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RESEARCH ARTICLE

Moral regulating role of environmental cleanliness: Evidences from both practices and field experiments

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ABSTRACT

Moral judgment and behavior have long been considered as the result of reasoning and conscious thought while contextual influence being downplayed. Cleanliness is a fundamental feature of the environment. Previous research relevant to cleanliness focused on body cleansing behavior's effect on one's moral consciousness. According to a view of anthropology, cleanliness, as a key environment feature, symbolizes social order. Thus, we contend that the state of environmental cleanliness may metaphorically link to the concept of public moral norm. Three studies were conducted in a manufacturing group company. Study 1, using ten-year monthly records of disciplinary violation rates during the implementation of 5S practices from four different companies of the same manufacturing group, showed that improving workplace cleaning, neatness, and cleanliness could reduce employees' disciplinary violations. Study 2, by an experiment conducted at a real workplace, found that employees judged immoral workplace behaviors more morally wrong in the clean environment than in the dirty one; Meanwhile, conscientiousness trait weakens the effect of environmental cleanliness, whereas neuroticism trait strengthens this influence. Study 3, through an experiment priming awareness of workplace environmental cleanliness state, showed that employees showed harsher moral judgment on immoral workplace behaviors even when primed with the concept of clean environment than both the primed with the concept of dirty environment group and the control group. The results revealed the metaphorical association between the physical state of environmental cleanliness and the concept of abstract public moral norm, and provided a unique insight to the social significance of environmental cleanliness.

Keywords: Environmental cleanliness; metaphorical link; moral judgment; immoral workplace behavior; public moral norm

1. Introduction

An ancient Chinese idiom says: "One who stays near vermilion gets stained red, while one who stays near ink gets stained black", meaning that one in a good environment will be affected by the good, while in a bad environment will be affected by the bad; or closely related to a good person can make oneself better, while

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closely related to a bad person can make oneself worse. In Western culture, idioms with the same meaning say "He that lieth down with dogs shall rise up with fleas", or "One takes the behavior of one's company".

From the embodied cognition perspective, human mind's activities cannot be separated from the physical and bodily context in which they take place [1-3]. In the strongest possible characterization of the embodiment hypothesis, human actions are determined and constrained by the physical surroundings [3]. Conceptual metaphor and scaffolding of the human mind influence people's judgments and behaviors, and shape people's understanding of and reactions to the social world [4]. Conceptual metaphors are not only linguistic expressions but important cognitive mechanisms that shape the way individuals think and act [5, 6]. Most of human's abstract thinking utilizes metaphorical reasoning, which allows one to understand unfamiliar concepts by referencing familiar concepts [7]. Similarly, Williams et al. [4] and Fauconnier [8] claimed that features of abstract concepts are mapped onto specific perceptual features of concrete concepts, and through these mappings, higher-order concepts are constructed. Thus, without involving a person's explicit intent or awareness, the mind uses perceptual, environmental and body-based information as the scaffolding for the development of abstract concepts.

Up to now, many studies have found that environmental factors are metaphorically mentally linked to moral cognition. These environmental factors, such as brightness, temperature, smell, and so on, influence people's moral judgments and behaviors. Specifically, people exposed to contrastive environmental conditions (e.g., brightness vs. darkness; warmth vs. coldness; clean scents vs. disgusting odors) will display different moral judgments and behaviors [9-15].

According to the view of anthropological perspective [16], the concept of "pollution" not only involves the literal meaning, which contrasts to hygiene and health, but also carries the symbolic moral meaning of "impurity". The difference between cleanliness and uncleanliness is determined by the order and position of factors in a system. That is, dirt represents something that is disordered or out of place, and is therefore not preferable. In contrast, cleanliness represents order and is preferable [17]. Such symbolic ideas have permeated human society, where moral "purity" and "impurity" correspond to "cleanliness" and "dirtiness". In everyday life, people typically have the experience that their tolerance and assessment of immoral behaviors regarding public morality issues differs according to whether they are in a clean or dirty environment. In a clean environment, people are less tolerant of immoral behaviors such as spitting or littering than in a dirty environment.

Cleanliness is a fundamental feature of the environment, and it is the most direct feeling of people. May environmental cleanliness be metaphorically mentally linked to moral purity? Does environmental cleanliness influence people's moral judgment and behavior? But, so far, most research on cleanliness's moral effect focused on body cleansing behavior. Among these studies, the Macbeth Effect [18] is widely concerned, which indicates that self-cleanliness plays as a metaphor for moral purity, and a threat to people's moral purity leads them to seek and cleanse themselves. Recently, Lee and Schwarz conducted an extensive review and proposed grounded procedures of separation as a proximate mechanism underlying cleansing effects [19].

