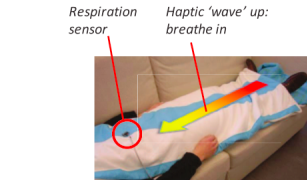

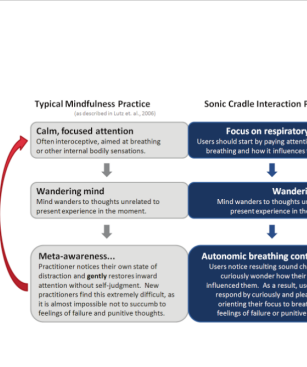
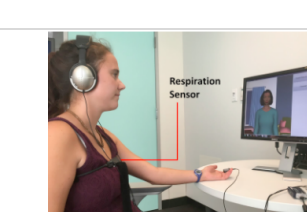
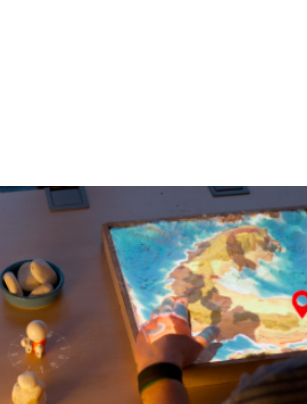
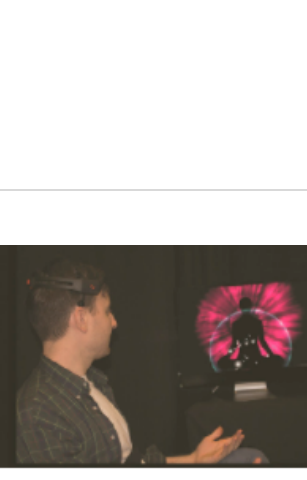
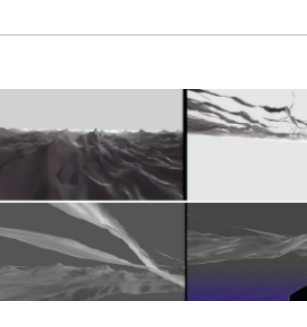
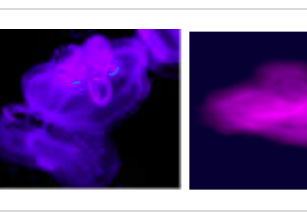

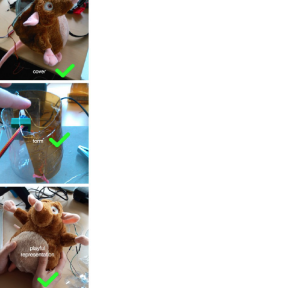

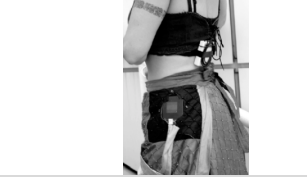
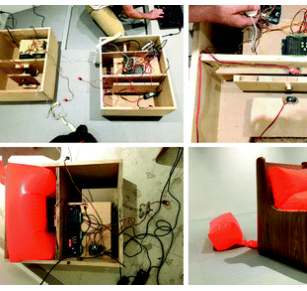
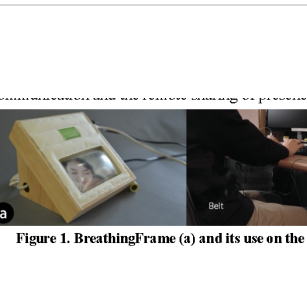

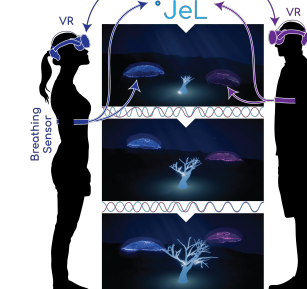
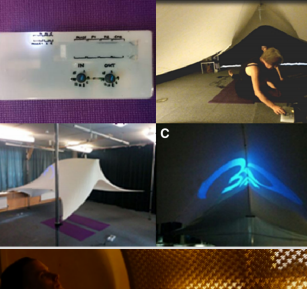
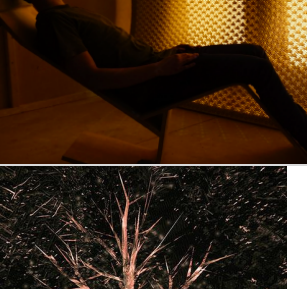
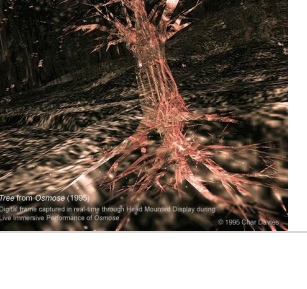


UNIQU E #	details	2. source and full reference	SYSTEM related	3. description and name of the immersive interactive system	year	1. THEORETICAL FRAMEWORK				THEORETICAL		2.1 TECH		2.2. BREATH + TECH		content in direct relation to breath					N of Users	
						1.1 theoretical grouping	1.2 AIM (what does the system do)	MOTIVATION (why this system is built, a big picture)	WHY DESIGN THIS SYSTEM	7. description FRAMEWORK	2.1.1. MEDIA: type of technology	2.1.2 sensor type	2.2.1 OUTPUT TYPE (SENSES breath is translated to : V-visual, A-Audio, H-haptic, VD-M, ...)	2.2.2 OUTPUT composition (content)	2.2.3 Interaction Mapping of Breath (direct, indirect, combo)	2.2.4 CONTENT breath is mapped to	2.2.5 CUES breath is following	interaction paradigm (feedback = SEIf-System-SEIf, paced = S-System-SEIf-S-System-SEIf)	Breath PARAMETERS	paced RATE (fixed or adaptive or combo)		strategy
1		Parnandi et al 2013 "Chill-Out": Relaxation Training through Respiratory Biofeedback in a Mobile Casual Game."	CHILL-OUT	Chill-out: mobile game that supports regulation of breathing patterns (slowing RR) through game mechanics	2013	TF1-regulation	decrease RR	stress	workplace stress related to obesity and chronic, cardiovascular diseases-leading cause for death. Reducing job stress increases quality of life, and economic benefit of employers.	Deep, diaphragmatic breathing activates parasympathetic NS that inhibits sympathetic NS activated during stressful episodes, lowering arousal and increasing HRV = relaxation state	mobile	chest belt	V (mobile game)	destroying marbles with a canon and collecting points	indirect	game mechanics: auto-shooting frequency	/	1: SE-SY-SE	RR	/	negative feedback	1
2		Bumatay & Seo. "Investigating the Role of Biofeedback and Haptic Stimulation in Mobile Paced Breathing Tools." In Augmented Cognition, Neurocognition and Machine Learning, 287-303. Lecture Notes in Computer Science, Springer, Cham, 2017.	X: paced breathing mobile app w audio, visual and haptic feedback	an app for paced breathing regulation with 2 modes of interaction, manual (users set the pace) or biofeedback (RR is measured on baseline and used to start feedback, and upon which the system behaves to decrease it; and 3 modes of feedback: audio, haptic, audio+ haptic)	2015-2017	TF1-regulation	decrease RR	stress	Increasing reports of stress in adults. Stress linked to cognitive and mental health issues. Stress can be alleviated through relaxation methods.	paced breathing stimulates vagus nerve and PNS which helps with stress alleviation and overall relaxation	mobile	chest belt	A, H, A+H: mobile app w audio and haptic feedback placed in the pillow	gong chimes used to direct inspiration and exhalation, as well as haptic feedback from the cellphone	combo: initially set to match the user's breathing rate, slowly increasing the interval to slow down the user's breath.	gong chimes	gong chimes (A), vibration (H)	2:SY-SE-SY	RR	combo: fixed + adaptive	fading off (A,H)	1
3		Abushakra, A., and M. Fezipour. "Augmenting Breath Regulation Using a Mobile Driven Virtual Reality Therapy Framework." IEEE Journal of Biomedical and Health Informatics 18, no. 3 (May 2014): 746-52. https://doi.org/10.1109/JBHI.2013.2281195.	X: VRT app	an app for lung cancer patients for raising awareness of lung capacity and to practice increasing lung capacity (ad oxygen intake)	2014	TF1-regulation	deep breathing, breath awareness	improving lung function	lung cancer patients have decreased oxygen intake, by performing breathing exercises oxygen intake increases	breathing exercise helps patients with lung diseases (cancer, asthma) by reducing stress and increasing oxygen intake	mobile app + VR-3d goggles	microphone	V: mobile app	the system generates visuals of an avatar of the patient around the chest area, gradually penetrating through skin, muscles, and finally approaching the lungs	direct	visualisation of expanding-contracting lungs (V)	/	1: SE-SY-SE	lung capacity and RR	/	expand-contrast (V), quantification	1
