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Articles

Understanding the impact of prison design on prisoners and prison staff through virtual reality: a multi-method approach

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Abstract

Purpose: The prison population is considered to be vulnerable to stress caused by the physical environment. The aim of this study was to evaluate the psychological effects of the prison's environment on both inmates and staff.

Design: We compared the psychophysiological arousal and self-report measurements of 73 participants (40 prisoners and 33 prison staff) to the prison environment through the exploration of three immersive virtual environments (the dormitory, the prison entrance, and the prison yard).

Findings: There were few physiological activation differences between inmates and prison staff during the task, but significant discrepancies did arise, particularly from self-reported assessments. Compared to prison staff, prisoners demonstrated a greater decrease in finger pulse, indicating a stronger orienting response to virtual environments. While prison staff emphasized the importance of good lighting throughout the environments, prisoners focused their hatred on the furniture of the cells and on the layout and function of the prison yard. Both groups had conflicting emotions towards the virtual environments.

Originality: Our study offers a realistic portrayal of the prison population's perceptions about the setting in which they are engaged in everyday life and activities.

Practical implications: Hence, there are implications for both prison rehabilitation and designing prison renovations that are in line with the psychological needs of inmates and prison staff.

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1. Introduction

According to the World Health Organization (2022; 2014), the higher prevalence of communicable (e.g., HIV, hepatitis C, and B) and non-communicable diseases (i.e., cardiovascular diseases, respiratory diseases, obesity, cancer, and psychiatric diseases), along with high suicide rates among both prisoners and staff (WHO, 2022; 2014; Frost and Monteiro, 2020) compared to the general population led to highlight the stressogenic nature of prison environments.

Based on this premise, Moran and colleagues (2020, p. 1781) have argued that well-being in prison could be defined as the presence of "*low levels of self-harm and violence*". Indeed, self-harm is often used by prisoners as an attempt to cope with negative emotions, which may be difficult to express and manage, especially for individuals incarcerated in foreign countries (Sorge and Saita, 2021). Other frequently reported maladaptive behaviors include misconduct and violence (prisoner on prisoner and prisoners on staff; Schenk and Fremouw, 2012), which negatively impact both the length of detention and conditions of confinement for prisoners as well as the organizational management of prisons, driving up institutional costs (Bosma et al., 2020).

Bad living conditions in prison are known to cause physiological and psychological distress also among prison staffs which frequently show behavioral issues such as an increase in sick leave and drug misuse to relieve stress (Bierie, 2012).

Among the factors that may influence both physical and mental health in prison (e.g., prior health conditions), several authors have stressed the role of the physical environment and how it is perceived by the prison population. For instance, in their literature review, Goomany and Dickinson (2015) have shown that negative perceptions of prison climate influence prisoners' mental health. Prison climate has been defined as "*the perceived quality of conditions of imprisonment, including interpersonal, material and organizational dimensions*" (van Ginneken and Nieuwbeerta, 2020, p.1; Ross et al., 2008).

The role of the environment on people's well-being has been widely discussed (Stevens, 2010). Notably, environmental psychology has focused on the investigation of cognitive and affective-emotional mechanisms that influence the perception of the environment, the meaning attribution of the environment, and how environmental stimuli affect behaviors or people's well-being (Canter and Craik, 1981). Due to the stressogenic nature of prisons outlined above, psychological research has studied the socio-physical environmental characteristics, along with the organizational aspects, that may affect the prison climate (Green et al., 2022; Thaler et al., 2022). However, not much data has yet been gathered in prison settings.

Among the architectural components that may negatively affect prisoners' and prison workers' well-being, physical characteristics of facilities (e.g., lighting, layout, view, color, air quality, noise, dirtiness, nature contact) have been shown to stress daily life conditions, health, relationships, and behavior (Engineer et al., 2021; Bernheimer, 2017).

For example, prisons often induce physical inactivity due to a lack of space and because inmates have little control over their daily activities and thus spend most of their time engaging in passive leisure activities (e.g., watching TV). Notably, research has shown that an impoverished environment characterized by a sedentary lifestyle, social isolation, and lack of cognitive stimulation negatively affects executive functions such as planning, problem-solving, working memory, set-shifting, and inhibition (Meijers et al., 2017). Along this line of reasoning, Meijers (2018) found that after three months of imprisonment, the participants in the study displayed significantly increased risk-taking, significantly deteriorated attention, and reduced self-control. In addition, it was noted that confining the area of movement can lead to a territorial phenomenon that takes the form of defending one's personal space (Balan et al., 2002). Moreover, prisoners have been found to decorate their cells with personal objects. Among the motivations behind inmates' decoration of prison environments, prisoners reported the need to create a home environment and to fill space (Baer et al., 2005).

In a large study involving thirty-two Dutch prisons, it was found that prison layout is related to the officer–prisoner relationships. Specifically, prisoners in panopticon layouts had fewer positive interactions than prisoners in other layouts. In addition, prisoners housed in older units and in units with more double cells were less positive about officer–prisoner interactions (Beijersbergen et al., 2014).

Along with ensuring safety and control, prison administrations' institutional mandate includes promoting prisoners' reeducation and resocialization through true engagement in correctional treatment activities, reducing recidivism risk, and ensuring the health of the prison population (Moran and Turner, 2019). Focusing on rehabilitation, it has been claimed that prisons should be organized to provide adequate and healthy spaces suitable for inmates' daily life activities (Galford, 2021; Hancock and Jewkes, 2011). In this regard, Engstrom and Van Ginneken (2022) have recently introduced the term "*ethical prison architecture*" referring to the relationship between the prisons' physical environment and the well-being of prison-building users. Improving space quality − along with the use of tools that address organizational issues (Gozzoli et al., 2018) − could reduce stress, and promote prison staff's well-being, commitment and motivation. It is well known how the nature of healthcare professionals work exposes them to various stressors and challenging situations that can lead to the development of Secondary or Vicarious Trauma

and Compassion Fatigue (Jimenez et al., 2021; Mento et al., 2020; Cocker & Joss, 2016). Secondary or Vicarious Trauma refers to the emotional and psychological impact that arises from witnessing or hearing about traumatic events experienced by others in the work context (Stamm, 1995). Compassion Fatigue, on the other hand, is a form of emotional exhaustion that arises from an overexertion of empathy and compassion towards others who are suffering (Figley, 1995). Both Secondary or Vicarious Trauma and Compassion Fatigue can have profound effects on the mental and physical well-being of correctional officers and health professionals (Bell et al., 2019; Campbell, 2019; Hatcher & Noakes, 2010; Newell & MacNeil, 2010; DePass, 2005). They may experience symptoms such as heightened anxiety, feelings of helplessness or guilt, increased irritability, sleep disturbances, and a decline in overall job satisfaction. Left unaddressed, these issues can lead to burnout and a reduced capacity to effectively carry out their duties. Discrepancies between high job motivation and expectations and the real work environment can be a further risk factor for the development of burnout (Maslach and Leiter, 2016). To mitigate the impact of Secondary or Vicarious Trauma, Compassion Fatigue, and burnout, correctional organizations need to prioritize the mental health of their staff and provide a healthy work environment. Addressing well-being among prison staff is also essential for maintaining a safe and functional correctional environment.

