

# Star-Stuff: A Shared Immersive Experience in Space

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Figure 1: Standing among the stars in *Star-Stuff*. Constellations are traced on the immersant's body while stars are emitted from the heart before orbiting around the body. Photo by the author CC BY-SA 4.0.

## Abstract

Inspired by Carl Sagan and emerging from the ashes of a rejected design, *Star-Stuff: a way for the universe to know itself* is a unique immersive experience that transforms immersants into galaxies and constellations. The two-player hybrid experience can be used telepresently or in a physical installation, connecting anonymous strangers through abstract virtual bodies. In this paper, I describe my inspiration and the open, intuitive process by which *Star-Stuff* was developed. I outline design decisions made along the way and present observations made during the artwork's first public exhibition.

## Keywords

Immersive Installation, Telepresence, Virtual Reality, Abstract Embodiment, Social Connection, Space Art

## Introduction

“We’re made of star-stuff. We are a way for the cosmos to know itself.”

*Carl Sagan* [21]

As a child watching *Cosmos*, Carl Sagan’s words resonated with me in a way that continues to drive my curiosity to this day. Watching that already well-worn VHS while sheltering from a cold winter’s day on the Canadian Prairie undoubtedly changed my life. It led me on a path of endless inquiry as I sought to better understand the infinite world that surrounds us. That inquiry has led me down a meandering path of self-discovery that recently crossed a serendipitous opportunity to pay tribute to Sagan’s as yet unmatched voice of inspiration.

As many children do, I grew up dreaming of being an astronaut. I stared at posters of space shuttles and a ceiling covered with glow-in-the-dark stars as I drifted off to sleep. Eyes-closed, I dreamed of visiting Jupiter, Saturn, of seeing the inside of a black hole, and imagined what the ‘edge of the universe’ might look like. I yearned to go to space and see the Earth, planets, stars, and universe from a new perspective.

I continue to marvel at the wondrous achievements that companies like Space-X manage to achieve. Yet I can’t help but feel like we’ve lost our way. Through the steady privatization of space travel, capitalism has extended its hegemony toward the final frontier. While NASA struggles to get us back to the Moon, billionaires posture and flex their dominance over the Earth by their capacity to leave it behind. Certainly, the Space Race was fueled by a similar posturing with nationalist ambitions, and it was tainted by its underlying mission to deliver nuclear warheads more efficiently. But somehow it felt more inspired, more poetic as the technologies that assured our mutual destruction simultaneously propelled our species further outwards into the Cosmos.

The nations whose rivalry drove the development of this technology finally came together with the construction of the International Space Station. This historic endeavour has delivered decades of groundbreaking scientific research in the interest of all humankind. It was *our* collective pursuit. One that brought humanity together in the pursuit of knowledge.

Today, we are sold the commercialization of space as ‘democratization.’ Corporate interests will purportedly make the stars accessible to the masses in ways that a bureaucratic institution never could. Certainly, I may be able to travel to the edge of space within my lifetime, despite not becoming an astronaut. However, this commodification of childhood dreams changes our relation to space.

As with many promises of democratization, it becomes a machine for furthering the gap between those with and without. Our skies become polluted with swarms of profit-producing satellites and our ambition for returning to the Moon shifts from the human drive to see how far we can go, to mining its vast resources. Space becomes yet another resource to be exploited, suffering for it as so much of our own planet already has. Commodification strips space of its poetic quality, its mystery which arouses our curiosity so greatly—its capacity to elicit poesis, to inspire us to make something new.

We need a renewed perspective on the Universe. One which is not clouded by the ego of out-of-touch CEOs but is fueled by childhood dreams of what lay beyond our skies. Carl Sagan saw the universe as something which can help us to understand ourselves. In *Cosmos*, he continuously reminds the viewer of how looking outward enables us to see deeper inwards. [21] Even external observations are often motivated by intrinsic questions of self-reflection. For example, the persistent existential question of ‘our place in the universe.’ We seek to belong [3], not only as individuals, but as a species. We yearn to find our place in society and in the Cosmos.

The social Virtual Reality (VR) experience, *Star-Stuff*: a way for the universe to know itself, began as a ‘happy accident.’ One born from listening to that childhood voice of intuition when a particular aesthetic emerged through open experimentation. Here, I will describe how playful experimentation, listening to intuition, and inspiration from scientific knowledge led to the creation of a simple yet profound moment for ‘the universe to know itself’ from a new perspective.

