Window Views: Difference of Perception during the COVID-19 Lockdown

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Abstract

The provision of daylight, fresh air, and of a view outdoors are among the known characteristics of windows. But how does the perception of a window differ when it becomes the primary way of connecting to the physical world outside? In the first half of 2020, many countries resorted to strict lockdown measures to control the spread of the SARS-CoV-2 virus. The impact of such confinement, and the restriction to movement and social contact between people, is currently undergoing intense research. As such, this study reports the findings of a global online survey, administered before and after the COVID-19 outbreak, aimed at identifying whether any significant difference related to the lockdown could be observed in the perception of windows. The results confirm a practically relevant increase in the importance given to windows as a way to provide an external view and a visual and social connection with other people. Conversely, the role of the window as a conveyor of information on weather and time of the day was less prevalent. This is one of the first studies evaluating the difference in the perception of windows within a period of enforced lockdown. The findings can help capture the psychological impacts of confinement on people and may be relevant when transferred to other domains where building occupants could strongly benefit from the restorative effects of window views.

Keywords

Window; Views; Perception; Preference; Lockdown; COVID-19

1. Introduction

The sudden outbreak of the SARS-CoV-2 virus across the globe in the first half of 2020 imposed strict confinement and social distancing measures in many countries as a means to limit the spread of the coronavirus disease (COVID-19) and reduce pressure on public healthcare systems (Wilder-Smith and Freedman 2020). In some countries, even if no lockdown had been imposed, many people chose to stay at home and limit their contact with others (Chauhan and Singh 2020).

While these measures have helped to contain, at least partially, the spread of the pandemic, several questions arise in terms of the impacts that the lockdown might have had on the wellbeing of people. For example, personal space encroachment (Wang, Zhang et al. 2020), solitary living for extended periods of time (Mackolil and Mackolil 2020, Odriozola-González, Planchuelo-Gómez et al. 2020), working, schooling or exercising from home, etc., may have blurred the conventional notions of space and time, while reduced social contact might have affected people's feelings and attitudes particularly with respect to the perception of their surroundings.

In this context, it is well established in the literature that windows provide daylight, ventilation, and a multi-sensory (audio-visual) relationship with the outside (Heschong 2003, Veitch, Christoffersen et al. 2013). They convey information about the time of the day and the weather, and proximity to them is often favoured particularly for workspace locations (Boyce, Hunter et al. 2003, Asojo, Bae et al. 2020).

On the assumption that windows are potential sources of interest and connection with the external world, the aim of this paper is to investigate how perceptions such as familiarity, preference, and satisfaction with a view out of the window, and with its size and location, might differ between a standard reference condition (pre-COVID-19) and a period of lockdown due to a sanitary threat such as the SARS-CoV-2 virus.

2. Materials and Methods

2.1. The Survey

A doctoral study is being conducted on window view preference by the first author of this paper. In this context, during the period between 21 October 2019 – 22 January 2020 an international online survey was run (*Survey 1*). The original survey was structured into 24 questions, ranging from exploring window characteristics to perceptions of view familiarity, preference, satisfaction, etc. The questions were based on a review of the literature focused on window view preference (Christoffersen, Johnsen et al. 2000, Farley and Veitch 2001, Heschong 2003, Hellinga and Hordijk 2014, Matusiak and Klöckner 2016). In this context, the term 'preference' was used in its noun form for expressing how much the participants 'liked' a view, for whatever reasons they may have (Kaplan, Kaplan et al. 1972, Herzog and Gale 1996, Herzog and Shier 2000).

A few months after the data collection was completed, a lockdown was imposed in many parts of the world in response to the spread of the SARS-CoV-2 virus. This presented an opportunity to collect new data to compare with the existing dataset, and investigate any impact that such a radical change to the ways of working and living, and interactions (or lack thereof) with the external environment, might have had on window perception. The same survey was opened for four additional weeks on 5 April 2020 (*Survey 2*), when the global response on containment strategies was at its peak (Hale, Angrist et al. 2020). Since the term 'lockdown' has been interpreted and implemented differently across the world, the 'stringency index' (Hale, Sam, et al., 2020) has been used as a comprehensive measure of government responses to the COVID-19 outbreak. Throughout the administration period of Survey 2 (see Supplemental Material, Appendix 2), this index ranged between 66.2 and 91.5 in average (on a scale of 0-100)

in 37 out of the 38 the countries from where data were gathered (Hale, Angrist, et al., 2020), and between 54.48 and 75.12 from participating US states (Hale, Atav, et al., 2020).

