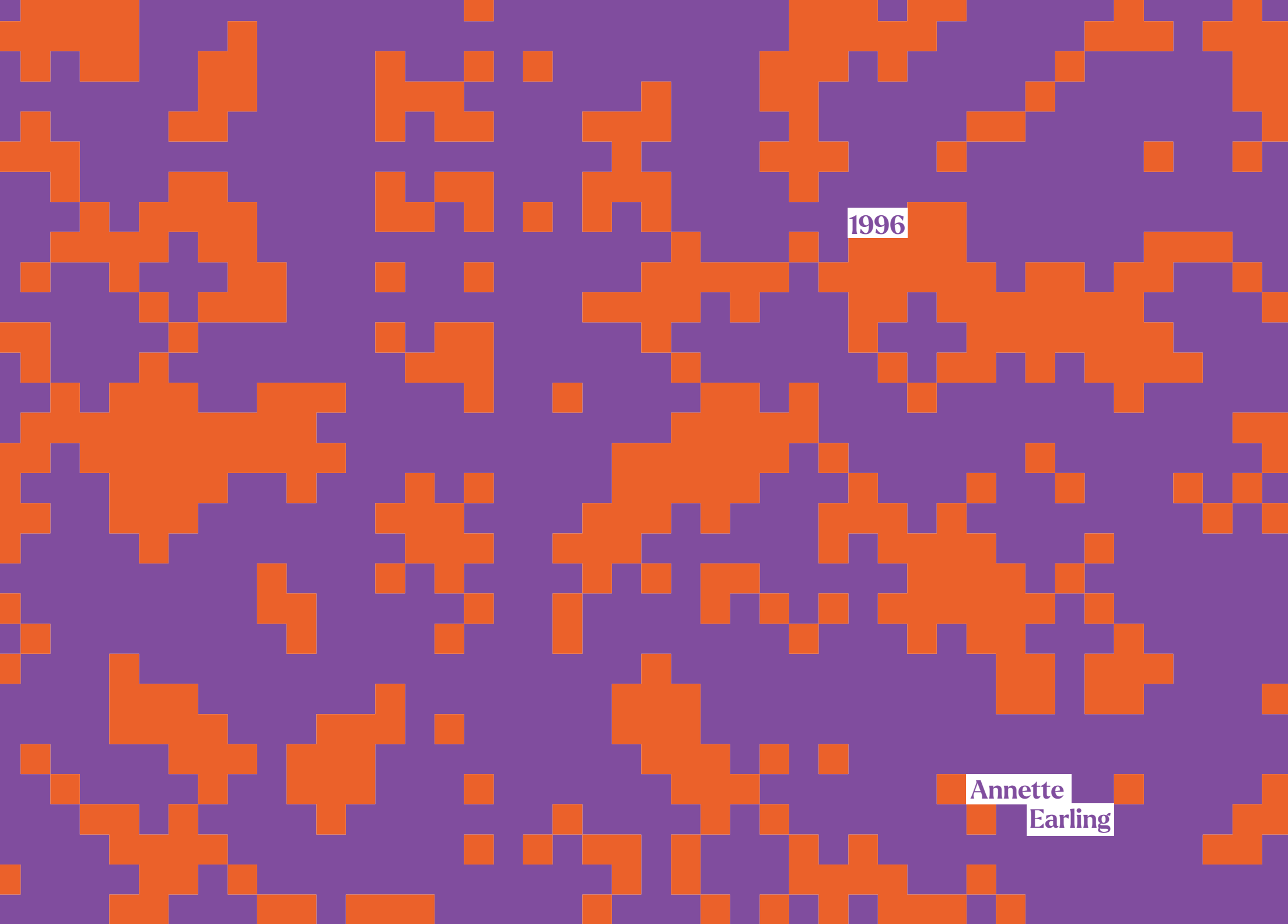
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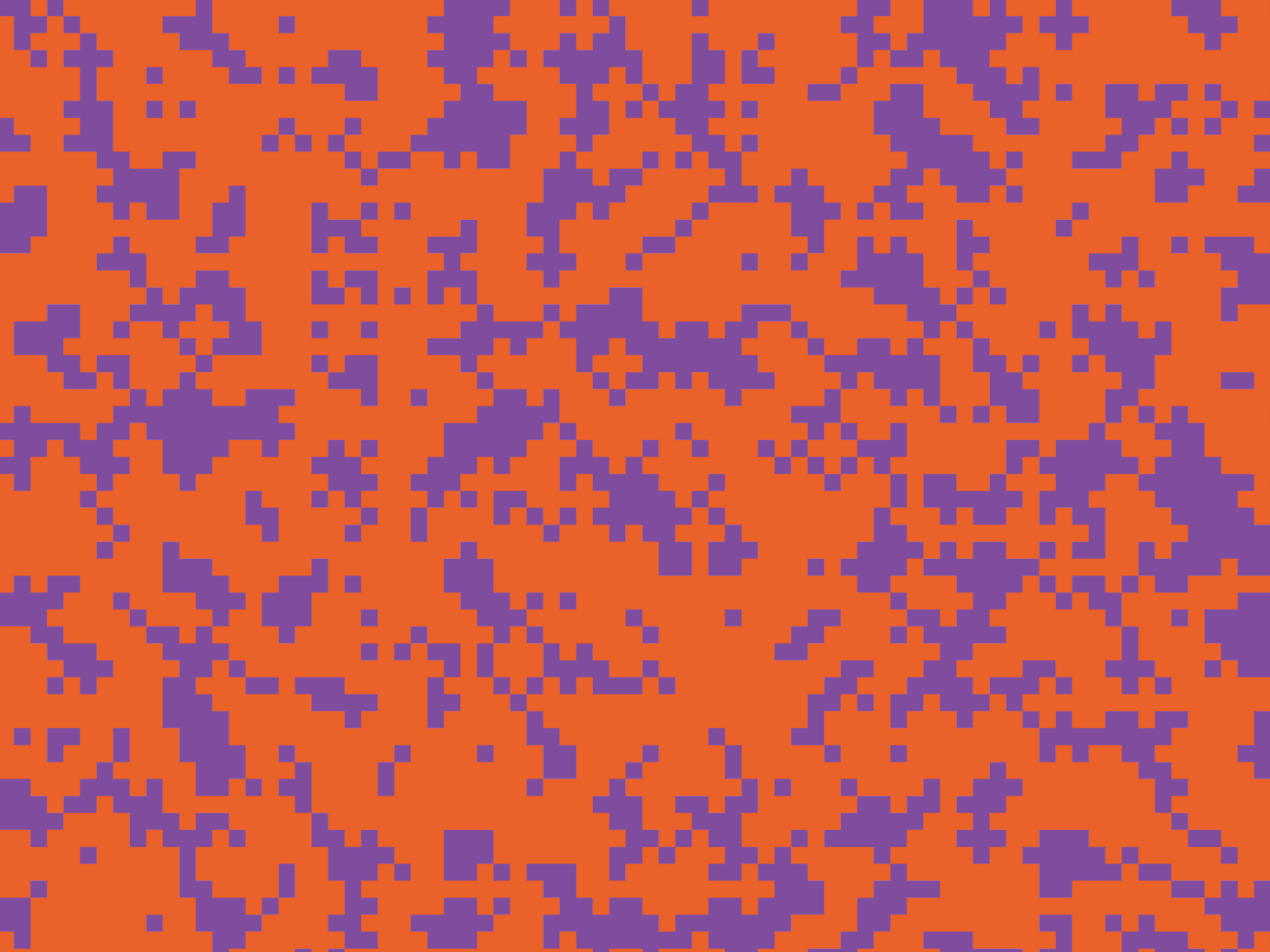
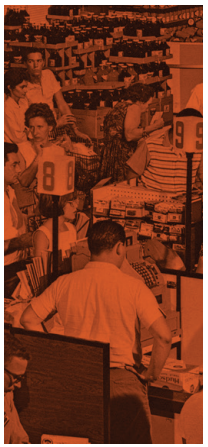


