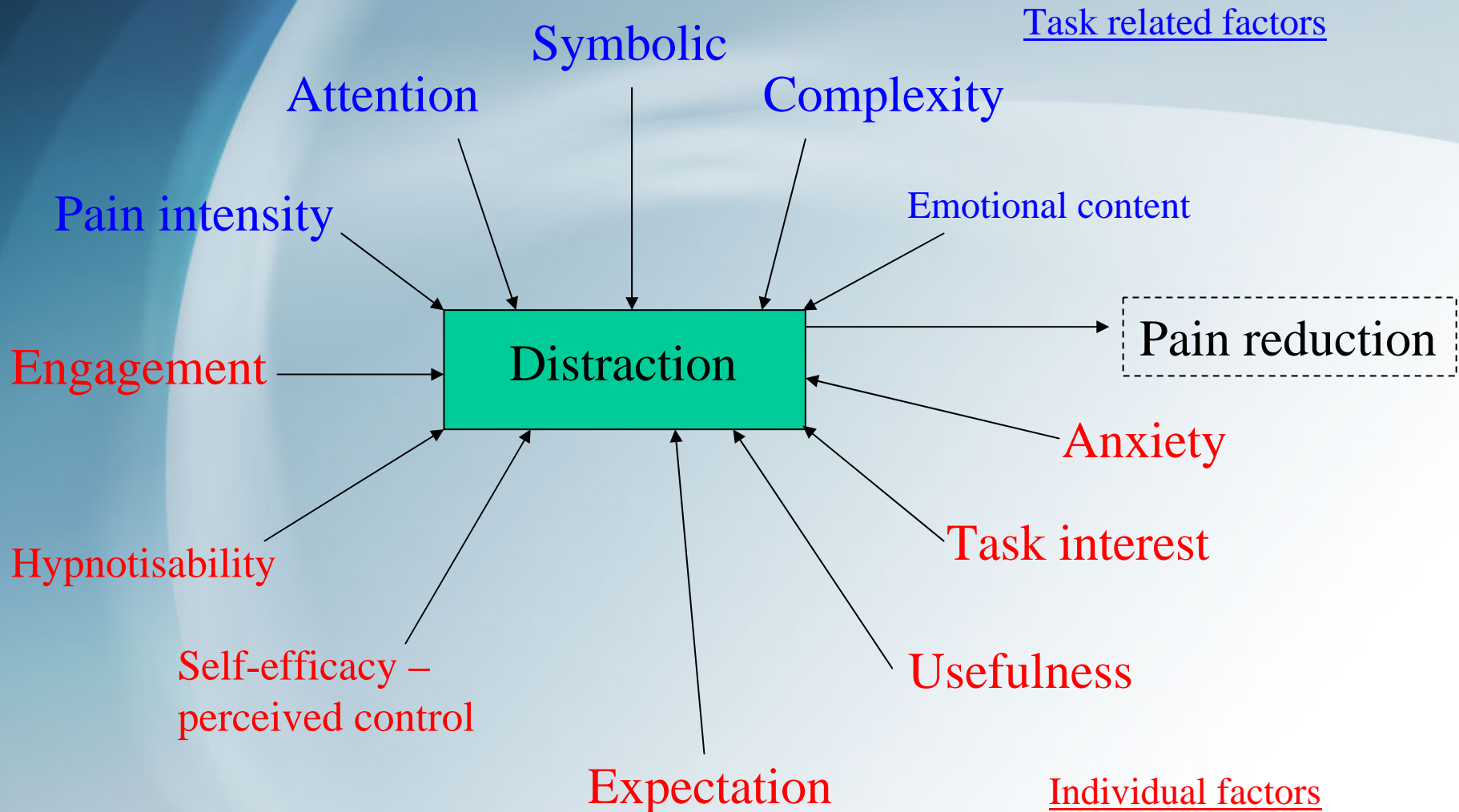
# Aim

- Summarize studies on VR in experimental and clinical pain management in order to highlight psychological variables that may be involved in the mechanisms of pain management using VR.

# Method

- Research in journal databases such as : *MedLine, PsycInfo* and *Web of Science*
- With key words such as : «pain» or «pain management» were crossed with key words such as «virtual» or «virtual reality»
- More than 110 articles were found (most of them were theoretical...)
- 17 empirical studies using VR to manage pain were found.
  - 7 used rigorous experimental protocols
  - 10 were more exploratory and had no experimental protocol

# Potential mechanisms



# Empirical studies using experimental protocols (7)

Studies (N)	Outcome	Sense of presence	Anxiety	Complexity	Emotional content	Pain intensity	Pain reduction	Engagement	Hypnotisability	Self-efficacy + control perception	Expectation	Usefulness	Task interest	Symbolic	Attention
<u>Clinical pain - Cancer</u>															
(1) Gershon (a) (2004) N = 59	X		X			X	X								
(2) Sander-Wint (2002) N = 30						X	X					X			X
<u>Experimental pain – Tourniquet technique</u>															
(3) Hoffman (a) (2003) N = 22	X	X	X	X		X	X								X

## Empirical studies using experimental protocols (7)

[illegible]

