

PainWEEK[®]

Within You, Without You: Virtual Reality for Pain Management

Ted Jones, PhD

Recognized as



“distinguished
comprehensive
multidisciplinary
pain care”

Disclosures

- None

Learning objectives

- State where the original work was done in using virtual reality for pain.
- Compare the amount of analgesia received from virtual reality to that of morphine.
- Describe two VR applications that decrease pain.

The Hype

- “Virtual Reality Won’t Just Amuse—It Will Heal Millions” – March 5, 2015
Wired Magazine
- “VR is here and it's real: companies taking virtual reality from niche toy to must-have business tool “- June 16, 2016 CBC News
- “Virtual reality game relieves pain as effectively as drugs” – July 20, 2016 The Times

TIME September 6, 2016

The View

INSTEAD OF TRYING TO PUSH NEGATIVE EMOTIONS ASIDE, WE SHOULD ACCEPT THEM — PAGE 19



Virtual-reality experiences, like this one from DeepStream VR, are increasingly being used to treat chronic and acute pain

HEALTH

Can virtual reality help people manage pain?

By Alexandra Sifferlin

SNOWFLAKES FALL AROUND ME AS I float above a river, weaving through an icy wonderland. I toss a fish to an otter, and it shivers with glee. Then, as I exit a cave full of colorful rocks, I flow into a bright spring landscape, complete with cherry blossoms.

This trippy yet oddly relaxing simulation (officially titled COOL!) comes courtesy of DeepStream VR, a Seattle-based virtual-reality startup. But it's no game: early research has shown that for people with chronic or acute pain, having the same experience I did can offer a much needed reprieve—not just during the treatment but for days after. “We can manipulate the experience to get the best outcome for people,” says Howard Rose, DeepStream’s co-founder and CEO. He’s not alone in that excitement.

As VR technology gets better, cheaper and more accessible—thanks in part to consumer-friendly headsets like the Oculus Rift, which debuted in March—a small but growing number of scientists and entrepreneurs are using it to treat medical conditions, including PTSD and chronic pain. The financial stakes are high: Goldman Sachs expects total revenue from the VR industry to hit \$95 billion in 2025, of which over \$5 billion could come from medical applications. Virtual reality could also reshape the nature of medicine itself, enabling doctors to abandon what Rose calls “a one-pill-fits-all approach” to treatment.

Right now, though, its proponents still have a lot to prove. Although individual studies of people with chronic pain have shown that VR can offer

How VR Could Break America's Opioid Addiction



So What is Virtual Reality (VR)?

Brief Review

- Virtual Reality (VR) is the name for having someone look at a viewer so up close that it gives the brain the perception that one is “there.”
- FOV >80°, good tracking & resolution = “immersion.”
- In 1996 Hunter Hoffman and David Patterson began experimenting with VR in the treatment of burn pain at UW’s Harborview Burn Center.