Do Computer Games Fry Your Brain?

March 28, 1996

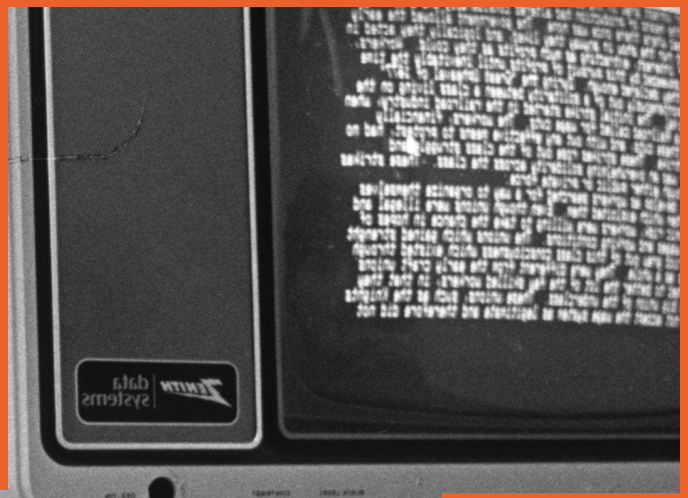
Written By Annette Earling



Walking through the aisles at the local Acme, trying to decide between Honey Nut or the new Frosted Cheerios, I notice how perfectly one set of cereal boxes would fit in with the gap on the row below it. Running doggedly around the track at the Y, bored out of my mind, I find myself focusing on the brick wall and calculating which direction I'd have to rotate those slightly darker bricks to make them fit in with the uneven row of dark bricks a few feet lower down the wall. Going out to get some fresh air after hours of work, I rub my watery, stinging eyes, look up at the Philadelphia skyline, and wonder, "If I flip the Victory Building on its side, would it fit into the gap between Liberties One and Two?"