In a recent qualitative study, Jewkes and colleagues (2020) explored rational and visceral responses of prisoners and staff to "*blue vista*" (i.e., a prison cell with a sea view). Participants reported that "*being able to see the sea at night had a soporific effect*". Others highlighted feelings of peace and relaxation due to the closer interaction with weather, sunset, sound, and smell of the sea. Although contact with nature in prison is recognized to offer significant health-promoting benefits, the existing literature is rather limited (Moran et al., 2022). Likewise, no previous research has demonstrated the psychophysiological reactions of people who live and work in prisons to prison architecture. To address this gap, the current study aimed to explore the negative impact of prison environments on prisoners and staff using a multidisciplinary approach that included the use of virtual reality (VR). VR has emerged as a transformative tool in the field of clinical psychology, revolutionizing the way mental health professionals approach assessment, treatment, and therapy (Riva, 2022; Bell et al., 2020). By simulating immersive, computer-generated environments, VR offers unique opportunities to enhance traditional therapeutic approaches and address a wide range of psychological disorders and challenges (Riva & Serino, 2020). One of the most significant advantages of VR in clinical psychology is its ability to create controlled and customizable environments. Therapists can design scenarios that expose patients to reaction-inducing situations in a safe and supervised setting. Taking advantage of this possibility, in our study we virtually reconstructed three environments of the

Como prison (Lombardy, Italy), which is known for its low levels of well-being and high levels of architectural deterioration.

1.1 A brief description of the Como prison

Como prison has been in operation since 1983. It has a planned capacity of 242 inmates, but it currently hosts about 350 inmates (overcrowding: 144%), the majority of whom are males (≈30% females, 6% transgenders). There is a predominance of individuals with short sentence ends.

Half of the current inmate population consists of Italian nationals, while the remaining consists of foreign inmates. In terms of age, there is a prevalence of young adults. More than half of the prisoners are known for drug addiction problems.

The prison staff currently comprises about 189 prison officers, 15 administrative workers, and 3 educators.

In 2020, there were 3 deaths by suicide, about 300 acts of self-harm, and a hundred acts of aggression.

1.2 The Present Study

The current study is part of a larger project called "*Ri-CO-struire: a multidisciplinary research study in the Como Prison for an architectural reform oriented to the well-being of prisoners and prison workers*" funded by Fondazione Cariplo.

Because of a lack of empirical data on the negative impact of the prison environment on prisoners and prison staff's psychophysiological parameters, this exploratory research was required.

The current study's objective was to examine the reactions of both prisoners and prison staff to prison architectural features. To that end, a 3D virtual rendering of three prison environments was created and shown to participants via a VR headset.

The participants' reactions were measured during and after viewing the stimuli in VR, using both physiological and psychological self-report measurements.

2. Method

2.1 Participants

A non-probability convenience sampling strategy was applied to recruit prisoners and prison workers at the Como prison. An a priori power analysis was conducted using G*Power version 3.1.9.6. (Faul et al., 2007) to determine the minimum sample size required to test the study

hypothesis. Results indicated the required sample size to achieve a power of .99 for detecting a medium effect size, at a significance criterion of α = .05, was n = 70 for the mixed factorial ANOVA 3 x 2. Thus, the obtained sample size of n = 73 was considered adequate to test the study hypothesis.

Seventy-three individuals (Males = 45; Females = 23; Transgender = 5), of which 40 prisoners and 33 prison staff agreed to participate in the study. Participants' characteristics are reported in Table 1. The mean age of the sample is 43.15 years (SD = 10.06; range: 23-61). Prisoners have been detained at Como prison for a period ranging from 1 to 65 months (M=12.46; SD=14.29) and were convicted for property crimes (62.5%), violent crimes (17.5%) or drug offenses (15%). Prison staff included 20 prison officers, 5 educational workers, 4 health-care workers, and 4 administrative workers.

Table 1. Descriptive statistics of the sample (N = 73)

Variable	Prisoners (N = 40)	Prison workers (N = 33)
Age, years	Valid = 39	Valid = 33
	Missing = 1	
Mean (SD)	41.08 (9.35)	45.61 (10.47)
Range	23-61	23-61
Period of detention in Como prison, months	Valid = 39	-
	Missing = 1	
Mean (SD)	12.467(14.27)	
Range	1-65	
Gender	Frequency (%)	Frequency (%)
	Valid = 40	Valid = 33
Female	14 (35)	9 (27.3)
Male	21 (52.5)	24 (72.7)
Transgender	5 (12.5)	-
Nationality	Valid = 35	Valid = 26
	Missing = 5	Missing = 7
Italian	25 (71.5)	26 (100)
South America	6 (17.1)	Southern Italy
North Africa	2 (5.7)	14 (54)
Eastern Europe	2 (5.7)	Northern Italy

		6 (23) Middle Italy 6 (23)
Completed education Primary school Middle school High school Graduate	Valid = 23 Missing = 17 3 (13) 15 (65) 2 (9) 3 (13)	-
Crime Type Property crimes Violent crimes Drug offences	Valid = 38 Missing = 2 25 (65.8) 7 (18.4) 6 (15.8)	-
Addiction Substance Gambling	Valid = 40 25 (62.5) 1 (2.5)	-
Prison ward 1° 2° 3° 5° 6° Female Parole	Valid = 39 Missing = 1 4 (10.3) 2 (5.1) 1 (2.6) 8 (20.5) 5 (12.8) 14 (35.9) 5 (12.8)	-
Role Prison officers Administration area Health care area Educational area	-	Valid = 33 20 (61) 4 (12) 4 (12) 5 (15)

2.2 Virtual reality environments

After obtaining permission from the local Penitentiary Administration, the computer-generated 3D renders of a selection of facilities within the Como prison were implemented. More

specifically, three spaces were chosen based on the level of social interaction, frequency of use, and level of environmental deterioration: the dormitory (environment 1; see Figure 1 and Figure 2), the prison entrance (environment 2; see Figure 3), and the prison yard (environment 3; see Figure 4). Three 360-degree immersive VR video clips of 15 seconds were then created. Each clip included a predefined automatic motion though the environment (e.g., the exploration of the yard at average walking speed). The immersive VR video clips were shown to the participants through an Oculus Rift head-mounted display. VR indeed provides participants with a simulated immersive experience, due to the perception of being present in the environment (Cipresso et al., 2018).