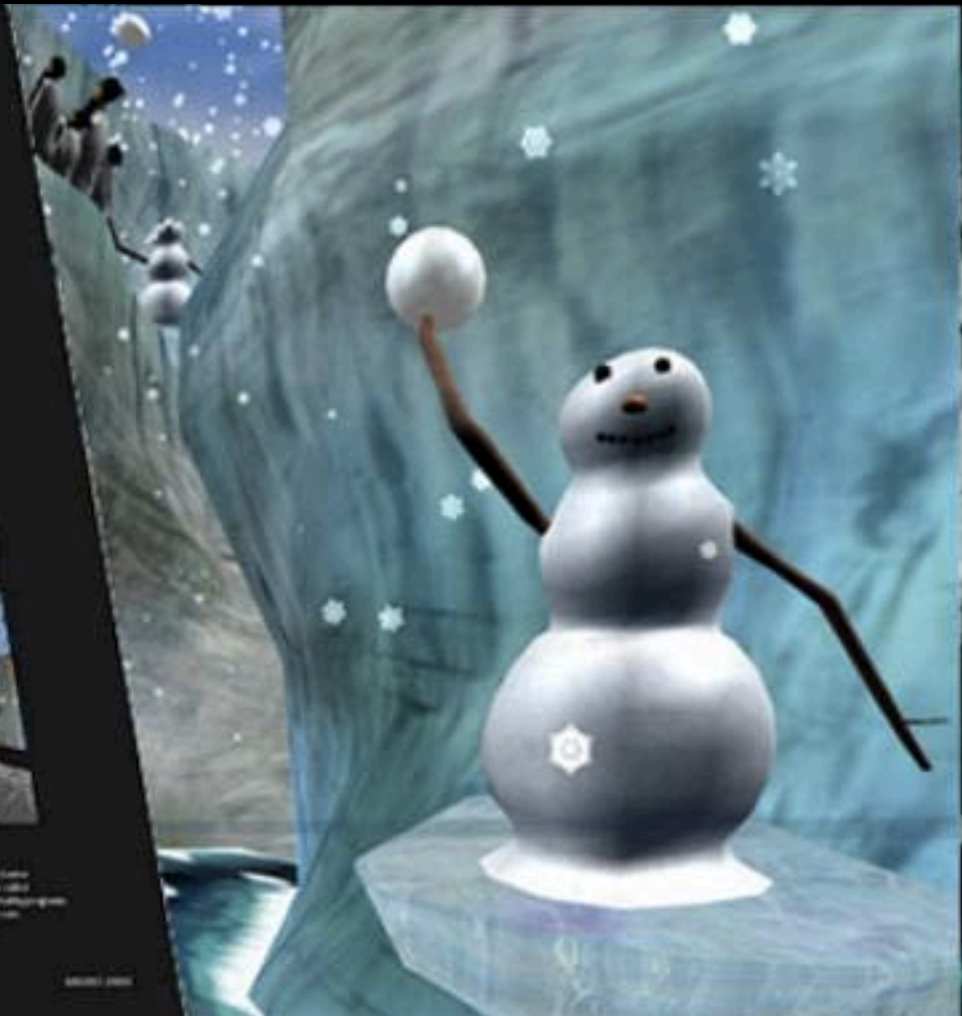
SnowWorld

VIRTUAL- REALITY THERAPY

Patients can get relief from pain or overcome their phobias by immersing themselves in computer-generated worlds. BY HUNTER G. HOFFMAN



PHOTO COURTESY OF THE UNIVERSITY OF MICHIGAN MEDICAL CENTER. THE SNOW WORLD VIRTUAL REALITY THERAPY PROGRAM IS A REGISTERED TRADEMARK OF THE UNIVERSITY OF MICHIGAN MEDICAL CENTER. THE SNOW WORLD VIRTUAL REALITY THERAPY PROGRAM IS A REGISTERED TRADEMARK OF THE UNIVERSITY OF MICHIGAN MEDICAL CENTER.





Link to U Washington's Work

- <https://www.hitl.washington.edu/projects/vrpain/>

Since 1996

- Over the last two decades multiple studies have shown that VR provides significant analgesia during painful procedures, such as wound debridement.
- See references at the end of this slide deck for citations of several studies, and there are more.
- There is evidence for its effectiveness in areas such as burns, dental procedures, surgeries of various types, for both adults and children.

Documented Effects

- fMRI studies can show the activity changes in the brain during VR and basically “see” the pain relief occur.
- And VR has been shown to give better analgesia than a video game.
- For whatever reason, it can give more powerful analgesia than other distraction techniques.

So..

- Why doesn't every hospital and every pain practice in the country have a VR system?
- One major barrier has been cost. In 2004 the cost of the system was about \$30,000.
- And to date VR sessions have not been reimbursable by third party carriers.

In case you missed it...