Although subsequent research revealed that a clean self (even hand washing alone) was associated with severe judgment on morally contested issues regarding most domains of private morality (i.e., using drugs, pornography, and masturbation)[20], the effect was failed to be replicated regarding public morality issues in a recent study[21]. The study found that workplace environmental cleanliness, rather than self-cleansing, led to harsh moral judgment on immoral workplace behaviors (behaviors violating organizational rules and hurting organizational interests). The participants were less willing to accept immoral workplace behaviors in the clean workplace environment than in the dirty one [21]. This suggests the old Chinese proverb (the famous saying from

Mencius, the ancient Chinese philosopher), which means that mind one's own business and keep one's moral purity away from the trouble of public good. Hence, a person with higher personal moral integrity by bodily cleansing may not necessarily be the one who preserves the interests of an organization or the society.

Air pollution is a serious problem that affects billions of people globally. The environmental and health costs of air pollution are well known. However, the recent studies suggested that air pollution not only deteriorates people's health, but also can contaminate their morality. Analyses of a 9-year panel of 9360 U.S. cities found that air pollution predicted six major categories of crimes [22]. Using the geolocation of crimes in Chicago from 2001-2012, a study compared crime upwind and downwind of major highways on days when wind blows orthogonally to the road, and found air pollution increases violent crime on the downwind sides of interstates [23].

Thus, here we contend that there may be a metaphorical link between the physical state of environmental cleanliness and the mental concept of public moral norm, and workplace environmental cleanliness may inhibit immoral workplace behaviors. Therefore, three studies were conducted to investigate the metaphorical link both in management practice and in field experiments.

Three studies and data sources were supported by a Chinese manufacturing group company. All the participants in study 2 and study 3 were employees from the company. The participants volunteered to participate in these two studies, and consent forms were collected.

1.1. Study 1: Evidence from documentary disciplinary data regarding 5S practices

There is important value in exploring the relationship between physical property of environmental cleanliness and immoral workplace behaviors through collecting practical data in real workplace, although it was very difficult. In this study, we explored the relationship between environmental cleaning, neatness, cleanliness and immoral workplace behaviors in practice using documentary disciplinary data from four different companies of a Chinese manufacturing group.

The 5S workplace management method aims to embed the values of sort, neatness, cleaning, standardization and discipline into the workplace [24]. The 5S practices initially derived from the Japanese acronyms of Seiri (sort and organization), Seiton (set in order and neatness), Seiso (cleaning and shine), Seiketsu (standardization and maintaining) and Shitsuke (sustain and discipline), and has received widespread attention [25]. The practice of 5S workplace management has been proved to effectively improve overall organizational performance, productivity [26] and customer satisfaction [27], and decrease industrial accidents. It was initiated in the manufacturing sector and then extended to other industries and services sector in Japan. The Toyota Production System provides a well-known example of 5S principles in practice [28]. Boeing in the USA pursues 5S as a world-class strategy [29]. And it has been 20 years since many Chinese manufacturing enterprises began to introduce 5S practices in management.

Since the practice of 5S management is known for emphasizing the concept "to create a better workplace" by strengthening cleaning, neatness, and cleanliness at workplace environment [25], it is reasonable to predict that the practice of 5S management could inhibit discipline phenomenon and reduce immoral workplace behaviors by improving the workplace cleaning, neatness, and cleanliness in organizations [21-23]. The effects of workplace cleaning, neatness, and cleanliness on immoral workplace behaviors can be reflected in the change of employee violations documented in the disciplinary record data in different stages of implementing 5S practices. Therefore, we predict a deduction of violations after the introduction of 5S practices in organizations as in Hypothesis 1.

Hypothesis 1: Implementation of 5S management practice can reduce disciplinary violations in organizations.

2. Materials and methods

2.1. Research design

Study 1 investigated the relationship between improved workplace cleaning, neatness, and cleanliness and changes in the number of employees' violations with disciplinary record data in the process of implementing 5S practices from four different companies of the same manufacturing group in China. The manufacturing group implemented 5S practices from December 2010. One of the four companies, denoted as Company X, implemented 5S practices exactly and achieved Bronze standard in September 2012 (*Note: This group company has designed three standards of 5S management: the Bronze is for qualified standard, the Silver is for good standard, and the Gold is for the highest level standard*). It achieved Silver standard later in September 2014. Although the other three companies, which were denoted as Company A, B, and C, implemented 5S practices as well, they did not exactly follow the requirements of 5S practices and thus did not meet any required standard.

Therefore, the comparison between Company X and the other three Companies forms a natural quasi-experiment, with Company X as the experimental group, the other three companies, Company A, B, and C, as the control groups, and different degrees of 5S practices implementation as the manipulation of environmental cleaning, neatness, and cleanliness.