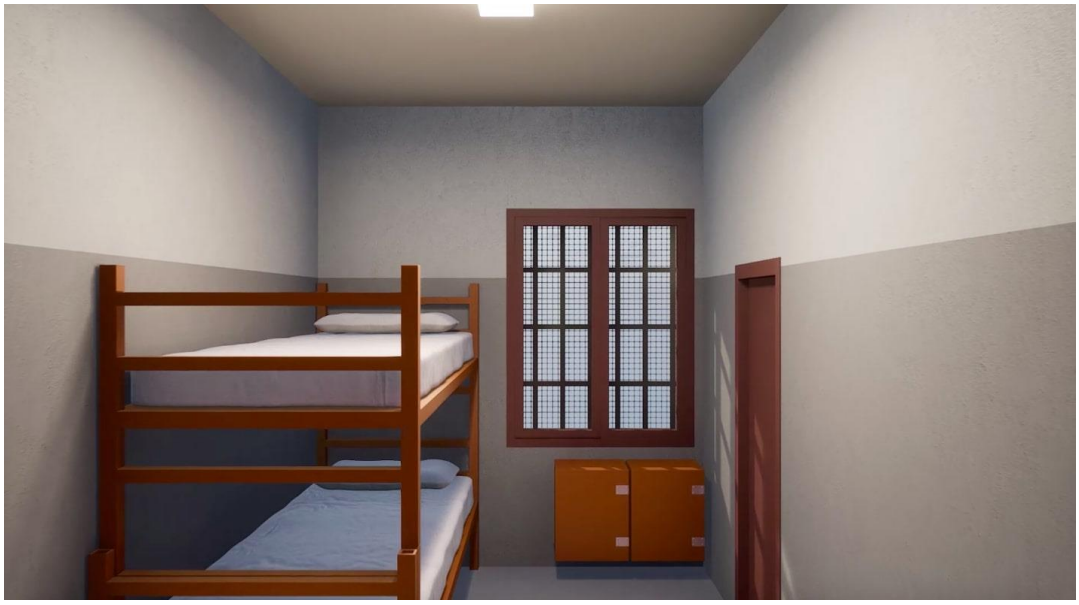

Figure 1. Virtual environment 1: dormitory

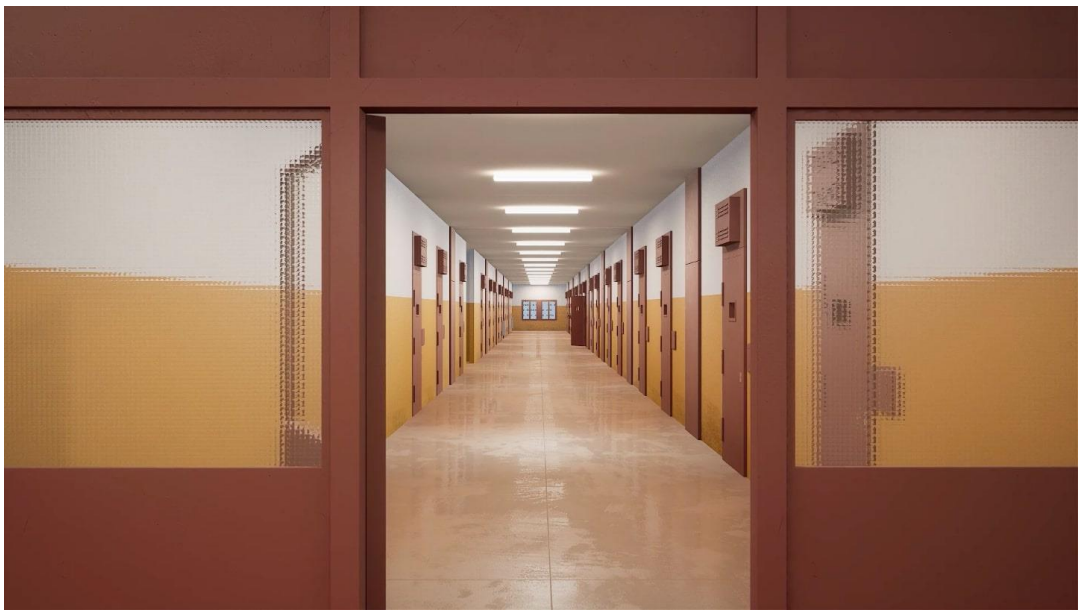

Figure 2. Virtual environment 1: dormitory

Figure 3. Virtual environment 2: prison entrance

Figure 4. Virtual environment 3: prison yard

2.3 Measures

Reactions to the prison's architectural features were measured considering two response systems, namely, physiological arousal and subjective experience.

Physiological arousal. Physiological data were recorded using the Biofeedback 2000 X-pert, Schuhfried data acquisition system. A multi-channel sensor was placed on the index finger of the non-dominant hand of the participants. The following parameters were considered: a) skin conductance level (SCL; i.e., variation of the eccrine sweat gland activity in response to sympathetic system activation); b) Finger Pulse (FP; i.e., a measure of heart rate); c) Blood

volume pulse (BVP; i.e., index of vasodilation and blood pressure); d) skin temperature, which reflects blood flow through blood vessels under the skin. Overall, sympathetic activity is known to increase heart rate, skin conductance, and peripheral vasoconstriction (resulting in lower temperature), while a decrease in sympathetic activity and\or an increase in parasympathetic activity should lead to reduced heart rate and peripheral dilation (an increase in skin temperature).

Cyber sickness. We used a self-report questionnaire designed to investigate the participants' perceived physical symptoms during their experience in the virtual environment. Items were derived from the ITC-Sense of Presence Inventory (Lessiter et al., 2001). In more detail, the scale consists of sixteen items assessed through a 4-step Likert scale (0-3): 0 = "none"; 1 = "low"; 2 = "moderate"; 3 = "high".

Emotional Thermometer. A visual self-report scale was used consisting of words and emoticons related to six possible emotional states experienced by participants during the task. For each emotion, participants were asked to rate the degree of intensity using a five-step Likert scale (1-5): 1 = "very low"; 2 = "below average"; 3 = "average"; 4 = "above average"; 5 = "very high".

Environments evaluation questionnaire. An ad-hoc self-report instrument was designed to assess how much the participants liked a set of pre-selected architectural elements. The questionnaire consisted of three parts, each corresponding to one of the environments explored (the dormitory, the prison entrance, and the prison yard). At the end of each section, the participants were asked to answer an open-ended question "*What would you like to change*?".

Checklist of positive/negative adjectives. This scale included three lists of pairs of adjectives with opposite meaning (positive/negative). The participants were asked to rate each of the three environments using these adjectives (i.e., selecting one adjective). For the dormitory, the following pairs of adjectives were used: beautiful-ugly, pleasant-unpleasant, warm-cold, comfortable-uncomfortable, desirable-undesirable, clean-dirty, cozy-unwelcoming, personal-impersonal, private-not private.

For the prison entrance, the pairs were: beautiful-ugly, pleasant-pleasant, warm-cold, comfortable-uncomfortable, desirable-undesirable, clean-dirty, hospitable-inhospitable.

For the prison yard the pairs were: beautiful-ugly, pleasant-pleasant, desirable-undesirable, useful-useless, safe-dangerous, open-closed, efficient-inefficient, well-maintained-degraded.

2.4 Procedure

Prior to data collection, permission from the local Penitentiary Administration and the prison warden was obtained. The study was then approved by the Ethics Committee of the Università

Cattolica del Sacro Cuore of Milan (protocol code: 37-22). Potential participants received information on the objectives and procedures of the study before enrollment. Researchers clearly explained that participation was voluntary and not associated with the Prison Administration.

Data was collected in July 2022, over the span of two weeks. After signing the informed consent, participants took part in a 15-minute experimental procedure individually. Prisoners completed the task in a private room of the prison without the presence of any member of the prison staff, while prison staff completed the task in a private room of the prison administration building. First, the participant was asked to sit comfortably on a chair. Then, the VR headset was mounted on the participant's head, and a multi-channel electrophysiological sensor was placed on the index finger of their non-dominant hand. Second, physiological data were recorded for a 5-minute resting period during which participants were asked to relax while observing a black screen (baseline). After this period, participants were presented with three short VR videos representing the prison environments (i.e., the dormitory, the prison entrance, and the prison yard). The order of the video presentation was randomized, while both the duration and the trajectory of the route were kept constant for all participants. During each VR clip presentation, physiological correlates were recorded. At the end of the VR presentation, the headset and the physiological sensor were removed, and participants completed the self-report questionnaires. Finally, the participants were debriefed and thanked for their participation in the study.

2.5 Analyses

Concerning physiological arousal, data were first visually inspected, and artifacts were removed. Second, we computed average values for each parameter across each of the time intervals (i.e., baseline and environment simulations). Then, change scores (simulated environment – baseline) were computed for each simulated environment. These scores were then analyzed using a mixed ANOVA (3 Environment x 2 Group).