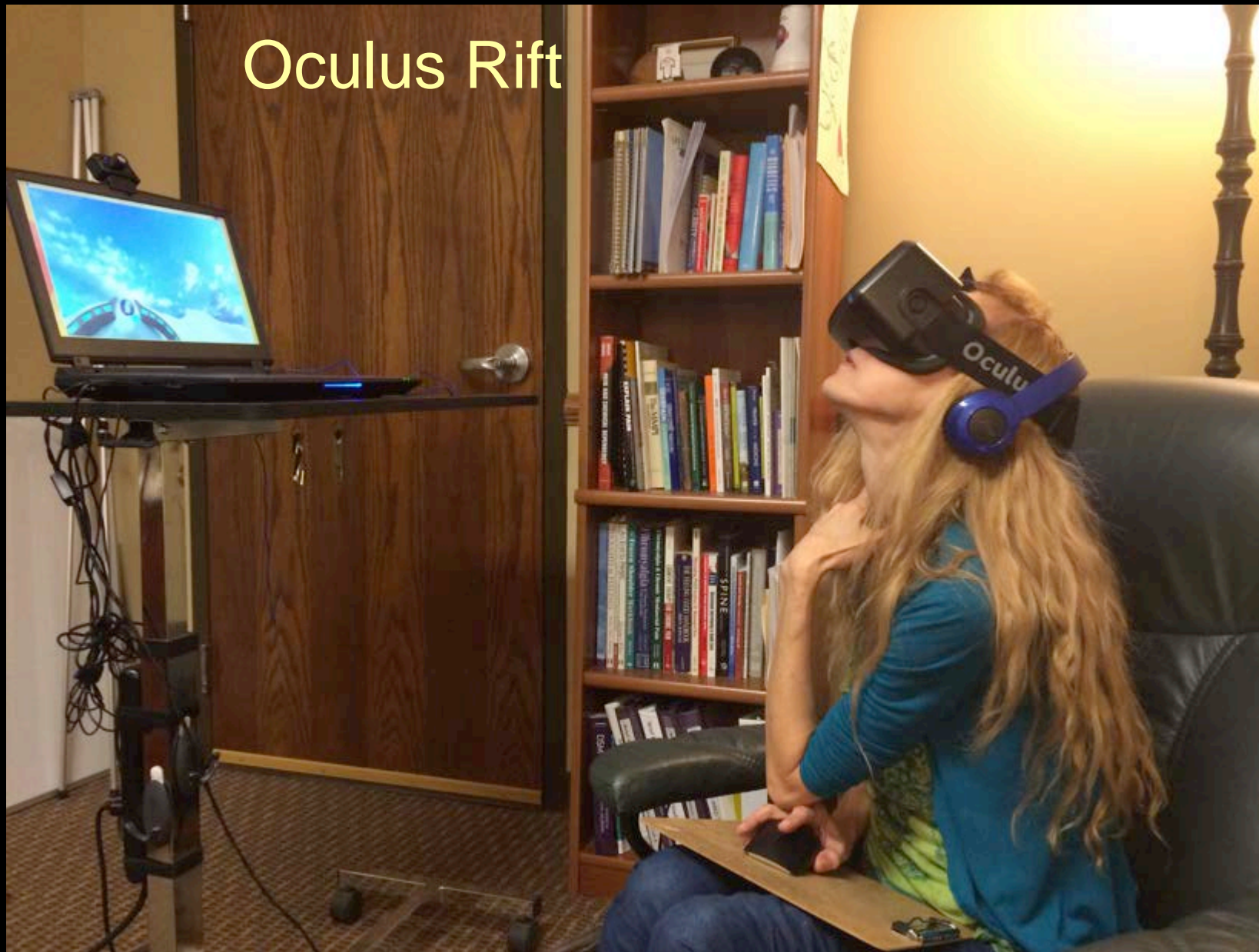
- The VR world got a huge boost in 2014 when Facebook invested a **billion** dollars in VR technology.
- With this investment and sign that VR was likely here to stay, in 2015 many companies got into the VR business and have been developing hardware and software.
- And some put energy into the pain world.

The Equipment

GearVR



Oculus Rift



The Vive



Deep Stream Viewer (IPad)



As far as I know

The Current Companies

Cognifisense

- CognifiSense is a company founded and run by Tassilo Baeuerle in San Francisco.
- CognifiSense is newer to the pain treatment space but has expressed a commitment to the use of VR for pain.
- Maureen Simmonds, a physical therapist at University of Texas' Health Science Center, is working with them to develop products.
- They are now developing and piloting apps for analgesia as well as for range of motion and for remodeling central processes.

AppliedVR

- AppliedVR's developed its main products in partnership with Cedars-Sinai.
- They use the GEARVR headset, which is cordless and runs using a phone.
- They have modules for various uses, such as pain relief and relaxation. They bill themselves as “the Netflix” of validated content.