2.2. Data

We collected monthly records data of disciplinary violations from these four companies ranged from January 2010 to December 2019. The monthly disciplinary violations records include five aspects: sick and personal leave violations, attendance violations, waste violations, safety violations and production quality violations. However, since the companies lack data at different times, we finally got data of Company X with 980 employees from January 2010 to December 2019 (a total of 120 months of disciplinary data). Available data of Company A with 331 employees and Company B with 292 employees are both from January 2013 to December 2019 (84 months of disciplinary violation data for each company). And data of Company C with 312 employees are available from January 2016 to December 2019 (a total of 48 months of disciplinary data) (*Note: The total number of employees was that in December 2019 in each company. It may change in different periods and the details can be found in the open database*). See Table 1A-1D: namely, monthly records of disciplinary violations over total number of employees per month.

Table 1A. Monthly per capita disciplinary violation record of Company X of the same manufacturing group (from January 2010 to December 2019)

Year \ Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2010	0 .10	0.11	0.14	0.11	0.08	0.11	0.07	0.07	0.06	0.03	0.10	0.11
2011	0.15	0.05	0.06	0.05	0.07	0.04	0.04	0.02	0.03	0.04	0.04	0.04
2012	0.05	0.03	0.06	0.02	0.02	0.04	0.01	0.02	0.05	0.04	0.06	0.08
2013	0.04	0.04	0.01	0.04	0.02	0.04	0.02	0.04	0.06	0.01	0.04	0.03
2014	0.01	0.02	0.16	0.05	0.04	0.01	0.01	0.02	0.01	0.02	0.10	0.12
2015	0.01	0.02	0.05	0.03	0.04	0.08	0.06	0.02	0.01	0.03	0.03	0.04
2016	0.03	0.00	0.05	0.01	0.03	0.02	0.06	0.02	0.02	0.05	0.02	0.02
2017	0.00	0.01	0.02	0.01	0.01	0.03	0.02	0.02	0.02	0.01	0.01	0.02
2018	0.03	0.08	0.09	0.07	0.09	0.11	0.03	0.07	0.09	0.09	0.07	0.07
2019	0.08	0.06	0.07	0.04	0.07	0.08	0.04	0.02	0.04	0.04	0.03	0.05

Source: *Authors own work*

Table 1B. Monthly per capita disciplinary violation record of Company A of the same manufacturing group

(from January 2013 to December 2019)

Year \ Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2013	0.01	0.01	0.04	0.01	0.01	0.01	0.13	0.11	0.13	0.10	0.11	0.11
2014	0.11	0.11	0.12	0.15	0.20	0.20	0.14	0.14	0.14	0.17	0.19	0.17
2015	0.19	0.17	0.20	0.18	0.18	0.26	0.20	0.18	0.11	0.13	0.12	0.11
2016	0.10	0.06	0.11	0.16	0.17	0.13	0.18	0.11	0.18	0.16	0.08	0.09
2017	0.07	0.15	0.07	0.09	0.11	0.07	0.10	0.10	0.10	0.10	0.04	0.08
2018	0.06	0.12	0.06	0.10	0.06	0.06	0.05	0.05	0.04	0.04	0.03	0.05
2019	0.10	0.13	0.08	0.11	0.07	0.10	0.10	0.08	0.12	0.11	0.12	0.10

Source: *Authors own work*

Table 1C. Monthly per capita disciplinary violation record of Company B of the same manufacturing group

(from January 2013 to December 2019)

Year \ Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2013	0.18	0.15	0.17	0.15	0.16	0.14	0.12	0.16	0.19	0.19	0.15	0.18
2014	0.17	0.10	0.08	0.14	0.04	0.07	0.07	0.22	0.19	0.18	0.18	0.24
2015	0.21	0.14	0.13	0.13	0.14	0.15	0.11	0.15	0.13	0.14	0.13	0.11
2016	0.14	0.13	0.19	0.10	0.13	0.12	0.17	0.16	0.15	0.10	0.15	0.14
2017	0.13	0.09	0.11	0.11	0.12	0.14	0.16	0.19	0.20	0.15	0.13	0.10
2018	0.18	0.12	0.09	0.09	0.13	0.08	0.08	0.14	0.10	0.14	0.15	0.13
2019	0.13	0.10	0.16	0.19	0.15	0.13	0.14	0.11	0.11	0.05	0.06	0.05

Source: *Authors own work*

Table 1D. Monthly per capita disciplinary violation record of Company C of the same manufacturing group

(from January 2016 to December 2019)