The original survey received ethics approval in October 2019. Participants were recruited using snowball sampling via various international networks. Anyone over the age of 18 could participate by signing an online consent form in compliance with the ethics statement and privacy protection regulations (GDPR 2016). No personally identifying information was collected in the survey. Taking approximately 5 minutes to complete, the questions were kept brief to prevent bias associated with response fatigue (Choi and Pak 2005). There were 507 complete responses in Survey 1 and 238 responses in Survey 2. Since participation to Survey 1 was not a condition for exclusion to Survey 2, we cannot rule out some overlaps in respondents. However, we have considered the possibility that sample values from participants to Survey 1 be related, or somehow paired or matched, with those for Sample 2 to be marginal. For this reason, independent sample statistics were conservatively used to analyse the data. The complete questionnaire can be found in the Supplemental Material, Appendix 1.

This paper does not aim to present a full analysis of all the items featured in the surveys, but only focuses on whether the perception of the window differed between a 'normal' (pre-COVID 19) situation and a lockdown period. Specific constructs were framed to detect differences in the perception of: familiarity with the window; preference (i.e., like or dislike) for the view out of the window; satisfaction with the view out of the window; satisfaction with the size of the room with respect to the size of the window; and, satisfaction with the participant's location with respect to the window.

Following a series of initial questions aimed at gathering information on the specific setting from where the survey was responded to, most personal evaluations

were measured on visual analogue scales. To further explore the responses provided, the survey featured multiple-choice questions on various window features and gave participants the opportunity to express open-ended comments in the form of free text.

2.2. Data Distribution

Survey data was collected from 44 countries in Survey 1 (N= 507) and 38 countries in Survey 2 (N = 238). The United Kingdom, United States, Italy, Spain, Pakistan, and Belgium totally accounted for, respectively, 57.2% and 76.5% of the responses in the two surveys. The majority of responses were received from the northern hemisphere, experiencing the winter season in Survey 1 (96.8%) and spring in Survey 2 (99.1%). The only exceptions were Australia (12 responses), New Zealand (2 responses), Chile (3 responses) and South Africa (2 responses) in Survey 1, and Indonesia (1 response) and Australia (2 responses) in Survey 2. In Survey 1, responses were given mostly in the afternoon (53%) and the morning (21%), followed by mid-day (17%), evening (7%), and night (2%). In Survey 2, respondents gave their answers in the morning (39%), and then in the afternoon (30%), mid-day (20%) and evening (11%). The orientation of windows in both surveys were almost equally distributed between cardinal points.

Distribution of participants' floor level location was similar in the two surveys. In Survey 1, most responses were given by people working or living on the first three floors of their building (78%); i.e. ground floor (26%), first floor (34%), and second floor (18%). In Survey 2, most respondents answered the survey from a location closer to the ground (82%), with ground floor accounting for 30%, and the first and second floors representing 33% and 18% of the total. The distance of the participants to the perimeter was consistent between the two surveys, with 90% of respondents sitting in proximity (within 2 meters) of the window.

In interpreting the distribution of the data, it must be reminded that Survey 1 could have been responded to while at a workplace or from home, while data for Survey 2 were collected from people that could have been confined at home due to government-imposed lockdowns or to voluntary self-isolation.

2.3. Data Analysis

The data were exported from the SoSciSurvey.de host website into Microsoft Excel (2016) and SPSS Statistics 26.0 (SPSS, Chicago, IL) for graphical visualisation and for quantitative and qualitative analysis of responses.

Initial quantitative tests were run to verify if the data met the assumptions for performing parametric statistical analysis. Although the tests of normality (Kolmogorov-Smirnov and Shapiro-Wilk) were both significant, visual inspection of the boxplots and histograms revealed skewness in the data and the presence of outliers (refer to the boxplots presented in the Supplemental Material, Appendix 3). Rather than deleting outliers, as they seemed to present valid cases (i.e., participants with a reasoned justification for their differences in perception), non-parametric Mann-Whitney U tests were used to analyse the responses. This is generally considered a more resilient approach to treat data with outliers (Field 2009). The Mann-Whitney U test is appropriate when variables fall under two conditions using different subjects.