### Inspiration & Guiding Principles

In creating *Star-Stuff* I was inspired by several beautiful and awe-inspiring VR experiences beyond *Cosmos*. In particular, I was inspired by the perpetually relevant work of Char Davies which identified and challenged the same problematic assumptions about VR that we face today. VR is an embodied experience [13] and as Davies did with *OSMOSE*, I seek to incorporate the body within the experience rather than leave it behind. [8] I aim to go beyond simulating everyday experiences, instead re-framing the immersant’s perceptions to offer an expanded view of reality.

I am also inspired by *Spheres*, a VR journey through space and time. [18] Instead of struggling to evoke the scale of the planets and universe as many space-oriented VR experiences do, *Spheres* gives us a god’s-eye perspective where the planets become instruments. Immersants play with the Solar System and fall into the depths of a black hole before traversing the history of the universe back to Earth. In the same vein *Star-Stuff* seeks to allow immersants to playfully dance with the stars.

*Star-Stuff* also builds upon my previous immersive artworks, *Body Remixer* [9] and *Transcending Perception*. My VR experiences are what Bourriaud refers to as relational artworks. They aim to create “free areas, and time spans whose rhythm contrasts with those structuring everyday life...” [7, p.16] I use VR to re-frame participants’ perceptions so that they might see a stranger in the same light as they see a friend or even themselves. I seek to create social affordances which encourage self-expression and inter-human connection. By altering social norms and temporarily hiding superficial appearances I hope to make immersants feel more connected, not only to those who they interact with but humanity at large. To achieve this, I give participants room for interpretation and appropriation [14] so that they might make the experience their own.

These experiences are not about some external narrative or the content of the experience itself so much as they are about re-framing immersants’ view of themselves and those who they meet. As such, in developing these experiences I endeavour to consider the many trajectories which may unfold [4], supporting entry into the experience through progressive engagement [11] and giving space for connection, discussion, and reflection when possible. Importantly, I consider where the experience might lead immersants long after their experience—how might it reshape their perspective on themselves, humanity, and the universe? Even if only in a small way.

### Design Process & Decisions

*Star-Stuff* began as an artistic experiment. A VR sketch of sorts wherein I was exploring different aesthetics of abstract bodies that could fit the aims of a VR performance I was working on. Exploring various possibilities in Unity’s VFX Graph, I created several such sketches. While I found what I was looking for, along the way I created many rejected sketches. Yet, while they didn’t fit that project, each seemed to offer up its own potentiality for future projects. One in particular, that traced triangles from random vertices on the surface of a mesh, reminded me of the appearance of constellations. Rather than leave it abandoned as a failure, I investigated where such an ‘accident’ might lead.

### Constellation Body Aesthetics

I began by making the visual effect more constellation-like, adding flickering stars to the vertices and varying the brightness and size of the traces and stars. While in the original sketch I had sought to erase connections that did not conform to the body, now those long connections between ordinarily disparate limbs were desirable and fitting (see Figure 2).

**Asymmetric body representation.** From the beginning, *Star-Stuff* was conceived as a two-player telepresent experience that would enable immersants to interact and play with each other in a unique way. As such, the design of the virtual body was critical in how immersants would experience themselves and others in the experience. Typically I would emphasize the use of a synchronized first-person full body representation and a virtual mirror [9, 10] as these can facilitate embodiment. [23, 12] However, in this case the traces

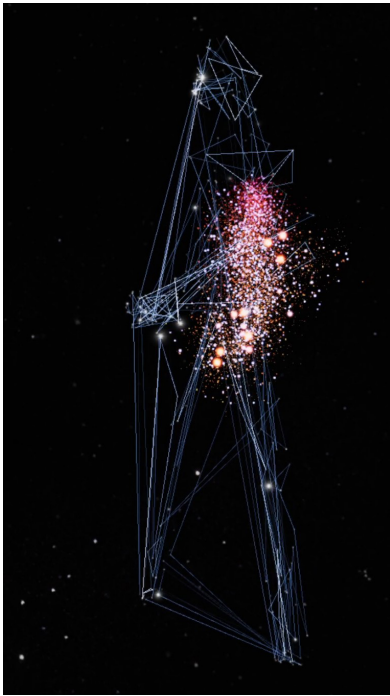


Figure 2: The constellation body. Immersants see others represented in this way. Photo by the author CC BY-SA 4.0.

of the constellation body interfered with the view of the rest of the experience. In light of this I showed only the hands (see Figure 3). My aim was to direct immersants to their capacity to interact using their hands while guiding their attention towards the other immersant's body rather than their own. Given that a mirror would not make sense in the context of this experience, I relied instead on immersants' interpretation of other avatars as a mirror of their own appearance.