Some of you will suffer a pang of instant recognition upon reading the above. The rest will speculate on the wattage of my porch light. I'm not suffering from a mental deficiency, but rather from something far more insidious — the Tetris Effect, one of the bizarre and frequently undiscussed side-effects of computer video game and virtual reality use, sometimes known as "Cybersickness."

An article in the July 1995 issue of Technology Review describes virtual reality as "any technology in which a person interacts with a computer-generated world that appears more or less real." Lately the term has come to describe more advanced computer-generated worlds which require special goggles and gloves that respond to the motions of the player, sometimes strapped in to a free-standing harness allowing complete body motion, a la Pierce Brosnan's wild rotations in Lawnmower Man. However, video and computer games, while not commonly perceived as VR, are considered subject to the same risks.



Up until a few weeks ago I had never heard of cybersickness or the Tetris Effect and didn't have a name for what was happening to me, although I could describe the symptoms perfectly. Raised pulse rate, tightened stomach muscles, strange dreams, and the squares... ohhh, the falling squares. I saw them everywhere, and when I didn't see them in skylines or grocery aisles, I had only to close my eyes and there they were behind my eyelids, falling faster and faster as I furiously rotated them mentally. Finally I saw an excerpt of a submission to RISKS Digest, an on-line journal that discusses the risks and side effects of technology.

Garth Kidd, an Internet consultant from Adelaide, Australia, wrote,

"There's a local nickname for the long-term effects of immersion games or simulations—it's the 'Tetris Effect.' Many people, after playing Tetris for more than an hour straight, report being plagued by after-images of the game for up to days afterwards, an ability to play the game in their head, and a tendency to identify everything in the world as being made of four squares and attempt to determine 'where it fits in'. Similarly, Descent players suffer from reflexes that tell them that their car should be fitted with various weapon systems ideally suited for educating their fellow commuters; Civilization players are known to dream that Gandhi is demanding technology from them at threat of war; and a friend of mine has been known to be unable to get out of bed because he's 'out of movement points'."

Annette Earling, 1996

Cereal boxes aside, I wasn't alone, and I wasn't going insane.

I'd always been more of a pinball geek than a video gamer as a kid. I'd had my brief flings with Asteroids, Centipede and Frogger, but remained fairly mystified by the full-time Space Port rats who fed quarter after quarter into the machines, let alone by current tales of ten-year-olds brought up on non-stop Nintendo. Then about a year ago (I've always been a late bloomer) I saw my first Tetris game. It's a fairly simple game as video games go, in which the object is to rotate falling sets of squares to form completed rows at the bottom of the screen. When a row is completed it disappears, but if you leave an empty slot it will be covered over by a non-fitting piece and the screen will fill up with squares until it reaches the top and — ha ha — you lose.

I was introduced to Tetris while looking over a friend's shoulder as she played on a hand-held game that her son had gotten for Christmas. I knew immediately that I was in big trouble, because it took every ounce of my willpower not to grab the thing out of her hands and go hide with it behind the couch. My greedy nature was foiled when her six-year-old son fell victim to my same impulse, and I couldn't very well whisk it away from a child... at least not while everyone was looking.

A few weeks later a colleague at the office installed a copy of Annoying Tetris on her computer. "Annoying" because aside from taking you through varying levels of difficulty, it taunts you during play with obscenities, animal sounds, comments such as "I assume you know what you're doing," and some particularly disgusting bodily function noises. I quickly figured out how to turn off the sound and spent the next four months in Tetris hell. My descent started off slowly enough; a quick game was my reward for a few hours of work. But when I got my own computer at home and installed it on my hard drive, it blossomed into a full-blown obsession. Upon finding me holed up in the study yet again, bathed in the phosphorous glow long after he'd gone to bed, my husband (now my ex-husband... hmmmm... do ya think...? Naaah!) could only shake his head in disbelief.

But my obsession/addiction was only the beginning. My life became a matter of "ooooo, that would fit

in there PERFECTLY" (sexual innuendos notwithstanding). The worst of it was, I could control neither my compulsion to hit the command for "just one more game," nor the increasing after-images and near-hallucinations I was experiencing.

These symptoms brought to mind other unusual reflexes that I had experienced after prolonged computer use. With Macintosh computers, the "undo" function is a combination "command-Z" keystroke. It's used to undo your most recent action, effectively taking you back a few seconds in time, as if that ridiculous paragraph you just wrote had never existed. After a few months of steady Mac use I found myself reflexively hitting the command-Z combination IN MY HEAD, WHEN I WAS NOWHERE NEAR A COMPUTER. If I stubbed my toe or spilled my drink or did another of the awkward gaffes that I'm so prone to, my first reaction was to simply "undo" it. (My second reaction was a vague disappointment that I couldn't, and speculate as to how I could invent an undo button for real life.) Several Mac user friends have confessed to the same impulse, and one revealed that she has a similar problem with the "save" command. If she does something good, for example, if she cooks a particularly amazing bouillabaisse, her first impulse is to "command-S" it, to save that moment for all eternity.