4		Wongsuphasawal, Kanit, Alex Gamburg, and Neema Moraveji. "You Can't Force Calm: Designing and Evaluating Respiratory Regulating Interfaces for Calming Technology."	X: mobile app	a mobile app with 2 feedback modes: audio, and visual, for paced breathing (at 6.4 bpm)	2012	TF1-regulation	decrease RR to 6.4 bpm (which causes the highest HRV)	stress	Chronic stress impacts physical, emotional and cognitive health	paced breathing helps with stress and overall relaxation, however calm != lower RR	mobile app	stretch belt	A, V: mobile app with A or V mode	the circle is pulsating at 6.4 bpm. The other circle shows RR of a user	direct	visualisation of expanding-contracting circle (V), sound of water (A)	circle	1+2: SY-SE-SY + SE-SY-SE	RR, amplitude	fixed	expand-contrast (V), fading off (A)	1
5		Moraveji et al 2011 "Peripheral Paced Respiration: Influencing User Physiology During Information Work." UIST '11.	X: desktop interventions for paced breathing	a desktop overlay animation showing a horizontal bar as a visual reminder for regulating bpm	2011	TF1-regulation	decrease RR 20% below resting rate	increase HRV, stress reduction	computer data entry workers experience 26% increase in breath rate. Increased breath rate leads to decreased HRV	peripheral paced respiration can help users regulate their bpm during executing tasks	desktop	stretch belt	V: (desktop app)	the horizontal bar moving up and down across the screen	indirect	/	horizontal bar, vertical movement	2:SY-SE-SY	RR	adaptive	vertical movement	1
6		Ghandeharion, Asma, and Rosalind Picard. "BrightBeat: Effortlessly Influencing Breathing for Cultivating Calmness and Focus." In Proceedings of the 2017 CHI Conference Extended Abstracts on Human Factors in Computing Systems, 1624-1631. CHI EA '17, New York, NY, USA: ACM, 2017. https://doi.org/10.1145/3027063.3053164.	BrightBeat	BrightBeat: changes in screen brightness, headphone volume, and wristband's temperature (they beat in calming frequency, matching user's relaxed breathing rate)	2017	TF1-regulation	decrease RR, regulating slowing RR to 120% of resting rate	stress reduction	a vast majority of population uses technology that could be delivering subliminal, calming effects without disturbing the primary activity, and toward the goal of reducing stress through breathing interventions (hint towards meditation but not explained further)	breathing and calmness,	desktop	chest belt	A+V + haptic (temperature) desktop	changes in the screen brightness, headphone volume, and a custom wristband's temperature that oscillate with a calming frequency (120% resting rate)	indirect	/	screen brightness, loudness of white noise	2:SY-SE-SY	if RR > goal RR (mean RR*120%)	adaptive	intervention on existing application (screen brightness), linear min-max at the frequency of goal RR	1
7		Moraveji, Neema, Athman Adishesan, and Takehiro Hagihara. "BreathTray: Augmenting Respiration Self-Regulation Without Cognitive Load." In CHI '12 Extended Abstracts on Human Factors in Computing Systems, 2405-2410. CHI EA '12, New York, NY, USA: ACM, 2012. https://doi.org/10.1145/2212776.2223810.	BreathTray	Breath Tray: a notification bar in the system tray displaying breath rate calculated each sec breath rate as a percentage of resting breath rate "calm points" resting rate performance: below (blue) resting respiratory rate == breath (in+out) per minute, here the max is 40 (that is too many)	2012	TF1-regulation	decreasing RR to resting rate or lower	stress reduction	stress of information workers is ever present, the authors are looking at finding solution that can augment self-regulating processes without interrupting main task	stress impacts negatively productivity and cognitive abilities, focus is on information workers (high cognitive demand). Paced breathing is one way of self-regulating psychophysiology that has positive impact on stress.	