**Altering perception of self and other.** The hands were tracked using the Oculus Quest 2 allowing for a very high-fidelity representation. While there is considerable flexibility in how VR representation can be extended to bodies considerably different from our own, [25] a need for precisely responsive hands was identified in my experience developing earlier VR experiences including *Body Remixer* [9]. The hands used in *Star-Stuff* are very visually abstract; however, agency over that abstract appearance is supported by precise movement and scaling of the hands and fingers.

Embodying an avatar can reduce our implicit biases towards others through increased association. [17] In this way, the common appearance of the hands and bodies is designed to evoke a sense of oneness by allowing immersants to see their fundamental sameness as "being made of star-stuff." The experience temporarily suspends superficial appearances and allows immersants to see one another from another perspective.

Moreover, altering the responsiveness of one's virtual representation can affect the perception of the physical body, making it feel heavier or lighter. [16] In *textitStar-Stuff* the constellations do not directly and immediately follow the

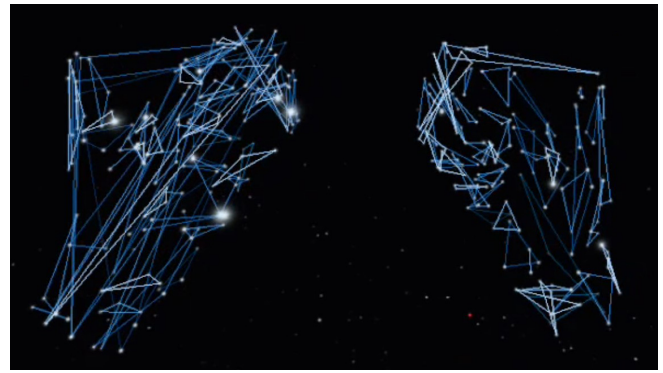


Figure 3: Constellation hands are all the immersant sees of their own body. Photo by the author CC BY-SA 4.0.

body and hand position, but are instead attached through a virtual spring and damper. This was used to make immersants feel larger-than-life while also encouraging slower, meditative movements.

The hands were represented using 19 joints each while the entire body of the other immersant is represented using only 22 joints. However, social presence can be elicited by a simplistic array of as few as 13 dots so long as those dots are dynamic and moving. [5] The Quest 2 is limited to tracking head and hand positions so *Star-Stuff* uses Root Motion's VRIK inverse kinematics plugin<sup>1</sup> to estimate the position of the body from those 3 basic points. This can result in an awkward misaligned representation as the system is unconstrained. The movement is simultaneously familiar yet uncanny, resulting in a desirable humanoid yet alien appearance.

**Intimate stellar heartbeats.** Going beyond the more direct constellation representation I created a virtual galaxy which was emitted from and orbited around immersants' bodies. I decided to generate the stars from the immersants' heart to try to evoke a sense of intimacy. As heartbeat has been shown to evoke intimacy in VR, [15] the stars are emitted in a heartbeat pattern, pulsating at 60 beats per minute. The stars' birthrate, initial velocity, colour, and brightness all vary with this simulated heartbeat. As can be seen in figures 1, 2, and 4, new stars are redder and that redness pulsates, slowly dissipating as the stars go off to live out their own independent lives. While the current version is solely visual and artificial, future versions will incorporate heart rate tracking and audio feedback to further reinforce this effect.

### Simulating Galaxies with Particle Systems

The constellation bodies and stars which comprise the galaxies are simulated using Unity's VFX Graph particle system.<sup>2</sup> I wanted the experience to be aesthetically enjoyable while allowing immersants to implicitly learn about the Universe. As such, the design was a compromise between a realistic portrayal and an aesthetic which fits the artwork.

<sup>1</sup><http://www.root-motion.com/finalikdox/html/page16.html>

<sup>2</sup><https://unity.com/visual-effect-graph>



**Realistic stellar evolution.** The stars follow a life-cycle inspired by actual stellar evolution. [19] Each star is generated with a random mass which determines how it will evolve. The smallest stars are dim white and red dwarfs that have the longest lifespans. These stars stay relatively static over their life, quietly fading away as they reach maturity.