Recent Study by AppliedVR

- 2017 published study. 100 Ss, 50 in each group. Medical inpatients with pain ≥ 3 .
- Compared Gear VR pain application vs HiDef 2D nature video. 15 minutes.
- VR application significantly reduced pain more than 2D video.
- VR reduced pain 24%; video reduced pain 13%.

Pain RelieVR



FirstHand Technology

- Used the name DeepStreamVR for a time
- Based in Seattle and Palo Alto
- They were involved with SnowWorld.
- Uses a corded headset (Vive or Oculus).
- Pain application is Cool! (“Son of SnowWorld”)
- They also have a biofeedback application called “Glow.”

Cool!



Some data

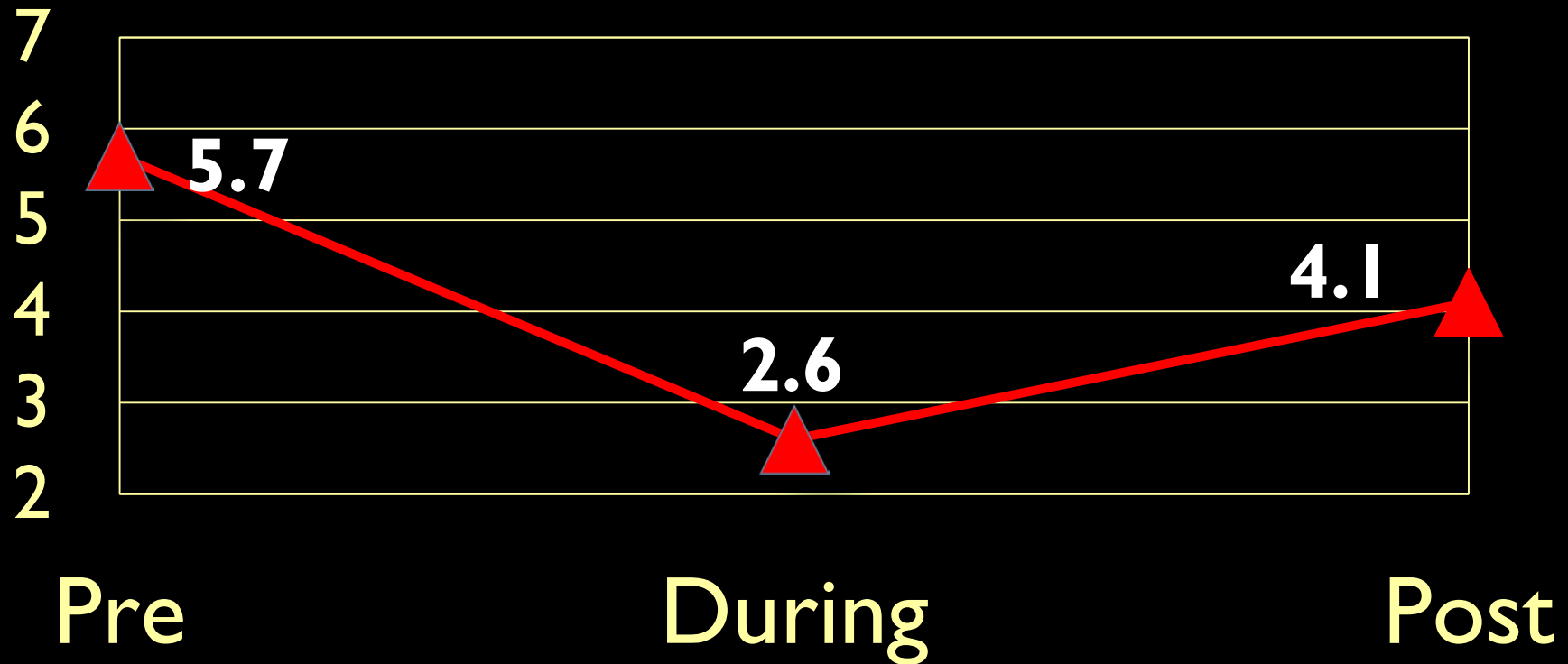
Use of VR on Outpatients with Chronic Pain

Our First VR Study

- 30 Ss were recruited within an outpatient program for chronic pain.
- All sorts of pain disorders were represented.
- Each was given a 5 minute session in Cool!
- All used the Oculus Rift device. (HMD)
- They were asked their pain before the session. After they were asked what their pain was now (post session) and what it was during the session.