desktop	stretch belt	V (desktop app) widget	information tray displaying: (1) one's breath rate in real-time updated every second, (2) breath rate displayed as a percentage of their individual resting breath rate, (3) earned "calm points", an indicator of recent respiratory patterns, and (4) being below or above one's resting breath rate, which colors the text of the entire display blue or red, respectively.	direct, indirect (calm points); "Calm points" are incremented when the user has been breathing at or below their resting breath rate for over 1 min	breathTray: score (quantified) RR	/	1: SE-SY-SE	RR	/	quantification	1
8		Sonne, Tobias, and Mads Møller Jensen. "ChillFish: A Respiration Game for Children with ADHD." In Proceedings of the TEI '16: Tenth International Conference on Tangible, Embedded, and Embodied Interaction, 271-278. TEI '16.	ChillFish	a game and custom built lego controller with breath input for relaxation and reduction of bpm in ADHD kids	2016	TF1-regulation	lowering RR to 6 bpm	stress reduction and emotion regulation	kids with ADHD have emotion regulation difficulties and higher stress levels	regulating breathing can help kids with ADHD control their stress levels	desktop + input device	thermistors	A+V (game)	a puffer fish (player) collects points. It moves on vertical axis when the player blows the air into it which makes the fish expand and move towards the surface	combo: direct, indirect (stars collected)	a puffer fish, movement on Y axis	stars	1+2: SY-SE-SY + SE-SY-SE	RR, amplitude	fixed	expand-contrast, vertical movement, quantification (game mech)	1
9		Harris, Jason, Sarah Vance, Odair Fernandes, Avinash Parnandi, and Ricardo Gutierrez-Osuna. "Sonic Respiration: Controlling Respiration Rate Through Auditory Biofeedback." In CHI '14 Extended Abstracts on Human Factors in Computing Systems, 2383-2388. CHI EA '14, New York, NY, USA: ACM, 2014. https://doi.org/10.1145/259206.2591233.	Sonic Respiration	Sonic Respiration is an app for music listening that degrades the quality of sound if the breathing rate is above 6bpm	2014	TF1-regulation	decrease RR (5.5-6.5 bpm)	stress	work-related stress is a global epidemic	decreased RR leads to increases HRV that helps the users fight stress-related disorders	audio intervention on mobile app	chest belt	A: mobile app	the audio quality degrades the more user's RR deviate from 6bpm	indirect	white noise, # of audio tracks playing simultaneously	/	1: SE-SY-SE	RR	/	negative feedback: obscuring the X: disruption	1
10		Rooij, Marieke van, Adam Lobel, Owen Harris, Niki Smit, and Isabella Granic. "DEEP: A Biofeedback Virtual Reality Game for Children At-Risk for Anxiety." In Proceedings of the 2016 CHI Conference Extended Abstracts on Human Factors in Computing Systems, 1989-1997. CHI EA '16, New York, NY, USA: ACM, 2016. https://doi.org/10.1145/2851581.2892492.	DEEP	VR game for kids with ADHD for arousal regulation (stress regulation)	2016	TF1-regulation	decrease RR and diaphragmatic breathing	"main aim is to provide an immersive and relaxing experience; there are no explicit tasks or goals for the players to attain" p1991	anxiety disorder amongst most prevalent interventions available for kids with anxiety are not very efficient	reduce arousal, relaxation for kids with ADHD through breath regulation, anxiety regulation in kids, diaphragmatic breathing is a validated technique for stress and tension relief	VR: HMD	stretch belt	V: HMD VR	moving through underwater fantasy world. RR is reflected in expanding/contracting circle. If lungs are at 50% capacity, gravity is applied, inhaling moves the user up on vertical axis (in water) or forward (on the ground). Slow and deep breathing make the user progress in the game	combo: direct (circle) indirect (lung capacity = gravity force)	expanding-contracting circle, movement on vertical/horizontal axis	/	1: SE-SY-SE	RR, amplitude, lung capacity	/	expand-contrast, vertical/horizontal movement, negative feedback: gravity	1