Of course, technology has been changing our ideas and perceptions forever. Even non-computer users can relate to the experience: Remember Jerzey Kosinky's Being There, in which Chance had a habit of pointing and clicking his remote control at unwanted intrusions in his life? And, be honest — since the advent of the VCR, how often have you found your thumb seeking out the "rewind" button when you miss a bit of a real-life conversation? The fact is that computer-generated worlds are demanding more and more of our attention, as they come to be used in the classroom, at work, and at play. The breakneck pace of development demands that we step back a moment and consider the implications of this technology on human behavior, health, psychology and community.

Just one more game.

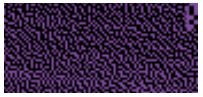
An article entitled Safety Considerations For Current & Future VR Applications, written by Scott A. Klein, Cyril A. Wantland and Subhas C. Gupta, MD, recently appeared in the Medical Infomatics web site of the University of Louisville School of Medicine. It enumerates the side-effects of extended VR and video game use, which are many and diverse.

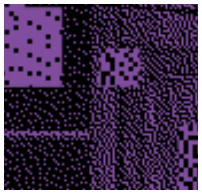
The most well-known of these effects are the repetitive stress injuries that result from, well, repetitive stress. These have been hotly debated for years as secretaries, programmers, graphic designers and others who spend long hours using a keyboard or mouse are plagued by such symptoms as burning, numbness, tingling and paralysis in their arms, hands, necks, backs and shoulders. The most commonly-discussed is carpal tunnel syndrome, which results from unnaturally extending the pinky or other fingers while the wrist remains unsupported. There are many other injuries, with even more ominous names, such as Guyon's Canal Syndrome, Extensor Wad Strain, and DeQuervain's Tenosynovitis. Many of these injuries have been filtered through the video-gamer culture, attaining new names such as Trigger Finger and Gamekeeper's Thumb. The scary part is, these are not merely physical annoyances; if left unchecked they can develop into chronic conditions that result in functional disability for the unsuspecting gamer.

Another type of injury that may seem almost comical at first glance are the immersion injuries sometimes sustained by VR users who become so engrossed in the task at hand that they become unaware of the real world around them and risk acting or reacting inappropriately. In other words, don't play your Game Boy while strolling down a highway median strip.

Annette Earling, 1996

Safety Considerations mentions one risk that seems a little Howard Hughs-esque, but I imagine that game manufacturers must consider it: transmittable disease.





"Airborne pathogens and skin flora thrive in environments similar to those of head mounted devices and hand controllers... Phthirus species is also of concern for VR equipment contacting body surfaces."

That would be body lice. Don't say you weren't warned.

The article also cites "cybersickness," describing it as a variant form of common motion sickness whose symptoms include apathy, headache, fatigue, and the bluntly put, "stomach awareness."

The fourth consideration involves the visual side-effects of VR use, the most common being asthenopia, or simple eye-strain caused by constantly refocusing one's eyes on the many images on a screen which is only inches from the face. More ominous is "binocular dysphoria," a confusion in depth perception that can persist for hours. Next comes nausea, brought about by visual and motion cues that are out of synch, and finally, damage caused by prolonged exposure to the low levels of radiation that emit from video display terminals (VDTs). Much more rarely these electromagnetic fields can cause something called "flicker vertigo," or "video game epilepsy." Sources differ on the window of flicker frequency that is required to provoke an epileptic seizure, but it seems to be somewhere between 8 to 30 flashes per second. A typical television screen flickers at 50 Hz, but advanced software and poor upkeep of computer equipment can put so much stress on the terminal that the frequency drops down to the danger level for some individuals. Most of these seizures are "petit mals," or a simple momentary loss of attention, but some people have suffered full-blown grand mal seizures. According to a world-wide study cited in the October, 1994 issue of The Lancet, two-thirds of video-game epilepsy patients had never before experienced a visually induced seizure. Game manufacturers have thus far avoided being implicated in this phenomena, despite such inflammatory media coverage as "Nintendo Killed My Son," published in the February 2, 1993 issue of (what else) the UK's The Star. However, concern persists that video games may be a causal factor and not simply a trigger, although in January of 1994 Nintendo won a lawsuit brought by a Michigan woman who claimed that her seizure was caused, rather than merely set-off, by one of the company's video games.

One final safety consideration involves the psychological effects that these games can trigger, including disorientation, anxiety, illusory motion sensations (persistent feelings that one is climbing, falling or flying long after the game is over), perceived disturbances in the visual field (hallucinations and after-images... er... ahem!), inappropriate reflexes and disrupted motor control. Astoundingly enough, consistent use of these programs creates new neural pathways in the brain — connections that may not be appropriate paths for brain impulses to travel in real-life situations. (Technology Review mentions a woman who, after using a virtual program designed to show the inside of the human body to doctors and medical students, became so disoriented that shortly afterwards, while drinking from a can of soda, poured soda into her eyes rather than her mouth. After years of anecdotal evidence that fighter pilots trained in flight simulators were experiencing flashbacks and disorientation while driving their cars, and a study that concluded that 14% of helicopter pilots trained in simulators reported motion sickness, and yet other studies that found flashbacks, disorientation, and balance disturbances that lasted for up to 12 hours, the Army, Navy and Marines have decided to ban driving or flying for 24 hours after the symptoms subside in people who have experienced cybersickness.)