In the middle of the range are the ‘main-sequence’ stars like our sun which vary in colour from orange to bright yellow. These stars have considerably shorter lifespans and transform into red giants as they reach maturity and run out of fuel, simulating the life-cycle of our own sun.

The most massive stars in the simulation are blue giants. These are the brightest and shortest lived stars, lasting only a few seconds before they implode. These massive stars have a chance of producing a supernova proportional to their mass. The immersant can watch as these huge stars grow and then collapse before bursting into a brief bright flash of light.

The life-cycle of the stars varies between 5–100 seconds, creating considerable variation in the stars’ appearance while allowing their life-cycles to be witnessed. The pacing was arrived at through repeatedly testing the experience to find a rate at which the general mass of stars seem to linger forever while focusing on a singular star reveals its dynamic and evolving nature.

**Emergent patterns from two-body gravity.** The movement of the stars is simulated using a modified gravity simulation. Simulating the actual gravitational relationship between tens of thousands of stars would be far more than the Quest 2 could handle. Instead, a two-body gravity simulation is used. Every star is attracted towards a center of mass at the approximated hip location of each immersant. To encourage the emergence of a galaxy-like aesthetic, the stars are accelerated tangentially around the hips’ vertical axis and stars that stray too far from this disc are drawn back in. Scrolling Perlin noise is used to randomize the forces acting upon the stars.

This layered simulation produces results that are simultaneously emergent yet consistently fall into a predictable overall aesthetic that evokes the appearance of a spiral galaxy. I wanted control over the stars to remain somewhat elusive to evoke their mass and power. Basing the gravity simulation around the hips gives participants limited control over the stars’ behaviours. The stars tend towards staying lower on the body, keeping the immersants’ view of each-other clear. Immersants can drastically alter the orbits of the stars by crouching or leaning over as the stars will begin to orbit more vertically. Moving between crouching and standing can lead to a resonant oscillation of the stars that begins to look like waves, evoking the sensation of standing in a cosmic ocean. By moving closer together or further apart, immersants can greatly vary the paths that the stars take by shifting the centers of mass.

**Preventing simulator sickness.** Standing in space amidst stars that continuously rotate around you has the potential to cause motion sickness. As such, I carefully considered and tested the disorientation and discomfort caused by the experience. The pacing at which the stars orbit the immersant are a carefully tuned balance between facilitating interaction and optimizing comfort. Stars that move quickly respond to

interaction more readily, but can lead to disorientation. I arrived at an optimized pacing through repeatedly testing different speeds until I found something that was fast enough to respond but slow enough as to cause no discomfort. I then tested the experience with friends and family with varying prior VR experience. The resulting pacing fit well with the meditative nature of the experience.

Originally, I had assumed that a ground plane would reduce disorientation and motion sickness; however, in this case it had the opposite effect. When it was combined with the orbiting stars it seemed to provide an overly strong frame of reference which led to rapid disorientation even at low star velocities. In the end, simply providing a static star background provided the best outcome.

## Fluid Interactions

I also wanted to give the immersants a direct and playful way to interact with the stars while remaining calm and meditative. To accomplish this, I incorporated a simple fluid simulation which treats the hand as a point in the stellar ether. Stars closer to the hand are quickly accelerated up to the velocity of the hand while those farther away are effected less up to a 0.5 meter radius. This evokes a sensation similar to splashing in water.

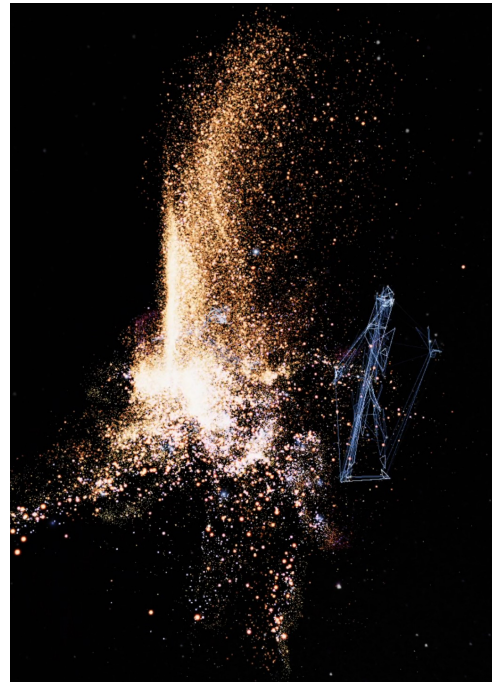


Figure 4: One immersant splashes stars into a huge column. Photo by the author CC BY-SA 4.0.