The emphasis of the inferential tests was placed on the significance of the statistical tests (at the α level of 0.05) and on the effect size, this providing a standardised measure of the practical relevance of the differences detected between the two surveys. The effect size was estimated by the Pearson's coefficient *r*, calculated from the z scores. The interpretation of the outcome was derived from published benchmarks, with values ranging between negligible ($r < 0.1$), small ($0.1 \leq r < 0.3$), medium ($0.30 \leq r < 0.50$) and large (≥ 0.50) (Cohen 1992) (Field 2009).

To interpret and contextualise any difference in perception detected in the quantitative analysis, responses to multiple-choice questions and open-ended comments on window features were explored using qualitative statistical approaches. More specifically, the open-ended comments were analysed using coding techniques through NVivo 12 (QSR International 1999, Creswell 2018), where categories of responses were initially identified as themes. Following this, a second and third analysis of the data led to the identification of emergent themes, these presented as frequency tables.

3. Results

3.1. Window Perception

The response frequency to question n. 5 on the time participants had occupied their current place (that is, the physical location from where the survey was responded to, e.g., the desk) is reported in Figure 1. The data shows similar distributions between the two surveys, with most participants in Survey 1 (37%) and Survey 2 (45%) having occupied the place from where they were evaluating their window and its view for more than 3 years. There is, however, a 16% frequency increase in the 'less than 3 months' category in Survey 2 (from 13% to 29%). It might be hypothesised that this could be linked to people providing their responses from a 'new' setting with respect to the window, either due to a physical readjustment or to a difference in perception.

Figure 1. Time of occupancy: response frequency to the question: 'How long have you occupied the place (e.g., desk)?'

Table 1 presents, for the complete dataset and for all category scores of window perception analysed, the medians (M_{dn}) and interquartile ranges (IQR), the means (M) and standard deviations (SD), the median difference (ΔM_{dn}, Survey 2 vs. Survey 1) between the groups and the outcome of its statistical significance (NHST, *p*-value calculated with a two-tailed test), the Mann–Whitney test statistic (U), and the effect size (r).

Table 1. Independent sample Mann-Whitney U test on window perception

		Survey 1 (N= 507)		**Survey 2 (N = 238)**				
		M_{dn} (IQR)	M (SD)	M_{dn} (IQR)	M (SD)	ΔM_{dn}^{NHST}	*U*	Effect size (*r*)
Window View	Familiarity	88.00 (26)	81.36 (21.27)	93.00 (22)	86.10 (17.24)	+5.0**	67752.0	0.10
	Preference	70.00 (43)	63.29 (28.20)	76.50 (28)	71.20 (22.78)	+6.5***	69406.5	0.12
	Satisfaction	64.00 (53)	59.88 (30.31)	73.00 (31)	69.31 (24.78)	+9.0***	70466.0	0.14
Satisfaction	Size of window	78.00 (28)	75.01 (22.43)	80.50 (30)	77.32 (19.86)	+2.5 n.s.	62439.5	0.03
	Size of room with respect to window	74.00 (32)	70.86 (24.14)	79.00 (33)	74.13 (22.92)	+5.0 n.s.	64941.0	0.06
	Location with respect to window	70.00 (35)	65.14 (25.05)	73.00 (29)	71.14 (21.84)	+3.0**	67794.0	0.10

***$p \leq 0.001$, **$p \leq 0.01$, *$p \leq 0.05$, n.s.= not significant ($p \geq 0.05$)
$r < 0.10$ = negligible; $0.10 \leq r < 0.30$ = small; $0.30 \leq r < 0.50$ =moderate; $r \geq 0.50$ = large
Shaded cells indicate practically-relevant (substantive) effect sizes

The results of the inferential tests indicate that differences across the independent variables between the two surveys are statistically significant, with effect sizes of substantive magnitude for all rating variables on window view: familiarity (p= 0.007**, r= 0.10), preference (p= 0.001***, r= 0.12), and satisfaction (p= 0.000***, r= 0.14). No statistically significant or practically relevant difference was found between the ratings of satisfaction with the size of the window (p= 0.441n.s., r= 0.03) and with the size of the room with respect to the window (p= 0.092n.s., r= 0.06). Conversely, satisfaction with the location of the respondent relative to the window was significantly and substantively higher in Survey 2 (p = 0.006**, r= 0.10).