Curious about the incidence of psychological side effects on video gamers, I asked friends about their experiences and posted the question on several of the Internet's Usenet gaming groups. Judging from the volume of responses, this is not an uncommon occurrence. These are some of the most interesting:

"After a long game of net-Descent I find that my visual field of concentration is wider than usual and I "spot" more than usual, but that I misjudge speed and placement, tend to "slide" around corners and bank my head when I turn, and rotate my body rather than my head to see things that aren't in front of me... When I was working on ARC/Info GIS, a geographical information system my work was using to digitize maps of land usage... whenever I closed my eyes the veins on the inside of my eyelids would turn to road-maps." -Garth

"I find that after playing for the evening (usually something like WC3 or Xwing) that when I am going to sleep I hear the sounds from the game and also can feel my eyes moving as if I was still looking at the screen." -David

"You're used to driving 300mph on the racing game, then you get in your car and peel out of the mall parking lot like hell on wheels, forgetting where you are." -Michael

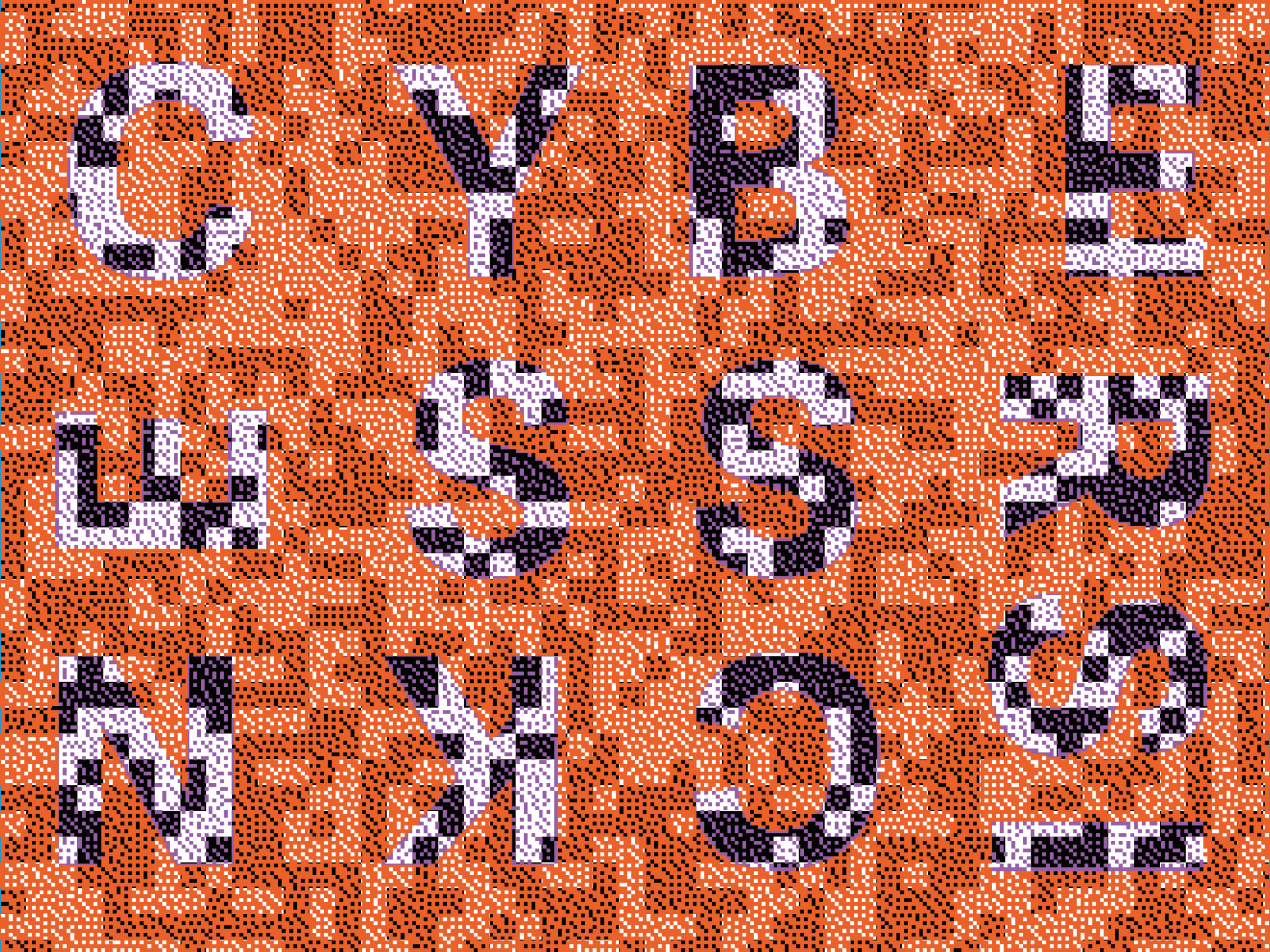
"In my Asteroids playing days, I would find myself reaching for the hyperspace button to escape close calls while driving." -Steve