I wanted to avoid more rigid interactions typical in VR experiences as the stars would then lack any weight or inertia. Instead, the stars respond in a way that evokes a subtle sensation of resistance. This kind of response can evoke tactile sensations known as pseudo-haptics [20] which have been reported with similar small virtual objects such as butterflies.



[6] Slow, careful movements barely disturb the stars while fast sweeping ones can launch the stars into huge columns as seen in Figure 4. To encourage further opportunities for meditative interaction, I also allowed immersants to catch stars if they were gentle enough. By holding a hand out in the path of a star they could catch it; however, moving too quickly would cause the star to evade them.

This design allows for an experience that is equally playful and meditative and open to a broad range of interactions allowing immersants to appropriate it for their own use. *Star-Stuff* is equally engaging whether standing still mesmerized by the stars' evolution and movement, carefully catching stars and reaching out to the other immersant, or making bold expressive movements that form ethereal sculptures in space.

## Sound Design

The sound design for *Star-Stuff* took a relatively basic approach as I wanted to focus immersants' attention on the visual experience. Thus, the sound design focused on encouraging immersion. Immersants hear a spatialized rumble from their own bodies as well as their partners', evoking a subtle but important sense of auditory presence. The choice of music for this experience was essential to immersion and was an intuitive and serendipitous choice. I had been listening to Dale Nichols' music<sup>3</sup> as he is creating the soundtrack for the main project which *Star-Stuff* spun off from. I kept coming back to the same two intimate and entrancing piano pieces throughout development, and as such asked to incorporate these fitting pieces into the finished artwork. The result is a soundtrack and visual experience that are enmeshed with each other, rounding out the experience into a finished product.

## Simple Telepresence

*Star-Stuff* was designed to provide telepresent experience in the simplest way possible. It uses Photon PUN 2<sup>4</sup> to synchronize immersants' bodies across multiple headsets using only the position and rotation of the head and wrists. This allows immersants in the same room or on opposite sides of the world to connect with relatively minimal lag and bandwidth. The telepresent version randomly connects a pair of immersants while the co-present installation always connects the headsets in the same room. Randomly connecting immersants is intended to evoke curiosity through anonymity. Immersants might plan to meet each other in *Star-Stuff* at a particular time, yet they cannot be sure that the other body they see is the friend with whom they had arranged a meeting.

The rest of the body is extrapolated using VRIK inverse kinematics. This allows for a full-body representation while minimizing the bandwidth required for synchronization. The simulation is run independently on each headset. While this results in some subtle asymmetry in the experiences, it is sufficiently deterministic to reliably transmit immersants' gestures and interactions.

<sup>3</sup>Dale Nichols' music can be found on Spotify and Apple Music.

<sup>4</sup><https://www.photonengine.com/en-US/PUN>

The experience is limited to two immersants to encourage an intimate experience. The ethereal bodies are designed to acknowledge their lack of physical presence while still evoking a sense of social presence. While touching the other's body is not likely to evoke any tactile sensations it is designed to encourage a sense of 'visual touch' akin to that described in PluginHUMAN's [*i miss your touch*] [22] where immersants interact with and touch each other's bodies as if they were physically present.

## Becoming a Galaxy

These design decisions come together to produce a conceptually simple experience that leads to relatively complex emergent and dynamic interaction. It allows for a peaceful moment to contemplate our place in the universe or a vast playground to meet and experiment with friends and strangers.<sup>5</sup>

The experience is designed to slowly and steadily immerse the user in the experience. It begins with the same quote that this paper opened with, drawing immersants' attention to their poetic relationship with the universe as "a way for the universe to know itself." [21] In this initial phase they can only see their hands and no stars are generated, giving them some time to become acquainted with this new view of themselves. Once the quote ends the system connects to the server and tries to connect to another immersant. Once connected, the galaxy stars begin to be generated. The galaxy shape slowly emerges over the first minute or two. When the system successfully connects with a second immersant their body slowly fades into view and begins generating stars. Immersants start 3 meters away from each other giving them room to interact independently or choose to come together.