What we found

Group Mean Pain Ratings,



-
- That's a 33% reduction in pain from the pre-session to the post-session,
 - And a 66% reduction in pain from pre-session to during the session.
 - As a comparison, morphine is generally thought to reduce pain 25-30%.

VR Study 2

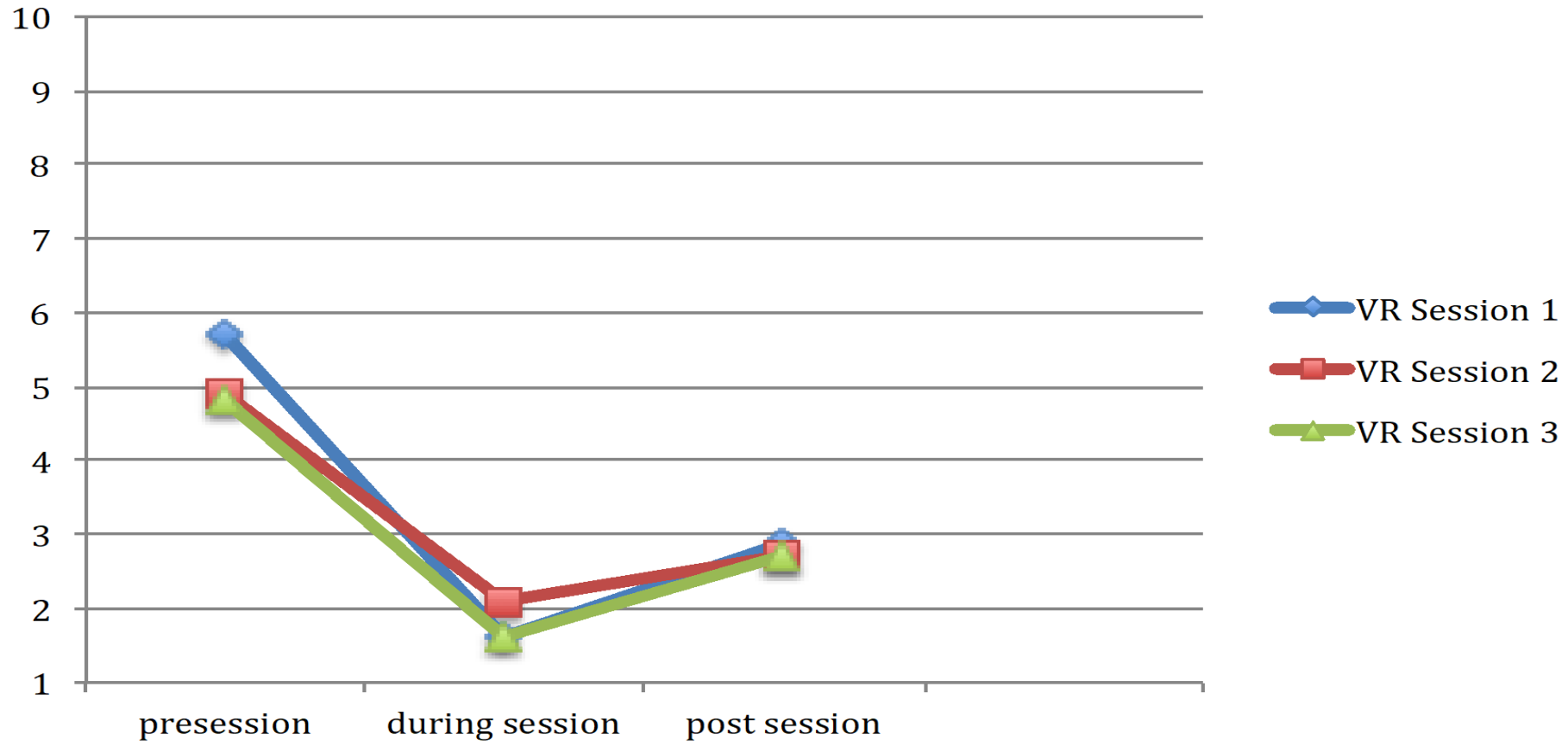
- Ten Ss were recruited with neuropathic pain (such as CRPS, neuropathy, or TGN).
- Each was given three sessions of VR lasting 20 minutes each time.
- Information was gathered using a variety of scales, including pre-post-during pain scores.