Concerning self-report measures, descriptive statistics were first computed. Second, independent t-test were used to examine differences among the two groups (prisoners vs. prison staff). In conclusion, qualitative analysis of open-ended answers was carried out.

3. Results

3.1 Psychophysiological Data

The results showed a small number of significant differences on physiological activation (see Figure 5). In more detail, concerning skin conductance level, no significant differences emerged

either among environments, $F(2,136) = 0.77$, $p = .465$, or between groups of participants (prisoners vs. staff), $F(1,68) = 1.66$, $p = .202$.

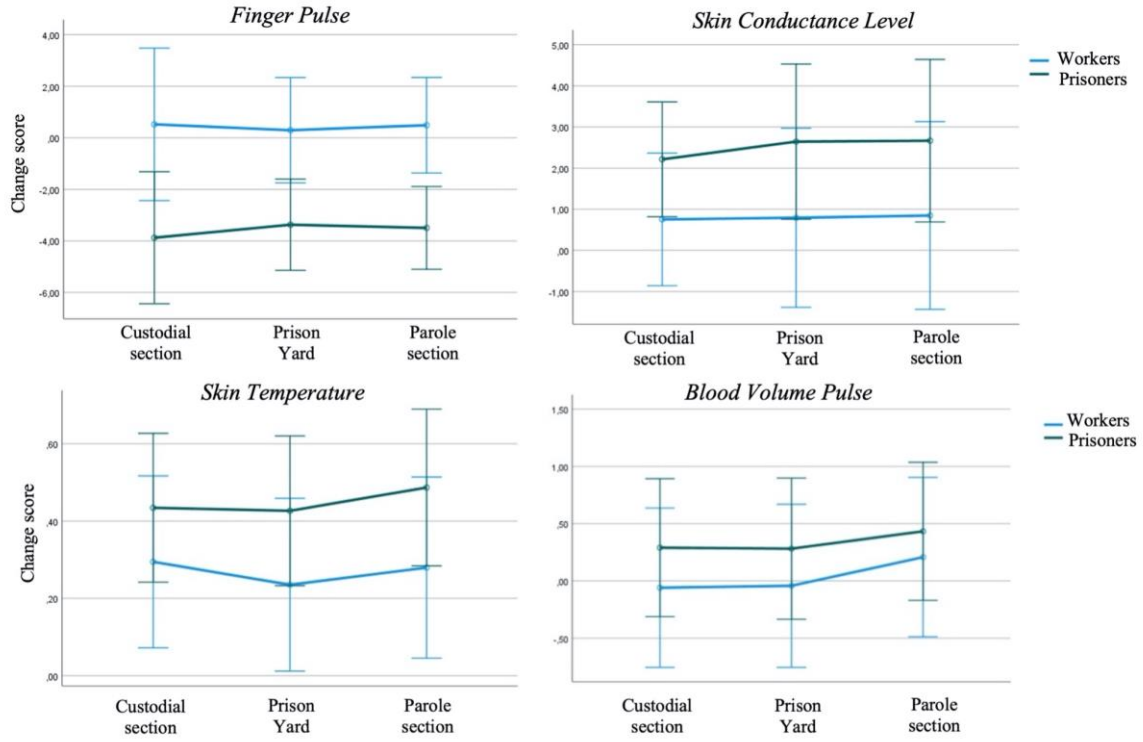

Figure 5. Physiological data: Mean change scores for Finger Pulse, Skin Conductance Level, Skin Temperature, and Blood Volume Pulse. Error bars represent 95% Confidence Intervals

Concerning finger pulse, a significant difference emerged between prisoners and staff: The former showed a greater decrease than the latter, $F(1,68) = 9.10$, $p = .004$.

Concerning skin temperature, a significant difference emerged among environments, $F(2,136) = 3.91$, $p = .044$: Participants showed an increase in skin temperature while watching the prison entrance simulation. No significant difference emerged between groups, $F(2,68) = 1.47$, $p = .232$.

Finally, concerning blood volume pulse, no significant differences emerged between groups, $F(1,68) = .44$, $p = .507$. The main effect of the type of simulated environment approached significance, $F(2,136) = 2.62$, $p = .097$. Similar to skin temperature (Peper et al., 2007), participants showed an increase in blood volume pulse (i.e., a decrease in blood pressure) while watching the prison entrance simulation.

3.2 Self-report measures

Cybersickness

On average, participants reported low general discomfort during the task (M = .67; SD = .914).

About this measure, tests of sixteen a prior hypothesis were assessed using sixteen independent groups t-Tests with a Bonferroni adjusted alpha level of .003 per test (.05/16).

The prisoners' group and the prison staffs' group did not significantly differ in cybersickness symptoms (see Table 2). However, the prison staff reported higher blurred vision (M = .52; SD = .619) than prisoners (M = .18; SD = .446).

Table 2. Independent groups t-test results comparing prisoners and prison workers on cyber sickness

Symptoms	Prisoners (N = 40)		Prison workers (N = 33)		Mean difference	*t*(71)	*p*	Cohen's *d*
	M	SD	M	SD				
General discomfort	.55	.932	.82	.882	-.268	-1.253	.214	-0.393
Fatigue	.33	.797	.30	.637	.022	.128	.898	0.041
Headache	.23	.698	.27	.626	-.048	-.305	.762	-0.060
Eye strain	.28	.554	.33	.540	-.058	-.453	.652	-0.091
Difficulty focusing	.35	.736	.52	.566	-.165	-1.057	.294	-0.258
Increased salivation	.28	.679	.18	.465	.093	.669	.505	0.171
Sweat	.40	.871	.45	.666	-.055	-.295	.769	-0.064
Nausea	.30	.758	.48	.712	-.185	-1.065	.290	-0.244
Difficulty concentrating	.13	.404	.33	.645	-.208	-1.612	.113	-0.371
Feeling of heaviness of the head	.35	.700	.58	.830	-.226	-1.261	.211	-0.299
Blurry vision	.18	.446	.52	.619	-.340	-2.642	.011	-0.630
Dizziness	.50	.961	.39	.704	.106	.528	.599	0.130
Vertigo	.08	.267	.09	.292	-.169	-1.470	.146	-0.035
Stomacache	.20	.608	.42	.751	-.224	-1.382	.172	-0.321
Need to burp	.13	.516	.00	.000	.125	1.533	.133	0.356

Emotional Thermometer

On average, happiness (M = 1.38; SD = 1.721) and sadness (M = .78; SD = 1.493) were the emotions reported most frequently. The results of t-tests showed no significant difference between the two groups (see Table 3).

Table 3. Independent groups t-test results comparing prisoners and prison workers on Emotional Thermometer

Emotions	Prisoners (N = 40)		Prison workers (N = 33)		Mean difference	*t*(71)	*p*	Cohen's *d*
	M	SD	M	SD				
Happiness	1.70	1.88	1	1.43	.700	1.80	.076	0.419
Sadness	.78	1.56	.79	1.43	.036	-.036	.856	-0.006
Fear	.40	.95	.36	.69	-.013	.182	.971	0.048
Worry	.48	1.06	.76	1.25	-.283	-1.04	.300	-0.241
Anger	.63	1.31	.48	1.14	.140	.480	.633	0.122
Boredom	.38	.95	.73	1.15	-.352	-1.43	.157	-0.331

Environments evaluation questionnaire

Concerning environment 1 (i.e., the dormitory), on average, the architectural element that obtained lower liking scores was the color of the walls (M = .40; SD = .493; 39,2%). The same result emerged also for environment 2 (M = .36; SD = .482; 35,1%) and environment 3 (M = .38; SD = .490; 37.8%).