These data indicate that, during the COVID-19 lockdown period, respondents felt more familiar and satisfied, and expressed a higher preference (like), with their view outside. They also expressed a higher satisfaction with their location with respect to the window. To further investigate the results of the statistical tests, the responses to multiple-choice questions related to different categories of window features, and the comments given by respondents in the form of free text, were thematically analysed.

3.2. Window Features

3.2.1. Positive Features

In response to a multiple-choice question on the positive features of the window (question n. 21), participants were asked to select their top three choices. The frequency of each statement in the two surveys was compared to explore the reasons behind the detected difference in perception. Table 2 summarizes the results.

Table 2. Perception of positive window features

	Survey 1 (N = 507)		**Survey 2 (N = 238)**		**Difference**
	N	**%**	**N**	**%**	**%**
Provides a view out	236	47%	136	57%	+10%
Allows fresh air into the space	159	31%	98	41%	+10%
Allows me to look away from my task (e.g., PC screen)	104	21%	69	29%	+8%
Provides good lighting in the space	185	36%	102	43%	+7%
Lets me interact with something/someone on the other side of the window	2	0%	6	3%	+3%
Lets me observe other people and activities outside	57	11%	26	11%	0%
Provides light to plants	59	12%	21	9%	-3%
Lets daylight in	382	75%	169	71%	-4%
Tells me the time of day	61	12%	14	6%	-6%
Tells me how the weather is outside	186	37%	49	21%	-16%

When looking at the differences in the frequency of choices, Survey 2 recorded an increase in responses for the provision of a view out (+10%), for allowing fresh air into the space (+10%), and for looking away from the task (e.g., PC screen) (+8%).

Conversely, the positive window features that in Survey 2 had a lower frequency of recurrence than in Survey 1 were related to information about the weather outside (-16%), the time of the day (-6%), and letting daylight in (-4%).

In order to contextualise these results, it must be considered that Survey 2 was run at the beginning of the northern hemisphere spring, this maybe having a role in the higher perceived importance of the window as a source of ventilation. Conversely, previous studies have reported an effect of window view perception on the ability to evaluate current weather conditions (Hellinga 2013, Matusiak and Klöckner 2016). The reduction in perceived need for knowledge of the weather and time of day might, however, be ascribed to the fact that many people were not allowed to go outdoors. Therefore, the weather and time may not have played as an important role in daily activities as they did at the time of Survey 1.

To further investigate the increase in perceived importance of looking out of the window in Survey 2, for its view or to move the gaze away from the task, we looked at the open-ended comments that some respondents added to their answers. Nine comments were provided in this part of the survey, implying that the windows were used to '*interact with a neighbour* (3 instances), *'blur the boundary between inside and outside'* (1 instance), '*see wildlife'* (1 instance), and to '*interact with nature'* (4 instances).

3.2.2. Blinds and Curtains

Blinds and curtains play a mediatory role between the window and the outside. To understand how often and why participants used blinds and curtains, two questions were asked. The first question in this category (n. 12) asked the participants about their ability to control the shading (e.g., blinds and curtains). 79% of participants answered

positively to this question in Survey 1 and 87% in Survey 2, an increase of 8% between the two surveys. This was followed up by another question (n. 13) exploring the reasons behind the opening of the blinds and curtains. The results are summarised in Table 3.

Table 3. Reasons for opening a blind/curtain

	Survey 1 (N = 507)		**Survey 2 (N = 238)**		**Difference**
	N	**%**	**N**	**%**	**%**
Provides a view out	182	37%	114	49%	+12%
Allows me to look away from my task (e.g., PC screen)	52	11%	39	17%	+6%
Provides good lighting in the space	218	44%	113	49%	+4%
Provides light to plants	52	11%	28	12%	+2%
Lets me observe other people and activities outside	57	12%	31	13%	+2%
Allows fresh air into the space	85	17%	43	19%	+1%
Lets me interact with something/someone on the other side of the window	5	1%	2	1%	0%
Lets daylight in	397	83%	188	81%	-2%
Tells me the time of day	42	9%	9	4%	-5%
Tells me how the weather is outside	191	39%	57	25%	-14%

The blinds/curtains were opened most frequently to let daylight in and provide good lighting of the space in both surveys. In Survey 2, a 12% increase from Survey 1 was recorded for providing a view out, followed by the opportunity to look away from a task (6%). The most evident decrease in statement selection was related to the information on the weather outside (-14%), followed by operating the blinds to connect with changes in time of the day (-5%). These results are, therefore, consistent with those related to the positive aspects of window features. There was a small positive difference (+2%) in the use of windows for observing people and activities outside. However, one should consider that, in Survey 2, there may have been limited observable activity outside due to the lockdown.