11		Patibandla, Rakesh, Florian "Floyd" Mueller, Matevz Leskovek, and Jonathan Duckworth. "Life Tree: Understanding the Design of Breathing Exercise Games." In Proceedings of the Annual Symposium on Computer-Human Interaction in Play, 19-31. CHI PLAY '17, New York, NY, USA: ACM, 2017.	LifeTree	Life Tree is a VR game for practicing Pursed-lip breathing (PLB) and rhythmic breathing. This paper presents design recommendations	2017	TF1-regulation	practice of pursed-lip breathing (deep breathing)	stress reduction PLB, rhythmic breathing; 3 prototype: space gaze, island tree, outlandish whisper + life tree	Easy thing to do: engaging in breathing exercises has multiple benefits to one's health: reduces stress, promotes relaxation, reduces ADHD, COPD, asthma, and increases overall wellbeing.	practicing PLB via game mechanics	VR: HMD	breathing headset, microphone	A+V: HMD VR: game	a colorless tree standing in the middle of a body of water. Sinks as a sign or a user to sit cross-legged, as the user exhales, the leaves are blown towards the tree that become colorful. The sound sets the pace for inhale and the tree trunk expands/contracts. If players continue to breathe rhythmically, the tree gets green and nicely colored. If non-rhythmic, blur effect is applied	combo: direct (expanding tree) indirect (tree color, blur),	tree, color, blur, movement on Y axis?	audio	1+2: SY-SE-SY + SE-SY-SE	exhalation time	fixed	expanding-contracting circle, color change, blur effect	1
12		Soyka, Florian, Markus Leyrer, Joe Smallwood, Chris Ferguson, Bernhard E. Riecke, and Betty J. Mohler. "Enhancing Stress Management Techniques Using Virtual Reality." 95-98. ACM Press, 2016. https://doi.org/10.1145/2931002.2931017.	UWE	UWE is an underwater world, the user follows a jelly fish with their breathing	2016	TF1-regulation	decrease RR 6 bpm	stress	Breathing exercises can help w chronic stress by eliciting PNS	stress-reduction = relaxation	VR: HMD	stretch belt	V: HMD VR	participants follow the movement on the vertical axis movement of jelly fish in the underwater environment	direct	/	jelly fish	2:SY-SE-SY	RR	fixed	vertical movement	1

13		Dijk, E. O., A. Weffers, and Philips Research. "Breathe with the Ocean: A System for Relaxation Using Audio, Haptic and Visual Stimuli." Univ. Twente, March 26, 2011. http://resolver.tudelft.nl/uuid:3b851450-7617-4238-932c-9b37cc6d2777 .	Breathe with the Ocean	Breathe with the Ocean; 3 embodiments of the concept via interaction loops: 1. closed, 2. open, 3. adaptive	2011	TF1-regulation	decrease RR	relaxation	development of relaxation system	relaxation	physical: light, audio, haptic (3 systems)	stretch belt	V (light) + Audio +Haptic (haptic blanket w room light)	the pacing is done by sound of waves and haptic movement along the user's body (vertical axis of user's body)	indirect: RR is calculated and decreased to the optimal RR if the user can keep up with that pace for 60 sec	/	sound of waves, haptic feedback	2:SY-SE-SY	RR, HRV (that is measured and paired with RR that induces highest HRV)	6 BPM OR system detects for each user, which respiration rate induces the highest HRV amplitude	vertical axis haptic movement,	1
14		Bingham, P. M., Bates, J. H., Thompson-Figueroa, J., & Lahiri, T. (2010). A breath biofeedback computer game for children with cystic fibrosis. <i>Clinical pediatrics</i> , 49(4), 337-342.	x	paced biofeedback game for children with cystic fibrosis	2010	TF1-regulation	promote awareness of breathing techniques in children with cystic fibrosis		provide an intrinsically motivating way for practice respiratory therapy through gamification	spacing at Resting Rate	desktop game	spirometer	V	movement of green circle on vertical axis	direct	position of a green circle	sine curve path to keep the ball on	combo (F+P)	RR, amplitude	fixed for each game, but can be chosen by the doctor	exhale=up, inhale=down, as if blowing on a balloon in a tube. Game mechanics	1