We found some significant differences between groups (i.e., prisoner or prison staff). The prison staff judged the lighting and the floor colors of environment 1 as more unpleasant than the group of prisoners (Table 4). The prisoner judged the furniture as the most unpleasant element of the dormitory (env. 1) (see Table 5). Concerning the prison entrance, prison staff rated lighting and wall colors as more unpleasant than prisoners (see Table 4).

Table 4. Independent groups t-test results comparing prisoners and prison workers on environments evaluation questionnaire

Environment 1	Prisoners (N = 40)		Prison workers (N = 33)		Mean difference	*t*(71)	*p*	Cohen's *d*
	M	SD	M	SD				
Lighting	.13	.33	.39	.49	-.269	-2.65	.010	-0.622
Floor color	.13	.35	.45	.50	-.330	-3.20	.002	-0.741
Environment 2	M	SD	M	SD	Mean difference	*t*(71)	*p*	Cohen's *d*
Lighting	.08	.267	.33	.479	-.258	-2.76	.008	-0.644
Wall color	.25	.439	.48	.508	-.235	-2.09	.041	-0.382

Table 5. Frequency of least liked architectural element choice

	Architectural elements	Prisoners (N = 40)	Prison workers (N = 33)	Total
Environment 1 Dormitory	Lighting	5	13	18
	Wall color	12	17	29
	Floor color	5	15	20
	Furniture	14	6	20
	Furniture arrangement	9	7	16
	Materials	6	4	10
	Others	11	3	14
	Architectural elements	Prisoners (N = 40)	Prison workers (N = 33)	Total
Environment 2	Accessibility	3	7	10

Prison entrance				
	Lighting	3	11	14
	wall color	10	16	26
	Floor color	9	12	21
	Furniture	4	4	8
	Furniture arrangement	3	3	6
	Materials	3	2	5
	Others	5	0	5
	Architectural elements	Prisoners (N = 40)	Prison workers (N = 33)	Total
Environment 3	Accessibility	2	4	6
Prison yard				
	Space distribution	9	11	20
	Materials	10	6	16
	Wall color	16	12	28
	Floor color	8	6	14
	Furnishing elements	9	7	16
	Others	11	0	11

Qualitative analysis of the responses to the open-ended item showed that prisoners answered more frequently (90%) to the question "*what would you like to change?*" than staff (63%). Specifically, the prisoners were more informative relative to env. 1 (the dormitory) and env. 3 (prison yard); while staff were more informative relative to env. 2 (prison entrance).

Prisoners would like to change the furniture of the dormitory (env. 1) and revise the spatial organization, while operators would like to change the color of the walls. Concerning the prison entrance (env. 2), prisoners reported that they mainly would like to change the color of the walls, while prison workers indicated the color of the floor. Concerning the prison yard (env. 3), prison

workers suggested the need to add furniture elements, while prisoners emphasized the need to be provided with equipment for sports activities and with naturalistic elements (not only for an aesthetic value, but also to be able to cultivate plants and care for them).

Checklist of positive/negative adjectives

Data showed that both prisoners and prison workers selected adjectives with a positive meaning more frequently than adjectives with a negative connotation to evaluate the three virtual environments explored. As exceptions, concerning environments 1 and 2, the entire sample selected the negative adjective of the pair clean-dirty. Moreover, concerning the prison yard, participants selected the adjective "dangerous" in the pair "dangerous/safe" (see Table 6). No significant difference between groups was found.

Table 6. Frequency of positive and negative adjectives associated with environments

		Prisoners (N = 40)	Prison workers (N=33)	Total
Environment 1	Beautiful	15	13	28
Dormitory	Ugly	14	12	26
	Pleasant	16	11	27
	Unpleasant	16	13	29
	Warm	13	17	30
	Cold	16	6	22
	Comfortable	15	17	32
	Uncomfortable	12	9	21
	Desirable	17	16	33
	Undesirable	9	6	15
	Clean	6	7	13
	Dirty	26	19	45
	Cozy	17	14	31
	Unwelcoming	13	10	23
	Personal	20	18	38
	Impersonal	7	7	14
	Private	17	16	33
	Not private	11	5	16

		Prisoners (N = 40)	Prison workers (N=33)	Total
Environment 2	Beautiful	15	14	29
Prison entrance	Ugly	10	12	22
	Pleasant	15	12	27
	Unpleasant	14	13	27
	Warm	18	20	38
	Cold	10	4	14
	Comfortable	18	11	29
	Uncomfortable	9	11	20
	Desirable	18	18	36
	Undesirable	8	5	13
	Clean	7	5	12
	Dirty	22	20	42
	Hospitable	15	13	18
	Inhospitable	15	11	26
		Prisoners (N = 40)	Prison workers (N=33)	Total
Environment 3	Beautiful	21	18	39
Prison yard	Ugly	7	8	15
	Pleasant	19	15	34
	Unpleasant	10	9	19
	Desirable	18	15	33
	Undesirable	7	6	13
	Useful	16	18	34
	Useless	11	7	18
	Safe	10	4	14
	Dangerous	17	18	35
	Open	19	10	29
	Closed	14	14	28
	Efficient	17	11	28
	Inefficient	10	11	21
	Well maintained	19	13	32
	degraded	13	11	24

4. Discussion

The primary purpose of this study was to look at how prisoners and staff reacted to the physical environments of Como prison. Participants' reactions were measured before and after a virtual reality task in which they were shown computer-generated 3D renderings of three different environments chosen based on the level of social interaction, frequency of use, and level of environmental deterioration. We used both physiological and self-report measures to achieve this goal. To our knowledge, while VR has already been used for therapeutic or learning purposes in prison contexts (Barnes et al., 2022; Teng & Gordon, 2021; Collins et al., 2020), this is the only study that uses an immersive VR experience to collect empirical data on participants' reactions to the prison's physical environment. Another strength of this study is the comparison of the reactions of two different groups to prison architecture, whereas previous research has primarily focused on prisoners' experiences or prison staff only.

Concerning physiological responses, our results suggest that VR environments induce few signs of physiological activation. Prisoners displayed a significantly greater decrease in heart rate (finger pulse) than prison staff, which can be interpreted as an orienting response to novel stimuli (Bradley and Lang, 2012; Lang et al., 1997). Moreover, participants in both groups showed an increase in skin temperature and blood volume pulse while watching the prison entrance simulation. Increases in skin temperature are due to vasodilation, which indexes calm and positive emotional experiences (McFarland, 1985). Likewise, stress-induced hyperthermia is an integral part of individuals' emotional states such as stress, anxiety, or excitement (Olivier et al., 2003; Reeves et al., 1985; Marazziti et al., 1992). Stress-induced hyperthermia occurs both prior to and during exposure to anxiogenic or stress-inducing stimuli, like noise, heat, handling, novelty, or pain. The physiological data we collected does not allow us to define whether the participants' reaction when faced with prison entry is a consequence of negative or positive emotional states. For this reason, we combined physiological measures with psychological ones.

Concerning subjective experience, participants of both groups reported happiness and sadness more frequently than other emotional categories, two feelings with opposite valence. This result and the findings concerning physiological activation, can be interpreted in different ways. First, in order to focus on the impact of the prison's aesthetic and architectural aspects, we excluded the presence of people and sound from our renderings. Aside from the high degree of similarity between virtual and real environments in some ways, our virtual scenarios may have failed to represent other environmental factors that contribute to poor living conditions in prison (e.g., overcrowding, noise), the effects of which have already been extensively researched. Second, it

is possible that the opportunity to participate in the study represented a primarily positive experience that interrupted participants' daily routine. Indeed, the decrease in heart rate during the task indicated that prisoners were more sensitive to novelty.