3.2.3. Negative Features

To get a balanced view of window perception, we included a question on the negative features of windows. Table 4 shows the list of statements that participants could select in response to the multiple-choice question on the negative features of the window, in their space (n. 22).

Table 4. Perception of negative window features

	Survey 1 (N = 507)		Survey 2 (N = 238)		Difference
	N	%	N	%	%
None	105	21%	69	29%	+8%
Other	30	6%	18	8%	+2%
Allows too much heat	72	14%	37	16%	+1%
Reduces the ability to freely furnish the space	36	7%	18	8%	0%
Allows too much sunlight	64	13%	29	12%	0%
Causes annoying glare	85	17%	41	17%	0%
Activities outside distract me	44	9%	18	8%	-1%
Allows others to see inside	108	21%	48	20%	-1%
Can`t see the sky	29	6%	9	4%	-2%
Provides poor working light	42	8%	15	6%	-2%
Allows too much noise from the street	103	20%	42	18%	-3%
Can`t see the ground	45	9%	12	5%	-4%
Provides too much cold draft in winter	147	29%	44	18%	-11%

When comparing the results from the two surveys, the most relevant differences were detected for the statements related to windows providing excessive draught (-11% in Survey 2) and for the “none” category (+8%). However, the decrease in the frequency of responses related to cold draughts can be attributed to the change in season, for most participants from winter to spring. Conversely, it is interesting to see more people not expressing any negative thought about their window in Survey 2. Potential effects of seasonality, for example, due to the change from summer to autumn rather than winter to spring, could not be further explored since only few responses were received from countries located in the southern hemisphere.

3.2.4. Differences due to the Lockdown

At the end of Survey 2, we asked two additional questions that were not originally included in Survey 1. These questions were added to offer to participants the opportunity to, *qualitatively*, elaborate on the changes to their daily habits and behaviours that had been imposed, voluntarily or due to external restrictions, by the lockdown. Firstly, we asked the respondents if their conventional workspace arrangement or location had been affected or not by the COVID-19 lockdown (question n. 25). The second question (n. 26) was open-ended and invited the participants to explain the changes, if any, that they had made.

Out of a total of 238 responses, 34.5% (N=82) of the participants gave an affirmative answer to question n. 25. For those that did not report a change in workspace arrangement or location, although not required by the survey, many participants added a comment that their situation had not changed since they already worked from home, or were not working at all, during the lockdown period. It must be noted that – based on the results of an additional Mann-Whitney U test run only on Survey 2 responses (N=238) – having reported a change in workspace arrangement did not have any statistically significant effect on the distributions of window perception responses for Survey 2 as presented in Table 1.

The analysis of qualitative responses allowed us to bridge the missing gaps in answers and provided a personal perspective on the function of windows at the time of Survey 2. Table 5 summarises the results of the content analysis, revealing specific trends in any change of behaviour.

Table 5. Themes in the content analysis of stated changes

In relation to the window, participants	N = 82	%
Left the blinds/curtains open more regularly or for longer	23	28.0%
Appreciated/noticed the view more	21	25.6%
Looked out more often	20	24.4%
Left the window open more regularly or for longer	17	20.7%
Took regular breaks from the task to look out	16	19.5%
Established a new connection with outside sounds, such as birds	9	11.0%
Are located away from the window, but walk up to it for breaks	5	6.1%
Appreciate the daylight more often	5	6.1%
Started an innovative activity through this new relationship with window	4	4.9%
Used the balcony more often	2	2.4%
Are looking out less because of less people/activity	2	2.4%
Don't look out because of others' privacy	2	2.4%

The participants stated that they left the blinds/curtains open for longer, and more regularly opened them, than before the lockdown (28%). While some respondents had a higher appreciation of their view out (25.6%), others specifically stated that they looked out of the window more often (24.4%). Some participants responded that they opened the window more often, or for longer periods of time (20.7%). They took regular breaks from the task at hand by looking out of the window (19.5%), even if they had to walk up to the window (6.1%). Some were more aware of the sounds outside the window, e.g. nature and street life (11%), and stated to appreciate having daylight through the window during the lockdown more often than before (4.9%). While privacy is a known issue in the design of windows (Markus 1967), only a few participants declared that they intentionally did not look out, or let the blinds down, to avert invading on their neighbours' privacy (2.4%).