15		Vidyarthi, J. (2012). Sonic Cradle: Evoking Mindfulness through Immersive Interaction Design (MSc Thesis). Surrey, BC, Canada: Simon Fraser University	Sonic Cradle	Sonic Cradle's interaction design cultivates focused attention on breath to support meta-awareness, and mindfulness-like states	2011	TF2-mindfulness	breath awareness, breath-based meditation	stress reduction	mindfulness is one of the self-regulatory practices that can help combat the stress and improve wellbeing	mindfulness linked to stress-reduction and well-being	audio installation	stretch belt	A: spatial installation	sounds are triggered with each deep breath and create a complex soundscape over time	direct	soundscape (audio complexity)	/	1: SE-SY-SE	RR	/	increasing complexity, curating experience for awareness,	1
16		Shamekhi, Ameneh, and Timothy Bickmore. "Breathe Deep: A Breath-Sensitive Interactive Meditation Coach." In Proceedings of the 12th EA International Conference on Pervasive Computing Technologies for Healthcare, 108-117. PervasiveHealth '18, New York, NY, USA: ACM, 2018. https://doi.org/10.1145/3202545.3025743 .	Meditation Coach	The virtual meditation coach	2018	TF2-mindfulness	sustained breath awareness, decrease RR, breath-based mindfulness meditation: practice	physical and psychological health improvement	many experience lack of focus and attention to focus on breath, coaches help but not wisely available, conversational agents can be helpful: practice	mindfulness meditation	desktop	stretch belt	A+ V: desktop app w automated conversational agent interaction	conversational agent senses user's RR and guides them to slow their breathing by giving them voice guidance	indirect	conversational agent	sound of breathing	1+2	RR, R amplitude	lower than baseline	mirroring (coach mirrors the breathing of user)	1
17		Roo, Joan Sol, Renaud Gervais, Jeremy Frey, and Martin Hachet. "Inner Garden: Connecting Inner States to a Mixed Reality Sandbox for Mindfulness." In Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems, 1459-1470. CHI '17, New York, NY, USA: ACM, 2017. https://doi.org/10.1145/3025453.3025743 .	Inner Garden	an augmented sandbox, designed to inspire the user's self-motivation and curiosity. By shaping the sand, the user creates a living miniature world that is projected back onto the sand. The natural elements of the garden are connected to real-time physiological measurements, such as breathing, helping the user to stay focused on the body. Moreover, using a Virtual Reality headset, they can travel inside their garden for a dedicated meditation session.	2017	TF2-mindfulness	breath and body awareness	MBSR helps with stress reduction and overall wellbeing	MBSR helps with stress reduction and overall wellbeing	MBSR helps with stress reduction and overall wellbeing	VR + augmented reality/sandbox	stretch belt	A+V+H: augmented sandbox + VR	projected on sand, water is mapped to breath: sea expands on inhale, contract on exhale, and breathing creates waves. In VR, exhale intensifies camp fire, and is mapped to wind and ocean waves. 2 modes: paced: sea is pacing you, feedback: breathing reflected in sea	direct	expanding/contracting sea	sea	1+2: SE-SY-SE + SE-SY-SE	RR, amplitude	NA	expand/contract	1
18		Prpa, Mirjana, Karen Cochrane, and Bernhard E. Riecke. "Hacking Alternatives in 21st Century: Designing a Bio-Responsive Virtual Environment for Stress Reduction." In Pervasive Computing Paradigms for Mental Health, edited by Silvia Marino, Aleksandar Matic, Dimitris Giakoumis, Guillaume Lopez, and Pietro Cipresso, 34-39. Communications in Computer and Information Science 604. Springer International Publishing, 2015. https://doi.org/10.1007/978-3-319-32270-4_4 .	Solar	an immersive virtual environment (VE) that assists novice users to learn the stress reducing practice of mindfulness meditation.	2015	TF2-mindfulness	breath awareness, mindfulness meditation: practice	stress reduction	supporting mindfulness meditation practice for wellbeing and stress reduction	MBSR helps with stress reduction and overall wellbeing	desktop VR	belt	A+ V: desktop app	blue circle that expands contracts with breath	direct	expand-contracting circle	/	1: SE-SY-SE	RR, meditation score (EEG)	/	expand-contrast	1