Year \ Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2016	0.09	0.09	0.04	0.26	0.04	0.04	0.05	0.07	0.07	0.05	0.07	0.06
2017	0.07	0.06	0.09	0.07	0.06	0.08	0.09	0.04	0.07	0.05	0.08	0.08
2018	0.08	0.06	0.04	0.09	0.16	0.05	0.05	0.05	0.06	0.08	0.06	0.08
2019	0.06	0.07	0.07	0.05	0.09	0.06	0.05	0.05	0.04	0.09	0.04	0.07

Source: *Authors own work*

2.3. Results and discussion

Since the collected data lacked independent variable, in order to detect the influences of improved environmental cleaning, neatness, and cleanliness, we compared the ratios of monthly records of disciplinary violations in different periods of implementing 5S practices and across different companies.

The effects of 5S practices on disciplinary violations hypothesized in hypothesis 1 were first shown in the longitudinal comparison of the disciplinary violations ratio before and after the implementation of 5S practices of Company X. Independent sample T-test results suggested that the ratio of disciplinary violations in the

workplace decreases significantly after the implementation of 5S practices (M_{before} = 0.09, M_{after} = 0.04, p < 0.01).

In addition, to better show the trend, we regroup the data of Company X into four different stages: Table 2 shows the disciplinary violations in those stages. In detail, the first stage is "before 5S practices", when 5S practices have not been implemented yet, and the mean disciplinary violation ratio is 0.09 (SD = 0.03). The second stage is from the beginning of 5S practices implementation to achieving the Bronze standard (from January 2011 to September 2012), and the mean disciplinary violation ratio is 0.05 (SD = 0.03), significantly less than that of the first stage (t (31) = 4.29, p = 0.00 < 0.001). The third stage is from achieving the Bronze standard to achieving the Silver standard stage (from October 2012 to September 2014), and the mean disciplinary violation ratio is 0.037 (SD = 0.03), also significantly less than that of the first stage (t (34) = 5.00, p = 0.00 < 0.001). The fourth stage is the stage after silver standard attainment stage from October 2014 to December 2019, and the mean disciplinary violation ratio is 0.04 (SD = 0.03), also significantly less than that of the first stage (t (73) = 5.22, p = 0.00 < 0.001).

However, it's worth noting that after Company X has attained the silver standard, the disciplinary violation ratio experienced an uptick in 2018 (See Table 1A and Figure 1). By further interviewing the managers in Company X, we found that the 5S management in Company X slackened after 2018. This shows additional evidence for Hypothesis 1.

Table 2. Disciplinary violations ratio in different companies during comparable time period

Time periods	Stages	Company X Mean (SD)	Company A Mean (SD)	Company B Mean (SD)	Company C Mean (SD)
2010.01-2010.12	Before 5S practices	0.09(0.03)	NA	NA	NA
2011.01-2012.09	Initiation of 5S practices-Bronze standard	0.05(0.03)	NA	NA	NA
2012.10-2014.09	Bronze-Silver standard	0.04(0.03)	0.10(0.06)	0.14(0.05)	NA
2014.10-2019.12	After Silver standard	0.04(0.03)	0.11(0.05)	0.13(0.04)	0.07(0.04)

Source: *Authors own work*

Although the data of companies A, B and C are incomplete and lack data at different times, it may as well make a comparative analysis of the data of these three companies with that of company X.