Concerning the evaluation of environmental elements, our results showed that the aesthetic qualities of the detention section (i.e., colors of wall and floor) were the elements that received the lowest evaluations by our sample. This result is consistent with prior literature. A recent review (Engstrom and Van Ginneken, 2022) has suggested that the aesthetic qualities (together with lighting, materials, noise, views, temperature, air quality, and privacy) are the environmental elements of a personal living space (i.e., cells or dormitories) that most influence the well-being of the prisoners and the prison staff. In general, prisoners and prison staff reported similar evaluations and perceptions of the environment, with few exceptions. More specifically, we discovered that prison workers were mostly critical of the environments' lighting and colours, whereas prisoners were mostly critical of the furniture and space organization. Such distinctions can be attributed to the fact that the environments serve different functions for the two groups (i.e. workplace vs living space).

Lighting dislike among prison staff can be explained in two ways. In the first place, we hypothesized that lighting might be a more attractive item for staff for a control requirement. Indeed, the lack of light in the prison environment (especially during the night) does not give a good idea of what is happening in certain areas and exposes operators to potentially dangerous and highly stressful situations. In addition, the results of several studies showed that physical environment characteristics of workplace (e.g., light, noise, air quality and space design) can negatively influence job satisfaction (Stinglhamber et al., 2022).

Prisoners' negative perceptions of furniture can be explained by referring to the so-called "hard architecture" and "uncomfortable furniture" (used in prison due to security concerns), which have been shown to affect prisoners' self-esteem, identity, and behavior by implicitly communicating to them that they are viewed as potential vandals or nasty people (Jewkes, 2018). Concerning prison architecture, the design of interior places (e.g., the position of the toilet in the cell) can affect prisoners' privacy (Engstrom and Van Ginneken, 2022). Constant exposure, even while using the toilet, represents the greatest loss of normal levels of social and spatial control (Wener, 2012).

The qualitative analysis of the participants' responses reveals the importance that the participants placed on the prison yard. Both prison staff and inmates suggested that this space should be changed by adding furniture elements (prison staff) or increasing the presence of

sport equipment and naturalistic elements (inmates). Extensive literature has shown the beneficial effect that naturalist environments have on people wellbeing (Cammack et al., 2002; Linden, 2015; Jewkes, 2018; Holmes and Waliczek, 2019). Recently, Lee and colleagues (2021) have observed positive changes in prisoners' mental health conditions before and after participating in a horticultural therapy program.

Qualitative data collected through the open-ended question were more informative for the prisoners' group, who provided a higher number of suggestions about possible changes in the environments considered in our research except for the prison entrance. We can assume less involvement from inmates because they have little experience with this environment, as opposed to the prison staff, who handle all the paperwork for the registration of new inmates here. Therefore, differences in involvement answering once again can be related to the environments' function (workplace vs living space) and to the frequency of use. In general, the participants' responses regarding the spatial, aesthetic, and comfort aspects of the prison, suggesting that the environment should be considered in its entirety when assessing its effects on well-being.

Despite the fact that we believe the current study has numerous advantages and contributes significantly to the body of knowledge, there are a few drawbacks to be aware of.

To begin, we used non-probability convenience sampling to collect data. Although convenience sampling does not yield representative results and may produce biased data, it is considered useful in prior researches (Galloway, 2005). To our knowledge, no previous studies using this methodology have been conducted.

Furthermore, we used a VR system that did not include the possibility to actively interact with the environment. Although we acknowledge that the lack of active interaction can reduce the quality of the immersive experience, we believe that the use of interactive models would have resulted in different aesthetic experiences of the environments among participants (e.g., some participants might have lingered longer in the exploration of the environment, while others might have run too fast toward the end of the path). Maintaining constant time and trajectories allowed us to provide all participants with the same experience and achieve more comparable results.

Finally, we used self-report tools to examine participants' perceptions and feelings about the prison environment. Despite the fact that self-report measures are subject to several biases and limitations, in our study, we chose to adopt a multi-method assessment approach based on psychophysiological data, which has given us a more global view.

5. Conclusions

The current study is part of a multidisciplinary research project aimed to examine the reactions of prisoners and staffs to physical prison environment. It demonstrated, as an exploratory study, how the prison environment produces similar emotional responses and arousal activation in both prisoners and prison staff. Participants, as stakeholders, also provide useful information about physical design features that they dislike the most. The term "prison staff" refers to everyone who works in a prison, not just correctional officers. Our findings allowed us to draw attention to the architectural elements of the environment that workers and inmates find the least tolerable. We believe that this has far-reaching implications. While there are numerous activities that could be considered beneficial for criminal rehabilitation, the psychological literature indicates that a lack of welcoming environments is a significant impediment to achieving resocialization and reeducation goals. We are all aware of the importance of the therapeutic environment to the process and outcome of therapy, as well as how poor living conditions in workplaces affect people's well-being.

Although interest towards the effects of institutions architecture on people's well-being has grown in recent years, there is still a paucity of data that empirically highlight its impact within the context of prisons.

As Dostoevsky has claimed in the House of the dead (1861), the civilization of a country is given by the conditions of its prisons. Based on these considerations, we believe that it is important to further examine the relationship between prison architecture and the well-being of inmates and staff.

Ethical approval

Prior to data collection, permission from the local Penitentiary Administration and the prison warden was obtained. The study was approved by the local Penitentiary Administration, the prison warden, and the Ethics Committee of the Università Cattolica del Sacro Cuore of Milan (protocol code: 37-22).

Informed Consent Statement

Informed consent was obtained from all subjects involved in the study.

Data Availability Statement

The authors confirm that the data supporting the findings of this study are available within the article

Conflict of interest statement

The authors have no conflicts of interest to declare.

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Author Contributions

Conceptualization (AS; AC; SB; DR; CB; ES); Methodology (AS; AC; SB); Software (AC; SB; DR; CB); Formal analysis (AS; AC; SB; ES); Resources (AS; AC; SB; ES; DR; CB); Writing - Original Draft (AS; AC; SB; ES); Writing - Review & Editing (AS; AC; SB; ES; DR; CB); Project administration (ES); Funding acquisition (ES).