19		"Prpa, Mirjana, Kvang Tatar, Jules Françoise, Bernhard Riecke, Thecla Schiphorst, and Philippe Pasquier. "Attending to Breath: Exploring How the Cues in a Virtual Environment Guide the Attention to Breath and Shape the Quality of Experience to Support Mindfulness." In Proceedings of the 2018 Designing Interactive Systems Conference, 71-84. DIS '18, New York, NY, USA: ACM, 2018. https://doi.org/10.1145/3196709.3196765 .	OutseBreath Water	IVR for eliciting breath awareness through visual cues and generative audio	2018	TF2-mindfulness	sustained awareness of breath and bodily sensations	Engaging in breathing exercises influence cognition, memory, and emotional processing [24, 79, 51], and decreases anxiety and stress [24], even in a young population [30].	Engaging in breathing exercises influence cognition, memory, and emotional processing [24, 79, 51], and decreases anxiety and stress [24], even in a young population [30].	MBD < FAM,	IVR	stretch belt	A+V: hmd VR	movement on vertical axis is determined by inhale/exhale, more rapid breathing triggers waves in the ocean	direct	movement on Y axis, ocean waves	/	1: SE-SY-SE	RR, amplitude	/	vertical movement	1
20		Shaw, Christopher D., Diane Gromala, and A. Fleming Seay. "The Meditation Chamber: Enacting Autonomic Senses." In Proc. of ENACTIVE'07, Grenoble, France, 2007. http://www.sfu.ca/~shaw/papers/Enactive07/MedChamber.pdf .	Meditation Chamber	lowering stress levels through meditation and muscle relaxation	2007	TF2-mindfulness	sustained awareness of breath and bodily sensations	lower stress levels through hbreath-based meditation and biofeedback (regulate psychophysiology)	stress negatively impacts health, meditation can combat that	MBSR for stress reduction	IVR	stretch belt	A+V: hmd VR	in the first scene, sun slowly descends as the users start breathing slowly, in scene 3, jelly fish pulse at the RR and with audio of moving water	direct	movement of sun, jelly fish	/	1: SE-SY-SE	RR, amplitude	/	minimize stimulus after regulation, movement (sun, jelly fish)	1
21		"Fisa, Andrea M., George Chernyshev, Andriana F. Nassou, and Kai Kurze. "Towards Interactive Mindfulness Training Using Breathing Based Feedback." In Proceedings of the 2017 ACM International Joint Conference on Pervasive and Ubiquitous Computing and Proceedings of the 2017 ACM International Symposium on Wearable Computers, 688-692. UbiComp '17, New York, NY, USA: ACM, 2017. https://doi.org/10.1145/312024.3129268 .	x	We attached a respiration detection strap with a stretch sensor around their chests to measure the rate, phase and depth of respiration. The amplification of the breathing sound was triggered when the breathing rate exceeded 10-11 breaths per minute [3].	2017	TF2-mindfulness	breath awareness	improved mental and cognitive health	Improving mental health	x	desktop app	microphone	A: desktop	the sound of the user's breath is fed back to them	indirect	breathing sound	/	SE-SY	RR, amplitude	/	mirroring	1
22		Aslan, I., Burkhardt, H., Kraus, J., & André, E. (2016, October). Hold my heart and breathe with me: Tangible somaesthetic designs. In Proceedings of the 9th Nordic Conference on Human-Computer Interaction (p. 92). ACM.	x	stuffed animal that "breathes in sync" with the user	2016	TF2-mindfulness/TF3-Soma	improve breath/body awareness through somatic introspection	gives haptic feedback of user's breathing which can support the lead practice of mindfulness stress reduction meditation	stress reduction therapy and meditation	supports body scan exercise in meditation through externalizing internal states. This can make the mindful practices more accessible for challenging groups such as children by introducing a playful artefact.	stuffed animal	haptic. Stuffed animal		stuffed animal mimicking breathing (expansion-contraction)	direct	plush toy=stuffed animal (some kind of rodent)	/	SE-SY	RR, amplitude	/	expansion-contraction	1