In four cases (4.9%), participants came up with creative ways to engage with their external world; two are worth mentioning. One participant shared that they started an item exchange scheme via ropes in the neighbourhood through their window. This is an interesting example demonstrating how a window can act as an *agency* for people's connection, not just visually but also in material form, triggering a new sense of

community. Another example is of an international collaboration, where a photographer started recording his relationship with his own window daily. He then proceeded to invite the world, with the slogan ‘from my window to yours’, to share window views with others via the web. This has been a recurrent phenomenon during the COVID-19 lockdown, where people all over the world have started sharing their window views, and lived experiences, on various social media (e.g., Facebook). A growing number of photographs have been posted in response to these calls (Duriau 2020, Hakim 2020). Conversely, many people have also started to post ‘silent messages’ (Mccluskey 2020) on their windows to communicate with their neighbours.

We know that many businesses moved to online practices since the start of the lockdown (Finn 2020), meaning that many people were working from their homes. Among the 82 respondents that declared to have changed their workspace arrangement or location, the textual data analysis revealed that 67 (81%) moved their desk closer to a window. Among the responses provided by these 67 participants, Table 6 summarises the stated reasons for having chosen a desk location closer to the window.

Table 6. Reasons for locating the desk closer to the window

	N= *67*	*Percentage*
To get daylight/sunlight	19	28.4%
To have a view out	18	26.9%
To look out	11	16.4%
To get fresh air	7	10.4%
Connect with people outside	5	7.5%
Rearranged to larger windows	5	7.5%
As a replacement for going out	3	4.5%
To be seen	2	3.0%
Receive solar gain	2	3.0%
Check weather/time	1	1.5%

The content analysis revealed that the underlying reasons for locating close to a window were provision of daylight/sunlight (28.4%), the ability to have a view out (26.9%), to look out (16.4%), to access fresh air (10.4%) and to be able to visually connect with people or neighbours (7.5%). A few participants relocated their workspace from another location in the house to be next to a larger opening (7.5%). Some respondents thought that setting up their workspace closer to a window would compensate for not being able to go out (4.5%), while only a few participants located themselves closer to the window to be seen by neighbours (3.0%), to warm up with solar gains (3.0%), or to check the weather and time of day (1.5%).

4. Discussion

This study shares the outcomes of a survey conducted before and during a period of lockdown, lending an opportunity to investigate any difference in the perception of windows. A summary of the core findings is presented below.

The familiarity and satisfaction with the space, and with the participant's location with respect to the window, were significantly and substantively higher in the lockdown period (that is, the differences detected were statistically significant and had a practically relevant magnitude of effect size). This is congruent with previous studies where familiarity is known to play a role in predicting preference in urban spaces (Herzog, Kaplan et al. 1976, Imamoglu 2000). With a likely increasing number of people working from home (Dingel and Neiman 2020), especially during the lockdown, this could mean an overall positive boost in the perceived satisfaction with respect to the windows in familiar spaces, and perceived control over the operation of blinds and curtains. The period of lockdown also resulted in a reduced negative perception of windows. Access to a window, and to daylight and view out, can play an important role

in the perceived satisfaction of a space. However, further research needs to be carried out before findings can be generalized to work-from-home conditions and its long-term effects.

Preference for, and satisfaction with, the view out of the window was significantly and substantively higher during the lockdown period. The fact that participants reported to notice the view more often, and kept the blinds and curtains open for longer to look out of the window, builds on the notion that human beings want to connect with the outside world. While confinement can have a detrimental effect on the psychological wellbeing of individuals (Hawryluck, Gold et al. 2004, Glynn, Boland et al. 2016, Mackolil and Mackolil 2020), an interest in the view out of the window has been found – among other effects – to increase tolerance to discomfort glare (Tuaycharoen and Tregenza 2007). Our findings, therefore, emphasize that, during a period of confinement, windows are in fact 'windows of opportunity' that can support the wellbeing of building occupants by becoming a vehicle to connect with the outdoors. This might be especially relevant in light of the risk of further global pandemic outbreaks (GPMG 2019).