# Empirical studies using no experimental protocols (10)

Studies (N)	Outcome	Sense of presence	Anxiety	Complexity	Emotional content	Pain intensity	Pain reduction	Engagement	Hypnotisability	Self-efficacy + control perception	Expectation	Usefulness	Task interest	Symbolic	Attention
	<u>Dental procedure</u>														
(8) Hoffman (c) (2001) N = 2	X	X				X	X								
	<u>Burn care</u>														
(9) Hoffman (d) (2004) N = 1	X	X				X	X							X	X
(10) Hoffman (e) (2001) N = 7	X	X				X	X								X
(11) Hoffman (f) (2001) N = 1	X	X	X			X	X								X



# Empirical studies using no experimental protocols (10)

Studies (N)	Outcome	Sense of presence	Anxiety	Complexity	Emotional content	Pain intensity	Pain reduction	Engagement	Hypnotisability	Self-efficacy + control perception	Expectation	Usefulness	Task interest	Symbolic	Attention
(12) Hoffman (g) (2000) N = 12	X	X				X	X								X
(13) Hoffman (h) (2000) N = 2	X	X	X			X	X								X
<u>Various medical conditions (gastroenterology, oncology, cardiology, nephrology)</u>															
(14) Steele (2003) N = 1	X		X			X	X								
(15) Holden (1999) N = 9			X			X	X								

## Empirical studies using no experimental protocols (10)

[illegible]

# Results

- Most studies showed an important and statistically significant reduction in pain.
- Although distraction is considered the key ingredient to explain these results, a detailed analysis reveals that several factors might be involved.
- These factors could be grouped in three categories: task relevant (e.g., attention required, task complexity and emotional content), individual (e.g., sense of presence, hypnotisability, self-efficacy and outcome expectations) and pain factors (e.g., pain intensity).

# Discussion

- We believe that by highlighting explicitly in this posters the variables that may lead to pain management, VR researchers can narrow more effectively their search for treatment moderators and mediators.
- We also believe that more studies must be done regarding the potential mechanisms underlying the efficacy of VR to reduce acute pain.
- Now that we know that VR work to reduce pain symptoms during painful medical procedures, it might be useful to understand how and why.

# Empirical studies

- 1(a) Gershon, J., Zimand, E., Pickering, M., Rothbaum, B.O. & Hodges, L. (2004). A pilot study of virtual reality as a distraction for children with cancer. *Journal of the American Academy of Child & Adolescent Psychiatry*, 43 (10), 1243-1249.
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- 3(a) Hoffman, H.G., Garcia-Palacios, A., Kapa, V., Beecher, J. & Sharar, S.R. (2003). Immersive virtual reality for reducing experimental ischemic pain. *International Journal of Human-Computer Interaction*, 15(3), 469-486.
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- 5(b) Hoffman, H.G., Sharar, S.R., Coda, B., Everett, J.J., Ciol, M., Richards, T. & Patterson, D.R. (2004). Manipulating presence influences the magnitude of virtual reality analgesia. *Pain*, 111, 162-168.
- 6 Bentsen, B., Svensson, P. & Wenzel, A. (2001). Evaluation of effect of 3D video glasses on perceived pain and unpleasantness induced by restorative dental treatment. *European Journal of Pain*, 5, 373-378.
- 7 Sullivan, C., Schneider, P.E., Musselman, R.J., Dummett, C.O. & Gardiner, D. (2000). The effect of virtual reality during dental treatment on child anxiety and behavior. *Journal of dentistry for children*, 193-196.
- 8(c) Hoffman, H.G., Garcia-Palacios, A., Patterson, D.R., Jensen, M., Furness, T. & Ammons, W.F. (2001). The effectiveness of virtual reality for dental pain control : A case study. *Cyberpsychology & Behavior*, 4(4), 527-535.
- 9(d) Hoffman, H.G., Patterson, D.R., Magula, J., Carrougner, G.J., Zeltzer, K., Dagadakis, S. & Sharar, S. (2004). Water-friendly virtual reality pain control during wound care. *Journal of Clinical Psychology*, 60(2), 189-195.

# Empirical studies

- 10(e) Hoffman, H.G., Patterson, D.R., Carrougher, G.J. & Sharar, S.R.(2001). Effectiveness of virtual reality-based control with multiple treatments. *The Clinical Journal of Pain*, 17, 229-235.
- 11(f) Hoffman, H.G., Patterson, D.R., Carrougher, G.J., Nakamura, D., Moore, M., Garcia-Palacios & Furness, T.A. (2001). The effectiveness of virtual reality pain control with multiple treatments of longer durations: A case study. *International Journal of Human-Computer Interaction*, 13(1), 1-12.
- 12(g) Hoffman, H.G., Patterson, D.R., & Carrougher, G.J. (2000). Use of virtual reality for adjunctive treatment of adult burn pain during physical therapy: A controlled study. *Clinical Journal of Pain*, 16(3), 244-250.
- 13(h) Hoffman, H.G., Doctor, J.N., Patterson, D.R., Carrougher, G.J., Furness, T.A. (2000). Virtual reality as an adjunctive pain control during burn wound care in adolescent patients. *Pain*, 85, 305-309.
- 14 Steele, E., Grimmer, K., Thomas, B., Mulley, B., Fulton, I. & Hoffman, H.G. (2003). Virtual reality as a pediatric pain modulation technique: A case study. *Cyberpsychology & Behavior*, 6(6), 633-638.
- 15 Holden, G., Bearison, D.J., Rode, D.C., Rosenberg, G. & Fishman, M. (1999). Evaluating the effects of a virtual environment (STARBRIGHT World) with hospitalized children. *Research on Social Work Practice*, 9(3), 365-382.
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