References

1. Baer, L. D. (2005). Visual imprints on the prison landscape: A study on the decorations in prison cells. *Journal of Economic and Human Geography*, *96*(2), 209-217.https://doi.org/10.1111/j.1467-9663.2005.00451.x
2. Bălan, A., E. Stănișor, and M. Mincă (2002), Penology. Bucharest: Oscar Print, 106.
3. Beijersbergen, K. A., Dirkzwager, A. J., van der Laan, P. H., & Nieuwbeerta, P. (2016). A social building? Prison architecture and staff–prisoner relationships. *Crime & Delinquency*, *62*(7), 843-874. https://doi.org/10.1177/0011128714530657
4. Barnes, N., Sanchez-Vives, M. V., & Johnston, T. (2022). On the practical use of immersive virtual reality for rehabilitation of intimate partner violence perpetrators in prison. *Frontiers in psychology, 13*, 787483. https://doi.org/10.3389/fpsyg.2022.787483
5. Bell, S., Hopkin, G., & Forrester, A. (2019). Exposure to traumatic events and the experience of burnout, compassion fatigue and compassion satisfaction among prison mental health staff: An exploratory survey. *Issues in Mental Health Nursing*, *40*(4), 304-309. https://doi.org/10.1080/01612840.2018.1534911
6. Bell, I. H., Nicholas, J., Alvarez-Jimenez, M., Thompson, A., & Valmaggia, L. (2020). Virtual reality as a clinical tool in mental health research and practice. *Dialogues in clinical neuroscience*, *22*(2), 169–177. https://doi.org/10.31887/DCNS.2020.22.2/lvalmaggia
7. Bernheimer, L. (2017). The shaping of us: How everyday spaces structure our lives, behaviour, and well-being. Hachette UK.
8. Bierie, D. M. (2012). The impact of prison conditions on staff well-being. *International journal of offender therapy and comparative criminology*, *56*(1), 81-95. https://doi.org/10.1177/0306624X10388383
9. Bosma, A. Q., C. van Ginneken, E. F., Sentse, M., & Palmen, H. (2020). Examining prisoner misconduct: A multilevel test using personal characteristics, prison climate, and prison environment. *Crime & Delinquency*, *66*(4), 451-484. https://doi.org/10.1177/0011128719877347
10. Bradley, M. M., Keil, A., & Lang, P. J. (2012). Orienting and emotional perception: facilitation, attenuation, and interference. Frontiers in Psychology, 3, 493. https://doi.org/10.3389/fpsyg.2012.00493
11. Brown, T.L. (2023). *Evaluating Correctional Environments: A Critical Psychosociospatial Approach*. In: Moran, D., Jewkes, Y., Blount-Hill, KL., St. John, V. (eds) *The Palgrave Handbook of Prison Design. Palgrave Studies in Prisons and Penology*. Palgrave Macmillan, Cham. https://doi.org/10.1007/978-3-031-11972-9_11
12. Cammack, C., Waliczek, T. M., & Zajicek, J. M. (2002). The Green Brigade: The psychological effects of a community-based horticultural program on the self-development characteristics of juvenile offenders. *HortTechnology, 12*(1), 8286. https://doi.org/10.21273/HORTTECH.12.1.82
13. Campbell, J. (2019). The impact of caseload and tenure on the development of vicarious trauma in Australian corrective services employees. *Psychotherapy and Counselling Journal of Australia, 7*(2). https://doi.org/10.59158/001c.71247
14. Canter, D. V., & Craik, K. H. (1981). Environmental psychology. *Journal of Environmental psychology, 1*(1), 1-11. https://doi.org/10.1016/S0272-4944(81)80013-8

15. Cipresso, P., Giglioli, I. A. C., Raya, M. A., & Riva, G. (2018). The past, present, and future of virtual and augmented reality research: a network and cluster analysis of the literature. *Frontiers in psychology, 2086.*https://doi.org/10.3389/fpsyg.2018.02086
16. Cocker, F., & Joss, N. (2016). Compassion Fatigue among Healthcare, Emergency and Community Service Workers: A Systematic Review. *International journal of environmental research and public health, 13*(6), 618. https://doi.org/10.3390/ijerph13060618
17. Collins, J., Langlotz, T., & Regenbrecht, H. (2020, November). Virtual reality in education: A case study on exploring immersive learning for prisoners. In *2020 IEEE international symposium on mixed and augmented reality adjunct (ISMAR-Adjunct)* (pp. 110-115). IEEE.
18. DePass, C. M. (2005). *Vicarious trauma in correctional mental health staff*. Carlos Albizu University.
19. Engineer, A., Gualano, R. J., Crocker, R. L., Smith, J. L., Maizes, V., Weil, A., & Sternberg, E. M. (2021). An integrative health framework for wellbeing in the built environment. *Building and Environment, 205*, 108253. https://doi.org/10.1016/j.buildenv.2021.108253
20. Engstrom, K. V., & Van Ginneken, E. F. (2022). Ethical Prison Architecture: A Systematic Literature Review of Prison Design Features Related to Wellbeing. *Space and Culture, 25*(3), 479-503. https://doi.org/10.1177/12063312221104211
21. Faul, F., Erdfelder, E., Lang, A.-G., & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods, 39*, 175-191. https://doi.org/10.3758/BF03193146
22. Figley, C. R. (1995). *Compassion fatigue: Toward a new understanding of the costs of caring*. In B. H. Stamm (Ed.), Secondary traumatic stress: Self-care issues for clinicians, researchers, and educators (pp. 3–28). The Sidran Press.
23. Frost, N. A., & Monteiro, C. E. (2020). The interaction of personal and occupational factors in the suicide deaths of correction officers. *Justice Quarterly, 37*(7), 1277-1302.
24. Galford, G. (2021). Prison as Home: Characteristics of Control Within General Prison and Solitary Confinement Environments. *Journal of Interior Design, 46*(2), 35-53. https://doi.org/10.1111/joid.12190
25. Galloway, A. (2005). Non-Probability Sampling. Editor(s): Kempf-Leonard, K. Encyclopedia of Social Measurement, Elsevier, 2005, pp. 859-864. https://doi.org/10.1016/B0-12-369398-5/00382-0.
26. Goomany, A., & Dickinson, T. (2015). The influence of prison climate on the mental health of adult prisoners: a literature review. *Journal of psychiatric and mental health nursing*, *22*(6), 413–422. https://doi.org/10.1111/jpm.12231
27. Gozzoli, C., D'Angelo, C., & Tamanza, G. (2018). Training and resistance to change: Work with a group of prison guards. *World Futures*, *74*(6), 426-449. 10.1080/02604027.2018.1485420
28. Green, E. L., Williams, L. S., & Chernoff, W. A. (2022). "This Place Is Going to Burn": Measuring Prison Climate in Three Facilities. *Correctional Facilities and Correctional Treatment*, 111. 10.5772/intechopen.106588
29. Hancock, P., & Jewkes, Y. (2011). Architectures of incarceration: The spatial pains of imprisonment. *Punishment & Society*, *13*(5), 611-629. https://doi.org/10.1177/1462474511422171