Study Design (N=10)



- Five Ss completed another psychology assessment packet four weeks before the Start (Time 0)
- Five other Ss completed another psychology assessment packet five weeks after the last VR session (Time 5)

Average Pain Ratings Before, During and Immediately After the VR Session



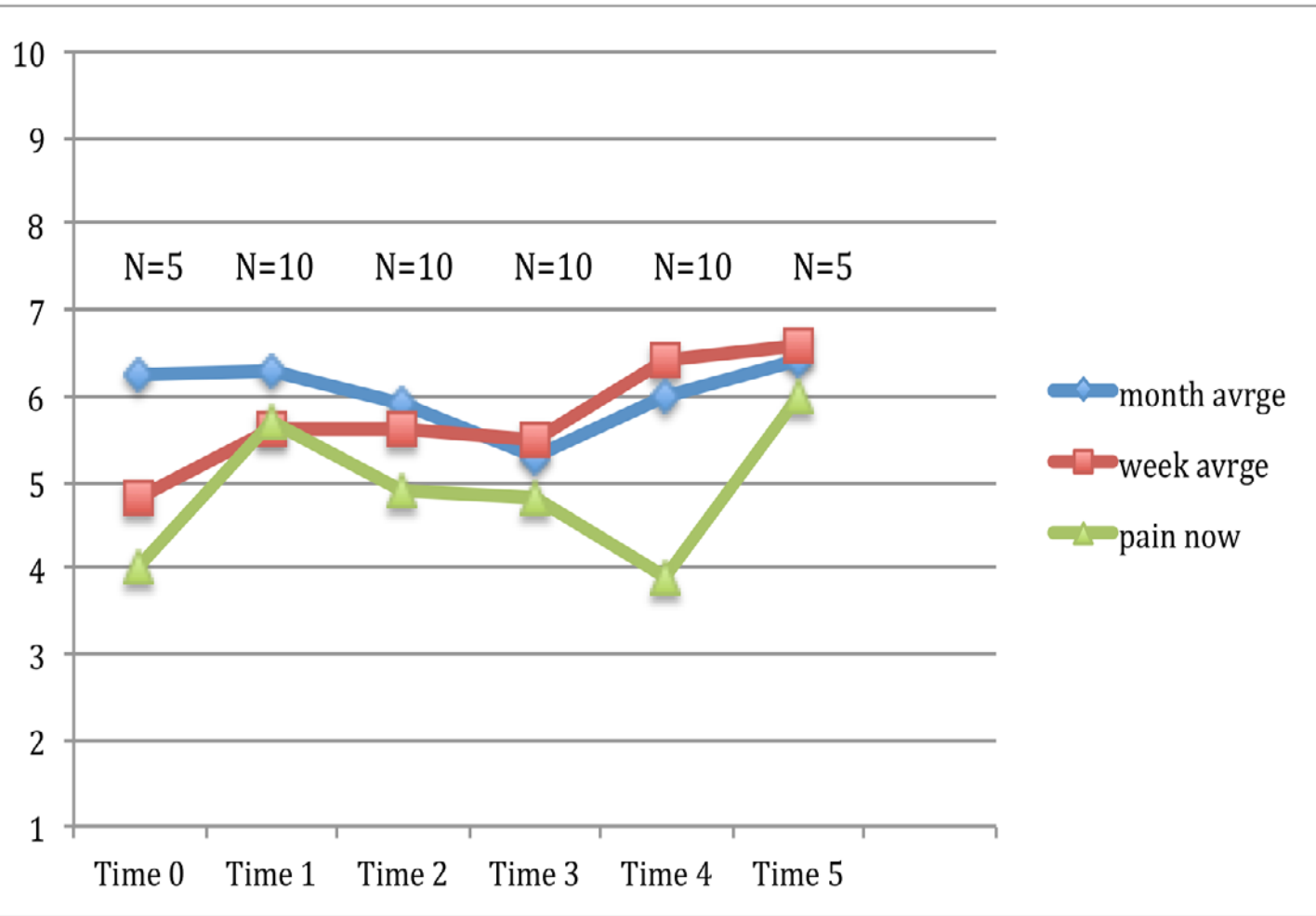
Analgesia

- A 69% reduction in pain during the session
- A 53% reduction in pain immediately after the VR session
- Subjects reported 97% of the time that they thought VR had helped their pain with only one subject in one session reporting that it did not help pain.