"I sometimes find that when I do something not the way it I should have done it then I want to do a 'load game'." -Mirko

"When I started playing Descent, I noticed some interesting carry-overs into the 'real' world. Once in a supermarket, on the edge of my field of vision I noticed a bright metallic blue sphere floating in the air (actually a novelty helium balloon) and immediately thought 'Shield powerup!'. I had began to drift toward it before I realized that I wasn't at my computer." -Michael

"After playing a first perspective shooting game such as Doom or Dark troopers for a long stretch, for a few days afterwards, I tend to look at the environment around me much the same as in the game — basically I start at one point, and my goal is to reach another point, no matter where I am going. I map out the floor plan of the best route in my head, even checking off areas I have been before, much like the game itself. And I tend to interact less with the people around me [They ARE the bad guys, after all :)]. " -Tim

"The worst examples of after-images I get are when I play a particular game for many hours in one day. I tend to believe I am playing a modified version of that game, which is usually changed in a way that gives it a darker, more sinister feel. I also dream about games even after a day without them. I once dreamt about a variation of Pac-Man in which he was a cellular creature that copied himself as he ate dots, much like the mitosis process." -Erik



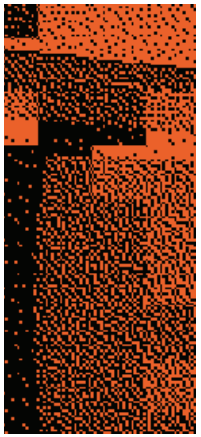
In the July 7, 1995 issue of Business Week, a McGill University psychologist warned,

"This is a totally new phenomenon. It may bring new kinds of emotional disturbances and mental illnesses... There could be some big lawsuits looming."

Video game manufacturers are taking this to heart. Perhaps you'll recall Sega Game's much vaunted Genesis 16 system, an inexpensive VR system developed for home use. After over a year of heavy promotion, all plans were inexplicably trashed and the Genesis 16 has not been heard of since. Sega refuses to discuss the reasons for the withdrawal, but an independent researcher has revealed that 40% of test users were experiencing some form of cybersickness. Many other companies are heeding the warnings and scurrying to develop safer games and products, such as VR goggles with an opening at the bottom that offer the player a view of his own feet, anchoring him in the real world as well as the virtual one.

Annette Earling, 1996

In an effort to better understand the physical and psychological processes of cybersickness, I spoke with Dr. Douglas Chute, a professor of neuro-psychology at Drexel University. Dr. Chute is currently working on computer technology that will assist people who suffer from some cognitive deficit, which is often brought about by stroke, head injury, or the aging process.



After I read him some of the anecdotal evidence cited above, the professor said, I laughed nervously and said, "What would you say if I told you that I recently went through a very long phase of this myself?"

He laughed along with me and said,

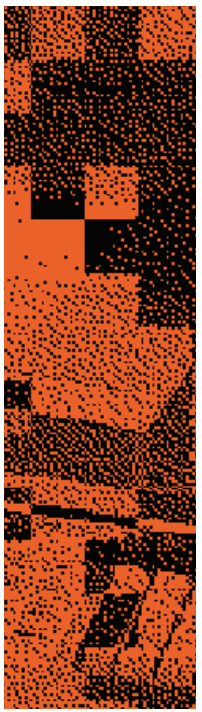
"Frankly, those people sound like they have a lot of problems."

I tried to explain the command-Z and command-S phenomena, citing friends and acquaintances who've had the same experiences, suddenly feeling a desperate need to convince this professor that he was not being interviewed by a psychopath. He said that, certainly, new technology has given us new terminology and a lot of great metaphors.

"How many times have I thought, 'my hard-drive is full', my brain simply will not accept any more information. But these are metaphors, and I imagine that you are speaking metaphorically and not literally... or at least I hope that you are."