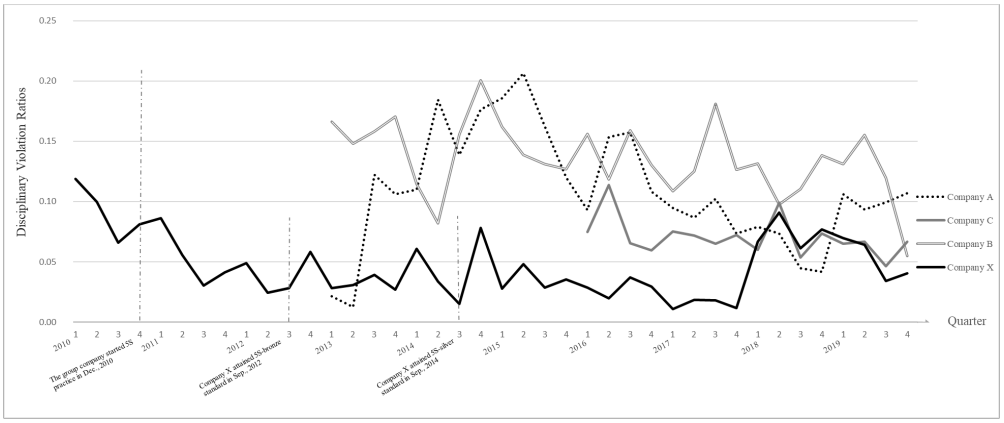

Figure 1. Disciplinary violation ratio in different stages

Source: *Authors own work*

Comparison between different companies also verified the effects of 5S practices on disciplinary violations. To exclude possible impacts from other factors, we compared the disciplinary violations ratio across three companies (Company X, Company A and Company B) in the same time period from January 2013 to December 2019 and two companies (Company X and Company C) in the same time period from January 2016 to December 2019. Paired comparison between Company X and the other three companies showed significant differences in disciplinary violations ratios. The ratio of disciplinary violations in Company X ($M = 0.04$, $SD = 0.03$) is significantly less than that of Company A ($M = 0.11$, $SD = 0.05$, $t(83) = -10.38$, $p = 0.00 < 0.001$) and Company B ($M = 0.14$, $SD = 0.04$, $t(83) = -17.03$, $p = 0.00 < 0.001$) in the same period from January 2013 to December 2019, and also significantly less than the ratio of Company C ($M = 0.07$, $SD = 0.04$, $t(47) = -4.09$, $p = 0.00 < 0.001$) during the period from January 2016 to December 2019.

In summary, both the cross-sectional comparison across different companies and longitudinal comparison in different periods of Company X implementing 5S practices supported Hypothesis 1.

The results of Study 1 suggested that environmental cleaning, neatness, and cleanliness induced by 5S practices could reduce disciplinary violations in workplace. It not only provided practical evidence for the effects of environmental cleaning, neatness, and cleanliness on moral behavior, but also verified the practical meaning of workplace environmental cleaning, neatness, and cleanliness.

However, Study 1 cannot fully confirm that the factor of environmental cleanliness causes the decline of disciplinary violations. 5S practices include five aspects, of which environmental cleanliness is only one. Moreover, in the 10 years of 5S practices, there may be other factors affecting employees' disciplinary violations. Therefore, the effects of environmental cleanliness should be verified in a more rigorous way and the influence mechanism behind environmental cleanliness should be further investigated. Study 2 and Study 3 were conducted by experimental methods at real workplaces.

2.4. Study 2: An experiment in an actual workplace environment

By running an experiment in the actual workplace environment (clean vs. dirty), Study 2 examined whether a clean state of workplace environment can influence moral judgment on immoral workplace behaviors, and whether there was a metaphorical link between workplace environmental cleanliness and professional ethics. In addition, this study also examined if the effects of environmental cleanliness on the severity of moral judgment varied with personality traits.

3. Materials and methods

3.1. Participants

One hundred sixty-five voluntary employees (66 females) from the above-mentioned manufacturing company with an average age of 35.34 years participated in this experiment. Each participant was awarded a souvenir from Palace Museum in Beijing valued at RMB 80. The participants were randomly assigned to one of two conditions, a clean environment (77 employees) and a dirty environment (88 employees).

G*Power analysis indicated that with this sample size, alpha = 0.05, and power = 0.80 when using T-test between two independent means could achieve a medium effect size of $d = 0.44$. All participants gave informed consent prior to participation and were told that they could abort the experiment at any time if they wanted.

3.2. Experimental settings and procedure

The experiment was conducted at a real workplace in the manufacturing company. Two workrooms were used. One workroom, that was thoroughly cleaned before the experiment and served as the clean environment. The other workroom that had not been in use for a long time and was dusty with stains on the floor and instruments was served as the dirty environment.

Each participant was firstly asked to rate the Big-Five traits scale before the experiment and then was led into one of the two workrooms (clean environment and dirty environment). After entering the experimental workroom, the participants were told to rate immoral workplace behavior items, followed by an environmental cleanliness questionnaire.

3.3. Variables

The independent variable of environmental cleanliness includes two conditions, a clean environment and a dirty environment. Considering that people have different subjective criteria regarding environmental cleanliness, the participants were asked to rate the cleanliness of the experimental room to examine the effect of manipulating the independent variable. A questionnaire including 3 items was designed for the participants to rate the cleanliness of the room on a 9-point scale (9 = very clean, 1 = very dirty).

Dependent variable was the participants' moral judgment. The moral judgment issues covered typical immoral workplace behaviors like counterproductive work behavior (CWB), integrating Spector et al.'s version [30] and Yang et al.'s version [31]. By combing some similar items and modifying several items to better reflect workplace behaviors in the Chinese context, the immoral workplace behaviors questionnaire is comprised of six dimensions (the average internal consistency reliability for this measure was $\alpha = .93$) and 28 items: sabotage (3 items, $\alpha = .64$, e.g., purposely damaged a piece of equipment or property), withdrawal (4 items, $\alpha = .75$, e.g., taken a longer break than permitted); production deviance (6 items, $\alpha = .82$, e.g., purposely worked slowly when things needed to get done), theft (3 items, $\alpha = .78$, e.g., took supplies or tools home without permission), abuse (9 items, $\alpha = .83$, e.g., started or continued a damaging or harmful rumor at work), and non-cooperation (3 items, $\alpha = .54$, e.g., delayed actions on matters that were important to others). Participants in both conditions were asked to rate 28 immoral workplace behavior items on a 9-point scale, from 9 (highly acceptable morally) to1 (highly unacceptable morally).