23		Stigahl, Anna, Martin Jonsson, Johanna Mercurio, Anna Karlsson, Kristina Hook, and Eva-Carin Banka Johnson. "The Soma Mat and Breathing Light." In Proceedings of the 2016 CHI Conference Extended Abstracts on Human Factors in Computing Systems, 305-308. CHI EA '16, New York, NY, USA: ACM, 2016. https://doi.org/10.1145/2851581.2889464 .	Breathing Light	turning gaze inwards	2016	TF3-soma	"aim to support a meditative bodily introspection subtly guiding participants to turn their gaze inwards, to their own bodies."	somaesthetic appreciation	body awareness through introspection	somaesthetics and appreciation of the exp	light	distance sensor (radar sensor)	V (light) + A (waves, wind, birds): spatial installation	user's breathing is synced w light intensity Optionally audio can be chosen	direct	light	/	1: SE-SY-SE	RR	/	fade in/out	1

24		Schiphorst, Thecla. "Breath, Skin and Clothing: Using Wearable Technologies as an Interface into Ourselves." <i>International Journal of Performance Arts and Digital Media</i> 2, no. 2 (January 1, 2006): 171–86. https://doi.org/10.1386/padm.2.2.171.1 .	exhale	"Exhale interaction enables an expression of collective group empathy through the use of breath" p.175	2006	TF3-soma/TF4-social	modes of self-to-self, self-to-other and self-to group communication;	somaesthetic appreciation, shared communication via breath	expressive nonverbal interaction that brings awareness to the body's states in the context of a wearable or ubiquitous environment	collective breath installation	skirt	stretch belt	V(lights)+ Haptic (air flow); wearable.	breath is mapped to air fans under skirts and each person can attend to their own breath, or share their breath with someone else.	combo: direct: indirect: when group breathes at the same bpm rate, the lights show that connection	air flow under skirt. lights	air flow	1+3: SE-SY-SE + SE-SY-OTH-SY-SE	exhale duration, synch of RR	/	shifting between 3 modes of attending: to your breath or someone else, self-other	2+
25		Sun, X., & Tomimatsu, K. (2017). Breath Is to Be Perceived - Breathing Signal Sharing Involved in Remote Emotional Communication. In N. Streitz & P. Markopoulos (Eds.), <i>Distributed, Ambient and Pervasive Interactions</i> (pp. 472–481). Springer International Publishing.	x	a pair of interactive breathing sofa systems to communicate with each partner's breath tempo in real time.	2017	TF4-social	emotion communication	emotional communication/exchange over distance, esp for long-distance relationship, supporting intimacy, build an emotional comfort connection for the long-distance communication	breath is component of emotional interpersonal communication that can help with soothing	physiology can communicate affective state	expandable sofa, pillows, belt-type pressure sensor	belt pressure sensor	H: cushion	2 sofas are connected in that each sofa's cushion expand/contract at the breathing rate of the person in the other sofa	direct	sofa cushion sizes	/ potentially other person's breath detected through the sofa	3: SE-SY-OTH-SY-SE	RR,amplitude	/	expand/contract, self-other	2
26		Kim, J., Park, Y.-W., & Nam, T.-J. (2015). BreathingFrame: An Inflatable Frame for Remote Breath Signal Sharing. In <i>Proceedings of the Ninth International Conference on Tangible, Embedded, and Embodied Interaction - TEI '14</i> (pp. 109–112). Stanford, California, USA: ACM Press. https://doi.org/10.1145/2677199 . Frey, Jérémy, May Grabli, Ronit Slyper, and Jessica R. Cauchard. "Breeze: Sharing Biofeedback Through Wearable Technologies." In <i>Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems</i> , 645–645:12. CHI '18, New York, NY, USA: ACM, 2018. https://doi.org/10.1145/3173574.3174219 .	BreathingFrame	BreathingFrame: a photo frame that breathes with your partner's photo	2015	TF4-social	emotion communication	supports emotional communication in long distance relationships, by applying one's breathing to an inflatable picture frame placed on the desk of their partner. Supporting intimacy	communication through shared physiology	expanding/contracting frame	latex-sheeted surface of the picture frame	belt	V+H	haptic+visual feedback; the Frame inflates with exhales etc. Additionally the level of noise in partners surroundings affects the dimness of the picture	direct	latex-sheeted picture frame	/	3: SE-SY-OTH-SY-SE	RR,amplitude	/	expand/contract, self-other	2