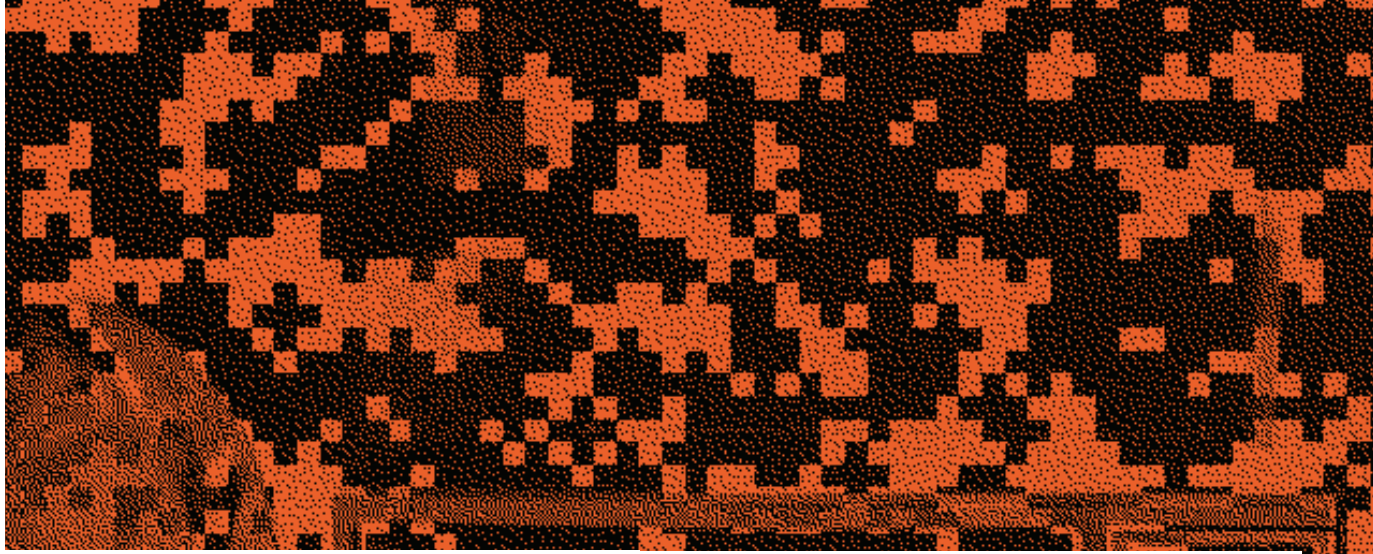
There was a long, awkward silence on my end of the phone call.

"I would suggest that you lie down on my couch and we have a nice long chat."

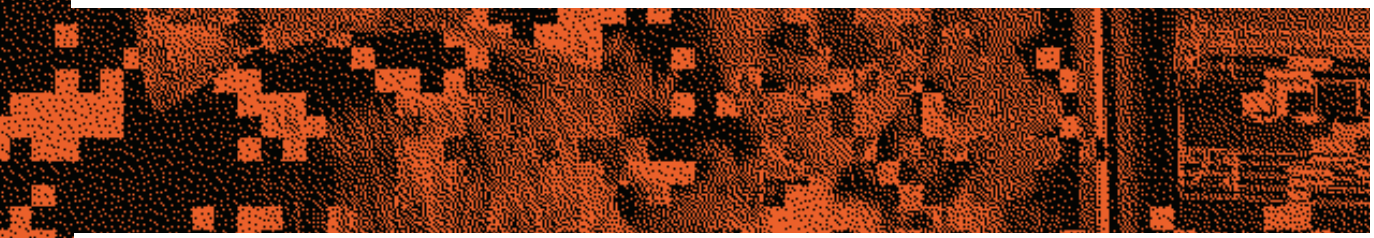


He had much more to say on the physical side-effects of virtual reality, explaining that much of cybersickness has to do with simple motion sickness, and is not at all unlike a child with an upset stomach in the back seat of a car. We all remember Mom's advice — look out the window, not at the back of the seat in front of you, and for god's sake stop choking your little sister. Motion sickness occurs when perceptual information is mismatched; your body and sensitive inner ear perceive the motion of the vehicle, but your eyes see the comic book, unmoving before you. Likewise, in a video game, your eyes are engulfed in a high-speed road race while your body remains still. Scientists call it cognitive dissonance.

He told me that when Universal Studios in Florida built one of its newest virtual reality rides, they had one minor drawback — vomit left by queasy passengers on this fairly tame ride (I mean we ain't talkin' Space Mountain here). The solution was to install complex motion sensors that matched the motion with the visual system, thereby avoiding any cognitive dissonance.