For measuring personality traits, John et al.'s Big-Five traits scale (with 44 items) was adopted [32].

3.4. Results and discussion

The ratings for workroom cleanliness in the clean environment ($M = 7.58$, $SD = 1.25$) were significantly higher than the ratings in the dirty environment ($M = 2.10$, $SD = 1.32$, $t(163) = 27.31$, $p < .0001$), indicating that manipulation of the independent variable was effective.

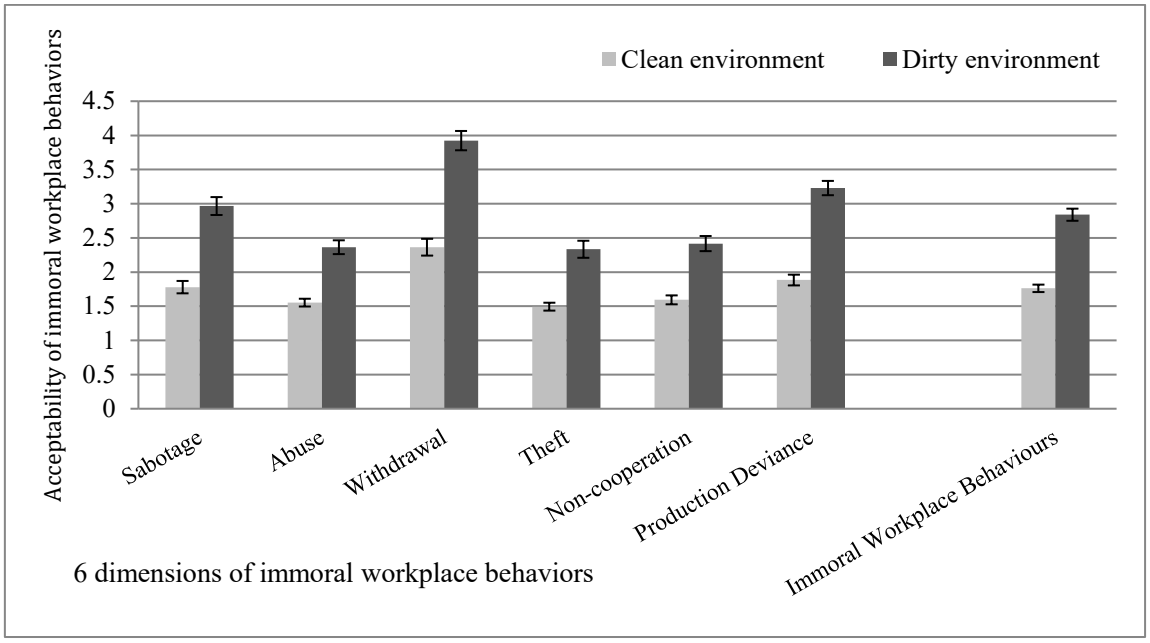

Figure 2. Moral judgment of immoral workplace behaviors. Higher score means more acceptability of the immoral workplace behaviors

Source: *Authors own work*

The result showed that the participants judged immoral workplace behaviors to be more morally wrong in the clean environment (M = 1.76, SD = 0.48) than in the dirty environment (M = 2.84, SD = 0.83, $t(163)$ = -10.35, $p < 0.001$); the participants in the clean environment were less likely to accept immoral workplace behaviors, while those in the dirty environment were more tolerant of immoral workplace behaviors (see Figure 2).

Further, we tested whether personality traits (The Big-Five factors) moderated the relationship between environmental cleanliness and moral judgment by hierarchical multiple regression. Environmental cleanliness and the standardized values of the five traits were entered in the first step of the regression analysis. In the second step of the regression analysis, the interaction term between environmental cleanliness and the standardized value of each trait was entered, and the interactions with conscientiousness, $\Delta R^2 = 0.03$, F (1,155) = 10.43, $p = 0.002 < 0.01$, and neuroticism, $\Delta R^2 = 0.01$, F (1,155) = 4.30, $p = 0.04 < 0.05$, both explained significant increases in variance in moral judgement. Thus, conscientiousness and neuroticism were significant moderators of the relationship between environmental cleanliness and moral judgement. In details, conscientiousness weakens the influence of environmental cleanliness on moral judgment, b = 0.34 , t = 3.23, $p = 0.002 < 0.01$, whereas neuroticism strengthens this effect , b = -0.21 , t = -2.07, $p = 0.04 < 0.05$. That means, individuals with higher level of conscientiousness maintain low acceptability of immoral behaviors, and environmental cleanliness has a weaker effect on their attitudes than on those with lower degree; for individuals with higher degree of neuroticism, a clean environment will lead to more severe moral judgment, compared to those with lower level (See Figure 3, Figure 4 and Table 3).