27		Frey, Jérémy, May Grabli, Ronit Slyper, and Jessica R. Cauchard. "Breeze: Sharing Biofeedback Through Wearable Technologies." In <i>Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems</i> , 645–645:12. CHI '18, New York, NY, USA: ACM, 2018. https://doi.org/10.1145/3173574.3174219 .	Breeze	the pendant for sharing breathing data between users.	2018	TF4-social	emotion communication	connectedness, empathy, awareness of body and mind	communicating through shared biofeedback	connectedness via biofeedback	pendant mobile app	IMU sensors: accelerometer, gyroscope, and magnetometer.	V, A, H: pendant	pilot: patterns are generated not collected from person; 2. 30 trials (10 patterns x 3 modalities) reathing patterns are mapped to light brightness of device, loudness of pink noise (sound of waves) and breath amplitude mapped to vibration	direct	/	light brightness, loudness of pink noise, and haptic feedback	3: SE-SY-OTH-SY-SE	RR,amplitude	/	fade off/in, self-other	2
28		Desnoyers-Stewart, J., Stepanova, E. R., Pasquier, P., & Riecke, B. E. (2019). JeL: Connecting Through Breath in Virtual Reality. <i>ACM CHI 2019 Late Breaking Work</i> , 1–6. Glasgow, United Kingdom: ACM.	JeL	an immersive system for synchronizing breathing	2019	TF4-social	promote the feeling of connection	encourages breath synchronization between 2 participants to support the feeling of connection	feeling of connection is important component of a prosperous society and healthy individuals	synchronization of physiological functions can support the feeling of connection and promote related pro-social outcomes.	HMD VR	stretch belt	A+V: hmd VR	each user's breathing controls one jelly fish	direct	jelly fish	/	1+3: SE-SY-SE + SE-SY-OTH-SY-SE	RR, amplitude, synch RR	/	self-other, vertical movement, expand-contrast	2
29		Moran, S., Jäger, N., Schnädelbach, H., & Glover, K. (2016). ExoPranayama: a biofeedback-driven actuated environment for supporting yoga breathing practices. <i>Personal and Ubiquitous Computing</i> , 20 (2), 261-275.	ExoPranayama	spatial structure	2016	TF4-social	support group yoga practice	supporting yoga and breathing practices	supporting group practice of yoga	supporting breathing practice in yoga	tangible+projection	stretch belt sensor	Visual, but tangible.	movement of the object along the vertical axis	direct	the tent	/	SE-SY-OT-SE	RR,amplitude, synchrony	/	expansion-contraction	2
30		Sjöman, Heikki, Nazare Soares, Martinus Suijkerbuijk, Jørgen Blindheim, Martin Steinert, and Dag T. Wisland. "The Breathing Room: Breathing Interval and Heart Rate Capturing Through Ultra Low Power Radar." In <i>Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems</i> , 1345–1345:12. CHI '18, New York, NY, USA: ACM, 2018. https://doi.org/10.1145/3173574.3174219 .	Breathing Room	shipping container with laser cut inside surfaces that react to user's breathing by expanding/contracting walls	2018	TF3-minfulness	allow for better coordination and modulation of breathing.	mind body ad technology in a discourse	"anart installation and mindfulness experience creating a unique dynamic interaction between 'human' and 'space' on top of a hitherto vilified technology, radar." p.2	/	installation spatial	radar	visual, but tangible	the expanding contracting wall	direct	laser-cut wall surface	/	SE-SY-SE	RR,amplitude	/	expand-contrast	1
31		Davies, C., & Harrison, J. (1996). Osmose: towards broadening the aesthetics of virtual reality.	Osmose	immersive HMD VR in which one explores virtual world	1996	TF3-minfulness	connecting mind and body	unity body and mind in immersive medium	unity body and mind in immersive medium	"The goal of this piece is to unite divorced Cartesian mind and body in an ambiguous environment, to bring together inner space and external space in interplay, by positioning the user in the center around which everything unfolds. Created as a single user piece, intention was brought to giving time and space for a user to reconnect with their inner space, find calm, and self-reflect."(p.	HMD VR	vest with breathing and balance sensors	visual, audio	the experience mimicks dynamic of scuba diving: the user transverses along vertical axis through their breathing	direct	movement on vertical axis	/	SE-SY-SE	RR,amplitude	/	movement along vertical axis	1