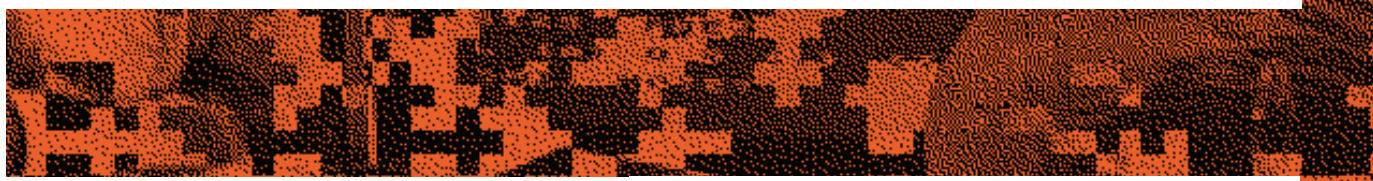


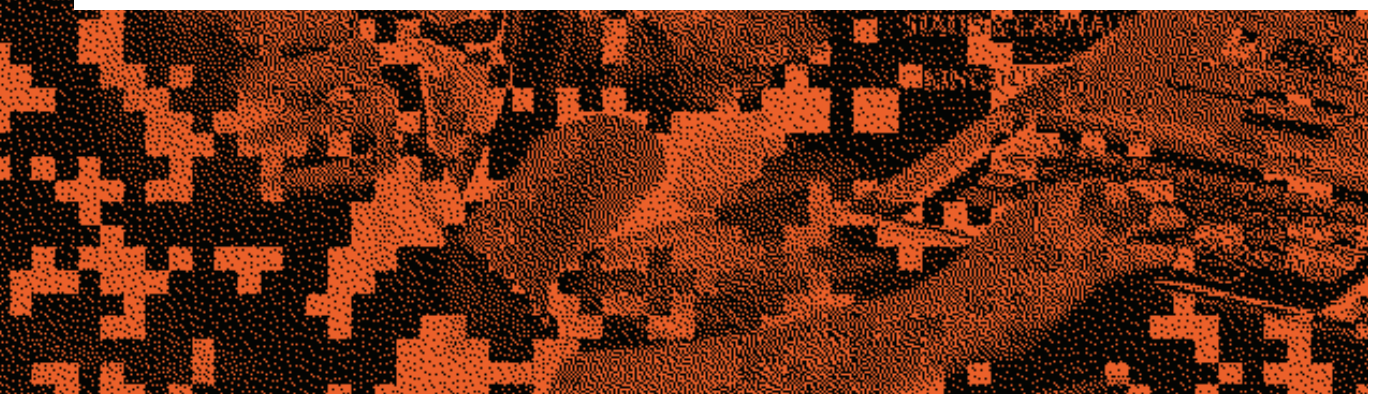
However, Dr. Chute was surprised by my questions about flashbacks, disorientation and after-images. He postulated that these sorts of things "happen to people with a limited capacity. People who have to concentrate too heavily on the task at hand." (Well, yes, it's true, I did get a little too wrapped up in my Tetris games, but I'm not totally convinced that my intellectual capacity is severely deficit.) When I brought up instances of fighter pilots whose ability to drive a car is compromised after using a flight simulator, he said, "NOW you're pushing my buttons! I could go into a 50-minute lecture on this one!" His short version is that the human brain is capable of learning and doing many things.



"You can learn to swim and learn to run the bases on a baseball field, and one does not interfere with the other." We are capable of switching easily from one activity to another, and simply because something is done on a computer, doesn't mean that we should find it difficult to do a similar thing

I brought up the issue of children raised on silicon, and the question of whether or not their left-brain abilities are suffering as a result of the visual, non-linear world of computers, while at the same time they are developing superior right hemisphere skills. Are today's children somehow "different," thanks to computer technology? Dr. Chute maintained that,





"People get good at what they like doing. Computers are very useful in education, but we haven't made anybody 'smarter.' Students today certainly aren't attaining higher grades than they once were, but we are capable of teaching them new skills that were once very difficult to teach. We anguish a lot about it... but from a teaching point of view, the computer is simply another tool."

I left the world of academia to seek information from an industry expert. Jason R. Rich is the president of Teen Talk Communications in Norwood, MA. He is a magazine columnist, author and consultant in the field of video and computer games.

When asked about some of the stranger side-effects of video game use he said that,

"Anything you do too much, whether it be alcohol, drugs or just watching television can cause problems. Yes, if you play a video game for hours on end, you are going to get a headache, or eyestrain, or some of the other symptoms you describe. When you watch television you aren't staring quite as intently at the screen at such a close distance, which is why it's necessary to take breaks from your computer screen."

When I mentioned some of the stranger psychological effects, such as those of the poor fighter pilots, he quickly stopped me.

"The virtual reality we have at home and the virtual reality used by fighter pilots are two very different things. One is a 100 dollar machine, while the other is a 100-million dollar machine. They have the next best thing to "reality." When they put on those goggles, they are cutting themselves off completely from the real world. But our home video games are nothing like that."

Moderation was the solution.

But over the next ten to twenty years, video game and virtual reality technology is sure to improve exponentially. Compare today's Myst with the granddaddy of them all, Pong. What steps are being taken now to prevent cybersickness in users of these improved versions? Rich maintains that while companies are working quickly to develop products such as the aforementioned goggles that prevent complete immersion in the cyberworld, we can't totally eliminate all symptoms.

"People who get motion sickness will get cybersickness if they play these games continuously. But, as in most things, if you start out slow and build up to it, you can prevent it from occurring. True consumer-oriented Virtual Reality is available only at arcades, and there the games last for 5 minutes, tops. And they won't let you continue to play after those 5 minutes are up."

Rich stresses that problems occur only after prolonged exposure to these games and are analogous to problems experienced after excessive exposure to many different types of stimuli.

"In the end, it's really up to parents to control the video game usage of their children. Let them play for an hour, after finishing their homework, or something like that."

Moderation was the solution to my own Tetris obsession. After many months, I became so proficient that I could play the game (literally) in my sleep and flew through every level. The challenge was gone, and now I play only occasionally. Now, when I load a new game onto my computer, I'm more judicious in how often and how long I play. The after-images have disappeared, and I can now walk through a supermarket aisle without incident.

To suggest that video games are dangerous is a gross exaggeration. However, evidence suggests that there are several risks that should be considered in any foray into the cyberworld, and we'd be wise to think about them now before the technology overtakes our capacity to deal with it.