Through this networked social experience *Star-Stuff* aims to utilize proven strategies for connection including play, reflection on unity, and a shared transcendent experience to evoke a sense of connection to humanity and the universe [24].

## Exhibition

*Star-Stuff* was exhibited at the hybrid VR festival, textitV-Unframed at Vancouver's Centre for Digital Media in October, 2021. Over 500 people attended the COVID-19 safe event over the course of 3 days.

## Physical Installation

Despite being conceived for telepresent use, *Star-Stuff* was easily adapted to a co-present physical installation. Two Oculus Quest 2s were used with parallel virtual spaces to facilitate social distancing as shown in Figure 5.

While I would ordinarily calibrate virtual spaces so that the physical and virtual overlap, here making them parallel allowed immersants to experience *Star-Stuff* in a way similar to how they would have connecting remotely from home. The offset simultaneously provided a COVID-safe interaction between strangers and afforded interactions uniquely possible without a physically synchronized other. Immersants could hug, dance, play, fight, and even walk through each other without fear of losing tracking or running into anyone.

<sup>5</sup>A video of *Star-Stuff*: <https://youtu.be/eRukMyGcVcI>.

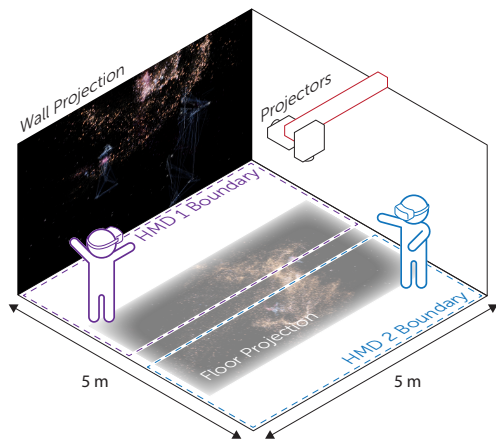


Figure 5: Layout of Star-Stuff at V-Unframed.

A large projection reflected the virtual space like a mirror to evoke curiosity and give onlookers a glimpse into the experience. A second projection was directed at the floor for subtle ambiance. The stars' orbits were faintly visible and occasionally splashed onto the immersants' physical bodies, further reinforcing the connection between their bodies and the visuals.

Fairy lights were used as a pragmatic compliment to the installation's aesthetic. The Quest 2 tracking performed poorly with the matte black curtains on one side of the installation. The fairy lights provided a fitting point of reference which significantly improved tracking performance as seen in Figure 6.



Figure 6: The physical arrangement of *Star-Stuff* at *V-Unframed*. The immersants are right next to each other in the virtual experience despite being physically separated. Photo Julia Read, 2021 CC BY-SA 4.0.

## Observations

From opening to closing the experience was continually in use. There were only a few brief moments where the installation was stopped to replace a headset that had run out of battery or encountered technical difficulties. As a result, it fully occupied myself and one volunteer in initiating immersants into the experience and managing the lineup. Due to its popularity I was unable to conduct interviews as initially planned; however, here I present my observations which were captured in photographs and field notes.

**A simple yet engaging immersive experience.** Participants consistently lingered much longer than expected. From the outside it sometimes looked like they were not engaged but they seemed to get lost in the experience and would easily spend 8 minutes with the installation whether engaging actively or standing still. This timing aligns with the duration of the two songs used for the soundtrack so it's possible that immersants assumed the experience was over when the music stopped. At first, we left immersants to play freely, but it quickly became clear that we needed to limit interaction to 4 minutes to keep the line manageable. Fewer than 10 immersants removed the headset in less than this 4-minute limit, suggesting most were quite deeply immersed and engaged with the experience. Many commented as they left about the fitting choice of the music and how it 'made the experience.'

**Slow immersion into another reality.** The slow introduction of various elements seemed to work well. Despite having seen the projections immersants were still surprised to see their hands and another body appear in the experience. Each new element was frequently accompanied by an audible gasp as immersants recognized their virtual hands and this strange other being standing across from them.

**Intuitive and open to exploration and appropriation.** While a few immersants were unsure of 'what to do' or 'what the experience was about' most engaged with the experience freely with minimal prompting. Facilitators only had to guide immersants to look at their hands, the other body, and to try 'playing with the stars as if they were water' to encourage exploration. Most immersants recognized their constellation hands as their own when asked 'can you see your hands?' However, on some rare occasions they had to be guided a bit before making the connection.