During the lockdown, many people tended to locate their work or desk closer to a window for daylight and view out, making the areas adjacent to the window vital in the use of their spaces. Access to daylight and view out could imply meaningful changes to the design of buildings, e.g. depth of building floors in relation to windows. We could extend these findings to other types of enforced confinement, e.g. during curfews, in prisons and in hospitals. Windows are known to be vital in health and palliative care facilities, where access to daylight (Keep, James et al. 1980, Gbyl, Østergaard Madsen et al. 2016) and quality views (Ulrich 1984) may play a positive role in patient's recovery time. Accordingly, windows should not be designed only to

admit daylight but also to enable a view out, giving critical consideration to the line of sight of the occupants in the room (CEN 2018).

A decrease in negative perceptions due to cold draughts was felt between the two time periods, possibly owing to the seasonal change from the winter to spring for the majority of respondents. We know that thermal comfort (e.g., radiative exchanges) plays a part in the perception of the window, consistent with previous literature (Shi, Qian et al. 2018). Unfortunately, in many countries, building regulations only partially embrace the multifaceted roles of windows (Boubekri 2004). In the UK, for example, an effort to minimise heat losses and construction costs (Lewis 2015) has led to reductions in window size. Since windows are considered generally less energy efficient than walls, 'tighter' envelopes with smaller windows are 'encouraged' in energy efficiency guidelines. Most often the choice of glazing type, shading devices, orientation and climate are the main parameters considered to define the size of the window (Badeche and Bouchahm 2020). Our research suggests that the criteria for the design of windows should give due importance to occupants' visual and psychological wellbeing (other than including further considerations not included in this study, such as circadian stimulation) ascribed to the window's provision of daylight and a view out.

An increase in the perceived importance of visual connection with the outside was complemented by the role of the window as a provider of information that also contains a social element, which for example a window in the roof (e.g., a skylight) may not be able to fulfil. Wherever possible, a window should be designed to provide visual connection with dynamic elements in the landscape but, crucially, also with other people. In fact, there was a small positive increase in the importance of windows to enable connection with activities and people between the two surveys. In particular, the open-ended comments revealed that some participants moved their desk closer to a

window also as a medium to communicate with their neighbours and be seen. Proximity to the window, however, is only one dimension to consider when analysing the means that people have to socially connect with the outside world.

Before the findings of this study can be generalized and transferred to other contexts, some methodological limitations should be acknowledged.

Online surveys can capture the perception that participants express for their window, *in situ*, without any possibility of experimental control. This, unavoidably, adds variability to the data, consistent with the challenges faced with this method of data collection. The data in the two surveys were gathered at different times of the year and some of the differences detected may possibly be ascribed to an effect of seasonality. In the absence of any previous global studies on window perception and window views, a comparison cannot be drawn. Nonetheless, we found a significant and substantive difference between perception of windows, and the value of the view out, in the first survey and during the lockdown, demonstrating the importance of windows during a period of confinement. The data in Survey 2 were collected for only one month to retain the answers limited to the period of lockdown in the different parts of the world. In comparison, Survey 1 was run for over 3 months with almost double the participants. Finally, Survey 2 was not purposely designed to investigate differences in window perception in a period of lockdown, but the same questions used in Survey 1 had to be employed to allow comparability of data.

Since a pandemic and the subsequent lockdown could not be anticipated, some potential confounding variables could not be addressed within the framework of this study. These include, but are not limited to, contextual factors (for example, working from home, sense of control, ability to position the desk as desired, etc.) as well as other aspects of organisational productivity that are known to have a significant impact on the

mental and physical wellbeing of building occupants, e.g., work-life balance and parameters of indoor environmental quality (thermal comfort, air quality, ventilation, lighting, etc.) (Newsham, Veitch et al. 2019).

5. Conclusions

This study provides statistically significant and practically relevant evidence that, during a period of imposed or voluntary social confinement such as the COVID-19 lockdown, windows are increasingly favoured for their view out and for their affordances to connect, physically and socially, with the outside.

Participants who sat near the window or moved their desk closer to it during the lockdown, particularly enjoyed the daylight that was brought in and the ability to look out, keeping their blinds and curtains open more often.

These results might have important implications on design practice and research, although further investigations are needed, considering that this was among the first studies analysing the differences in the perception of windows within a period of lockdown. Nevertheless, these findings can help capture the psychological impacts of confinement on people and may be relevant also to other domains, such as the design of prisons, hospitals or care homes, where occupants could strongly benefit from the restorative effects of window views.

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The authors have no financial interests to declare.

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