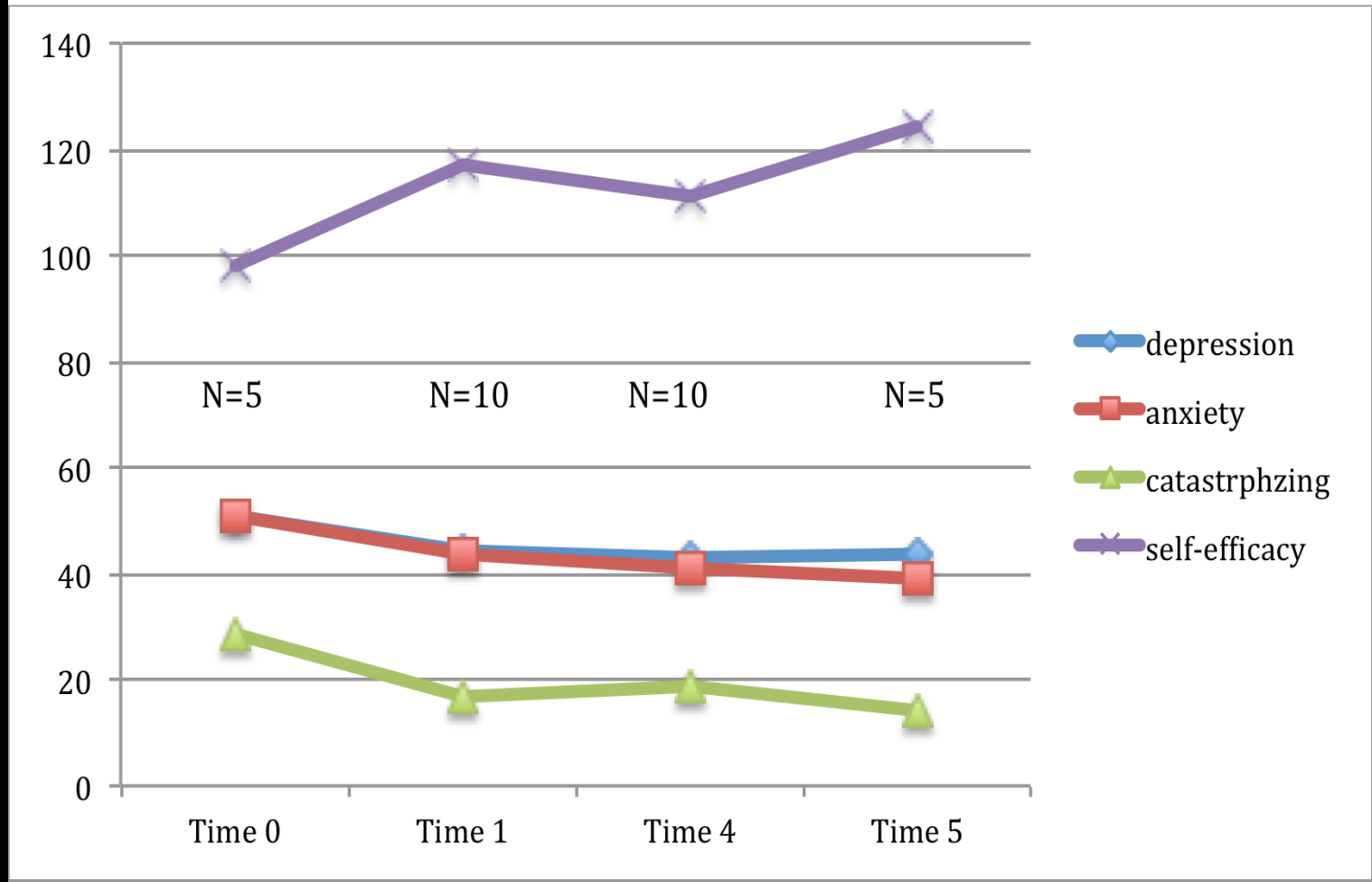
A “Tail” of Analgesia

- Ss were asked when they came back how long their analgesia from the last session , if they had any, lasted.
- The average estimate of how long the analgesia had occurred after the session was 30 hours.
- Ten percent of the time (three of thirty responses) subjects reported that there was no aftereffect of VR on their pain.
- 90% of the time there was some aftereffect, ranging from 30 minutes to a maximum of 72 hours.