I observed a wide variety of engagement from standing completely still to dancing or sometimes moving very erratically about the space. The slow orbit seemed to provide more timid participants with a dynamic painting to watch as it changed shape on its own. Meanwhile, the splashing interaction provided a natural way to engage more actively and invited playful exploration. Regardless of how they engaged, immersants regularly seemed to have enjoyed the experience suggesting that they may have been able to appropriate it to suit their personality, interests, and level of comfort.

**Real social behaviours in virtual space.** I observed many repeated social behaviours ranging from aversion to dancing and hugging. Many immersants would share their stars with

their partner by splashing them in their direction, like splashing someone while playing in a pool. I saw several pairs touching their hands together as shown in Figure 7 in what seemed to be the most common form of visual touch afforded by the experience. Despite not physically touching, immersants could be seen behaving *as if* they were touching, keeping their hands in close contact without passing through the virtual body, moving them together side-to-side.



Figure 7: Two immersants touch each other's virtual hands. Photo Julia Read, 2021 CC BY-SA 4.0.

The interaction seemed to vary considerably depending on immersants' existing relationship. While some strangers would interact playfully with each other, often the pairing was uneven, with one extroverted immersant directing their attention towards the other, while the other immersant seemed to just want to do their own thing. Some could even be seen avoiding the other immersant and one person specifically complained that the other virtual body kept invading their space despite physically being at least 2 meters apart at all times. This suggests that the abstract constellation body evoked a sufficiently strong sense of social presence to elicit a proxemic response. [2] This evasive strategy also aligns with the equilibrium theory of intimacy [1] and suggests that perhaps more could be done to encourage a shared level of intimacy in the experience. It is possible that the experience would be less invasive in a purely telepresent setting and that this aversion may have been the result of the stranger's physical presence.

On the other hand, families and friends were observed exhibiting very close and intimate behaviour. Children played and ran around each other, sometimes subverting the system by overlapping their bodies or peaking out from under the headset. Several people were seen hugging virtually. While they were not physically aligned, they embraced each other's avatar as if they were (see Figure 8). Some immersants also danced together in a variety of styles including ballroom dancing with one hand on the shoulder and the other holding hands.



Figure 8: Left: immersants hug virtually. Right: their offset physical hug. Photos Julia Read, 2021 CC BY-SA 4.0.

All in all the installation was very well received and was a favorite among those interviewed by the event coordinators. Despite the long line and short timeframe to visit other installations, several immersants returned for repeat playthroughs. Sometimes they just wanted to go back in and explore, while other times they brought a friend or family-member to share in the experience. One person in particular returned at least 4 times over a two-hour period. As the exhibition was drawing to a close I let them play freely with their sibling for over twenty minutes.

While the parallel experiences worked well overall it did evoke some confusion about the identity of the other. In some cases this was interesting as immersants commented on the other body being a reflection of themselves or some other remote body, not connected to the person they had entered with. However, for the most part immersants seemed to make the connection and were simply confused by the discrepancy between the visuals and sound. In the future I would likely have the immersants either completely co-located so that they can physically touch, or would have the immersants offset but facing each other rather than being completely parallel.

## Conclusion

By following an intuitive design approach inspired by an originally 'failed' design I created one of my most successful immersive experiences. *Star-Stuff* was not conceived from a precise or specific plan but emerged through an iterative, intuitive process that was free to meander and develop as needed. The result was a meditative yet playful experience which fits Carl Sagan's vision of renewing our perspectives of ourselves by looking out to the Cosmos. Immersants could connect with each other in a new way while simultaneously learning about the evolution of stars. Observing interaction at *V-Unframed* allowed me to see the joy and curiosity it evoked in immersants while better understanding the interactions it affords and improvements that might take it further. *Star-Stuff* demonstrates that abstract immersive social experiences can bring humans closer together, inspire a new generation, and provide a new "way for the universe to know itself."



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## Author Biography

John Desnoyers-Stewart is an interdisciplinary artist-researcher who creates immersive installations and performances to encourage new perspectives on immersive technology and to better understand its true potential. Through his artwork and research, he hopes to encourage social connection and collaborative creativity by exploring positive social applications of abstract embodiment in virtual reality.