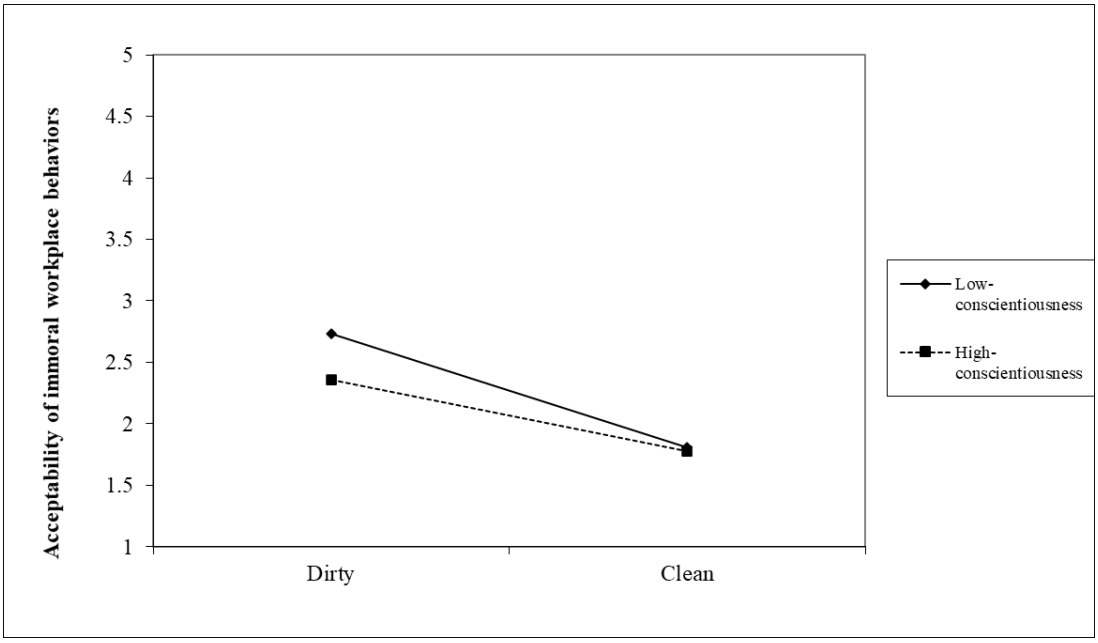

Figure 3. Moderating effect of conscientiousness

Source: *Authors own work*

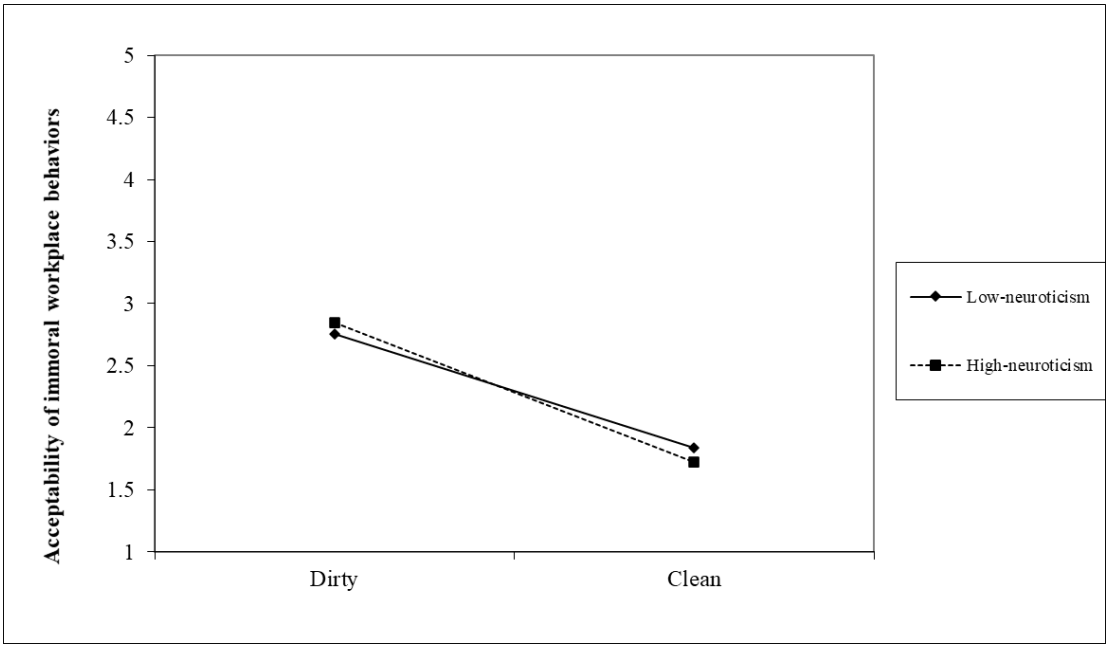

Figure 4. Moderating effect of neuroticism

Source: *Authors own work*

Table 3. Hierarchical regression results of the Five Traits' moderating effects

Variables	M1		M2		M3		M4		M5		M6	
	B	SE	B	SE	B	SE	B	SE	B	SE	B	SE
Constant	2.77**	0.07	2.77**	0.07	2.76**	0.07	2.73**	0.07	2.75**	0.07	2.77**	0.07
Clean Environment	-0.91**	0.10	-0.92**	0.10	-0.91**	0.10	-0.92**	0.10	-0.92**	0.10	-0.91**	0.10
Extroversion	-0.11	0.06	-0.14	0.07	-0.10	0.06	-0.08	0.06	-0.11	0.06	-0.11	0.06
Agreeableness	-0.10	0.06	-0.10	0.06	-0.14	0.08	-0.14*	0.06	-0.11	0.06	-0.10	0.06
Conscientiousness	-0.23**	0.06	-0.22**	0.06	-0.23**	0.06	-0.37**	0.07	-0.22**	0.06	-0.23**	0.06
Neuroticism	-0.00	0.07	0.00	0.07	0.00	0.07	-0.01	0.07	0.10	0.08	0.00	0.07
Openness	0.04	0.06	0.04	0.06	0.04	0.06	0.04	0.06	0.05	0.06	0.05	0.07
Environment×Extroversion			0.07	0.10								
Environment×Agreeableness					0.09	0.11						
Environment×Conscientiousness							0.34**	0.10				
Environment×Neuroticism									-0.21*	0.10		
Environment×Openness											-0.04	0.10
R^2	0.49**		0.49**		0.50**		0.52**		0.51**		0.49**	
R^2 change			0.00		0.00		0.03**		0.01*		0.00	

*Dependent Variable: moral judgment (acceptability of immoral workplace behaviors); N = 165; *p < 0.05 **p < 0.01.*

Source: *Authors own work*

Findings from the experimental study confirmed that a clean state of workplace environment can induce severe moral judgment on immoral workplace behaviors like counterproductive work behavior (CWB). CWB is a typical immoral workplace behavior, which is actually a professional ethics issue. Therefore, this experiment has indicated that environmental cleanliness has a metaphorical effect on morality, which can be a metaphor for social moral norms. Thus, individuals in a clean environment will experience an enhanced awareness of social moral norms, which can influence