Average pain ratings across time



Psychological Assessment Scores Across Time



Summary of Our Studies to Date

- VR cuts pain while doing VR about 67%
- Immediately after a VR session, pain is reduced 33-50%, with longer sessions yielding more analgesia.
- Some analgesia remains for 90% of patients, averaging about one day afterwards.
- VR sessions don't seem to change pain scores in the long term.
- VR sessions don't seem to change psychological variables such as catastrophizing or depression.

Let Matt tell you

VR is here

- There are VR applications out there now for pain. And more are coming.
- There are different hardware setups: some that go over the head, some that do not, some with cords, some with no cords.
- There is more than one company now that sells applications for pain relief.
- Systems now run around \$2000 to \$6500, depending on what you buy.

Some Challenges

- VR systems are less expensive than in the past but still are not cheap.
- High end computers run good graphics but home applications won't have this power.
- It's buyer beware; not all applications appear to give equal effect.
- Billing and reimbursement is still an issue, though insurers are becoming surprisingly open to the idea.

Questions?

References

- Gershon, J., Zimand, E., Pickering, M., Rothbaum, B. O., & Hodges, L. (2004). A pilot and feasibility study of virtual reality as a distraction for children with cancer. *Journal of the American Academy of Child and Adolescent Psychiatry*, 43(10), 1243–9. doi:10.1097/01.chi.0000135621.23145.05.
- 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. *The Clinical Journal of Pain*, 16(3), 244-250.
- Hoffman, H. G., Patterson, D. R., Carrougher, G. J., & Sharar, S. R. (2001). Effectiveness of virtual reality-based pain control with multiple treatments. *The Clinical Journal of Pain*, 17(3), 229–35. Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/11587113>
- Hoffman, H. G., Patterson, D. R., Seibel, E., Soltani, M., Jewett-Leahy, L., & Sharar, S. R. (2008). Virtual reality pain control during burn wound debridement in the hydrotank. *The Clinical Journal of Pain*, 24(4), 299–304. doi:10.1097/AJP.0b013e318164d2cc
- Narchant Jo. How VR Could Break America’s Opioid Addiction. Mosaic. April 25, 2017. <https://mosaicscience.com/story/vr-could-break-americas-opioid-addiction>

- Chan, E. A., Chung, J. W., Wong, T. K., Lien, A. S., & Yang, J. Y. (2007). Application of a virtual reality prototype for pain relief of pediatric burn in Taiwan. *Journal of Clinical Nursing*, 16(4), 786–93. doi:10.1111/j.1365-2702.2006.01719.x
- Maani, C. V, Hoffman, H. G., DeSocio, P. A., Morrow, M., Gaylin, C., Magula, J. Gaylord, K. (2008). Pain control during wound care for combat-related burn injuries using custom articulated arm mounted virtual reality goggles. *Journal of CyberTherapy&Rehabilitation*, 1(2), 193. Retrieved from <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.192.9242&rep=rep1&type=pdf>
- Maani, C. V, Hoffman, H. G., Morrow, M., Maiers, A., Gaylord, K., McGhee, L. L., & DeSocio, P. a. (2011). Virtual reality pain control during burn wound debridement of combat-related burn injuries using robot-like arm mounted VR goggles. *The Journal of Trauma*, 71(1 Suppl), S125–30. doi:10.1097/TA.0b013e31822192e2
- Jones T, Moore TM, Choo J (2016). “The Impact of Virtual Reality on Chronic Pain.” *PLOS ONE*. December 20, 2016. <https://dx.doi.org/10.1371/journal.pone.0167523>.
- Tashjian VC, Mosadeghi S, Howard AR, Lopez M, Dupuy T , et. al. (2017). Virtual Reality for Management of Pain in Hospitalized Patients: Results of a Controlled Trial. *JMIR Ment Health*, 4(1):e9. (online).