30. Hatcher, R., & Noakes, S. (2010). Working with sex offenders: The impact on Australian treatment providers. *Psychology, Crime & Law*, *16*(1-2), 145-167. https://doi.org/10.1080/10683160802622030
31. Holmes, M., & Waliczek, T. M. (2019). The effect of horticultural community service programs on recidivism. *HortTechnology, 29*(4), 490-495. https://doi.org/10.21273/HORTTECH04282-19
32. Jewkes, Y. (2018). Just design: Healthy prisons and the architecture of hope. *Australian and New Zealand Journal of Criminology, 51*(3), 319–338. https://doi.org/10.1177/0004865818766768
33. Jewkes, Y., Moran, D., & Turner, J. (2020). Just add water: Prisons, therapeutic landscapes and healthy blue space. *Criminology & Criminal Justice*, *20*(4), 381-398. https://doi.org/10.1177/1748895819828800
34. Jimenez, R. R., Andersen, S., Song, H., & Townsend, C. (2021). Vicarious trauma in mental health care providers. *Journal of Interprofessional Education & Practice, 24*, 100451. https://doi.org/10.1016/j.xjep.2021.100451
35. Lang, P. J., Bradley, M. M., and Cuthbert, B. N. (1997). *"Motivated attention: affect, activation, and action"* in Attention and Orienting: Sensory and Motivational Processes, eds P. J. Lang, R. F. Simons, and M. T. Balaban (Hillsdale, NJ: Lawrence Erlbaum Associates), 97–135.
36. Lee, A. Y., Kim, S. Y., Kwon, H. J., & Park, S. A. (2021). Horticultural therapy program for mental health of prisoners: Case report. *Integrative medicine research, 10*(2), 100495. https://doi.org/10.1016/j.imr.2020.100495
37. Lessiter, J., Freeman, J., Keogh, E., & Davidoff, J. (2001). A cross-media presence questionnaire: The ITC-Sense of Presence Inventory. *Presence: Teleoperators & Virtual Environments, 10*(3), 282-297. https://doi.org/10.1162/105474601300343612
38. Linden, S. (2015). Green prison programmes, recidivism and mental health: A primer. *Criminal Behaviour and Mental Health*, *5*(25), 338-342. https://doi.org/10.1002/cbm.1978
39. Marazziti, D., Di Muro, A., & Castrogiovanni, P. (1992). Psychological stress and body temperature changes in humans. *Physiology & behavior, 52*(2), 393-395. https://doi.org/10.1016/0031-9384(92)90290-I
40. Maslach, C., & Leiter, M. P. (2016). Understanding the burnout experience: recent research and its implications for psychiatry. *World psychiatry : official journal of the World Psychiatric Association (WPA)*, *15*(2), 103–111. https://doi.org/10.1002/wps.20311
41. McFarland, R. A. (1985). Relationship of skin temperature changes to the emotions accompanying music. *Biofeedback and Self-regulation, 10*(3), 255-267. https://doi.org/10.1007/BF00999346
42. Meijers, J., Harte, J. M., Meynen, G., & Cuijpers, P. (2017). Differences in executive functioning between violent and non-violent offenders. *Psychological medicine*, *47*(10), 1784-1793. https://doi.org/10.1017/S0033291717000241
43. Meijers, J., Harte, J. M., Meynen, G., Cuijpers, P., & Scherder, E. J. (2018). Reduced self-control after 3 months of imprisonment; a pilot study. *Frontiers in Psychology, 9*, 69. https://doi.org/10.3389/fpsyg.2018.00069
44. Mento, C., Silvestri, M. C., Merlino, P., Nocito, V., Bruno, A., Muscatello, M. R. A., ... & Kawai, T. (2020). Secondary traumatization in healthcare professions: A continuum on compassion fatigue, vicarious trauma and burnout. *Psychologia, 62*(2), 181-195. https://doi.org/10.2117/psysoc.2020-B013

45. Moran, D., & Turner, J. (2019). Turning over a new leaf: The health-enabling capacities of nature contact in prison. *Social science & medicine (1982)*, *231*, 62–69. https://doi.org/10.1016/j.socscimed.2018.05.032
46. Moran, D., Jones, P. I., Jordaan, J. A., & Porter, A. E. (2020, p. 1781). Does nature contact in prison improve well-being? Mapping land cover to identify the effect of greenspace on self-harm and violence in prisons in England and Wales. *Annals of the American Association of Geographers*, *111*(6), 1779-1795.
47. Moran, D., Jones, P. I., Jordaan, J. A., & Porter, A. E. (2022). Nature contact in the carceral workplace: greenspace and staff sickness absence in prisons in England and Wales. *Environment and Behavior*, *54*(2), 276-299. https://doi.org/10.1177/00139165211014618
48. Newell, J. M., & MacNeil, G. A. (2010). Professional burnout, vicarious trauma, secondary traumatic stress, and compassion fatigue. *Best practices in mental health*, *6*(2), 57-68.
49. Peper, E., Harvey, R., Lin, I. M., Tylova, H., & Moss, D. (2007). Is there more to blood volume pulse than heart rate variability, respiratory sinus arrhythmia, and cardiorespiratory synchrony?. *Biofeedback, 35*(2).
50. Olivier, B., Zethof, T., Pattij, T., Van Boogaert, M., Van Oorschot, R., Leahy, C., ... & Groenink, L. (2003). Stress-induced hyperthermia and anxiety: pharmacological validation. *European journal of pharmacology*, *463*(1-3), 117-132. https://doi.org/10.1016/S0014-2999(03)01326-8
51. Reeves, D. L., Levinson, D. M., Justesen, D. R., & Lubin, B. (1985). Endogenous hyperthermia in normal human subjects: experimental study of emotional states (II). *International journal of psychosomatics: official publication of the International Psychosomatics Institute*, *32*(4), 18-23. https://doi.org/10.3758/BF03326531
52. Riva, G. (2022). Virtual Reality in Clinical Psychology. *Comprehensive Clinical Psychology, 91*–105. 10.1016/B978-0-12-818697-8.00006-6.
53. Riva, G., & Serino, S. (2020). Virtual Reality in the Assessment, Understanding and Treatment of Mental Health Disorders. *Journal of Clinical Medicine*, *9*(11), 3434. https://doi.org/10.3390/jcm9113434
54. Ross, M. W., Diamond, P. M., Liebling, A., & Saylor, W. G. (2008). Measurement of prison social climate: A comparison of an inmate measure in England and the USA. *Punishment & Society, 10*, 447-474. https://doi.org/10.1177/1462474508095320
55. Schenk, A. M., & Fremouw, W. J. (2012). Individual characteristics related to prison violence: A critical review of the literature. *Aggression and Violent Behavior, 17*(5), 430-442. https://doi.org/10.1016/j.avb.2012.05.005
56. Sorge, A., & Saita, E. (2021). Assessment of suicide and self-harm risk in foreign offenders. Evaluating the use of tree-drawing test. *Mediterranean Journal of Clinical Psychology*, *9*(3). https://doi.org/10.13129/2282-1619/mjcp-3024
57. Stamm, B. (1995). Secondary traumatic stress: Self-care issues for clinicians, researchers, and educators. The Sidran Press.
58. Stevens, P. (2010). Embedment in the environment: A new paradigm for well-being?. *Perspectives in public health, 130*(6), 265-269. https://doi.org/10.1177/1757913910384047

59. Stinglhamber, F., Nguyen, N., Josse, M., & Demoulin, S. (2022). The Development of Prison Officers' Job Satisfaction and its Impact on Depersonalization of Incarcerated Persons: The Role of Organizational Dehumanization. *Criminal Justice and Behavior, 49*(11), 1600–1617. https://doi.org/10.1177/00938548221087182

60. Teng, M. Q., & Gordon, E. (2021). Therapeutic virtual reality in prison: Participatory design with incarcerated women. *new media & society*, *23*(8), 2210-2229. https://doi.org/10.1177/1461444821993131

61. Thaler, O., Barkworth, J. & Howard, M. (2022). *A qualitative exploration of factors influencing prison social climate at Rapid Build and traditional correctional centres*. NSW Government.

62. van Ginneken, E. F., & Nieuwbeerta, P. (2020, p.1). Climate consensus: A multilevel study testing assumptions about prison climate. *Journal of Criminal Justice*, *69*, 101693. https://doi.org/10.1016/j.jcrimjus.2020.101693

63. Wener, R. (2012). *The environmental psychology of prisons and jails: Creating humane spaces in secure settings*. Cambridge University Press.

64. WHO, 2022. Addressing the noncommunicable disease (NCD) burden in prisons in the WHO European Region. Interventions and policy options. WHO/EURO:2022-4912-44675-63435 available in: https://www.who.int/europe/publications/i/item/WHO-EURO-2022-4912-44675-63435 Accessed: 27/12/22

65. WHO, 2014. Prisons and health. WHO Regional Office for Europe ISBN: 978 92 890 5059 3. Available in: https://www.euro.who.int/__data/assets/pdf_file/0005/249188/Prisons-and-Health.pdf. Accessed: 27/12/22

DOI: 10.13129/2282-1619/mjcp-3808