their moral judgment, as demonstrated by harsher judgment and more normalized behavior. In comparison, when people are in a dirty environment, their awareness of social moral norms can decrease, as demonstrated by their ignoring immoral conduct and exhibiting relatively weak moral judgment [20]. Therefore, the result of Study 2 suggested that there may be a metaphorical link between the state of environmental cleanliness and the concept of higher mental moral norm, and environmental cleanliness may directly impact moral behavior through the metaphorical link between environmental cleanliness and social moral norms.

To further substantiate this argument, Study 3 was conducted.

3.5. Study 3: An experiment priming the concept of environmental cleanliness

Study 3 designed an experiment that primed the concept of environmental cleanliness to investigate whether there was a metaphorical link between the concept of physical environmental cleanliness and the concept of higher mental moral norm. By activating individuals' different awareness of environmental clean state, we examined whether it can license different severity of moral judgments on immoral workplace behaviors.

4. Materials and methods

4.1. Participants

One hundred eighty employees (32 females) with an average age of 33.84 years from the same manufacturing company volunteered to participate in the experiment. Each participant was awarded a souvenir

from Palace Museum in Beijing valued at RMB 80. They were randomly assigned to one of the three groups: the group primed with concept of clean environment (60 participants), the group primed with concept of dirty environment (60 participants), and the control group (60 participants). All the participants gave informed consent as in Study 2.

G*Power analysis indicated that with this sample size, alpha = 0.05, and power = 0.80 when using T-test between two independent means could achieve a medium effect size of $d = 0.52$.

4.2. Procedure and materials

The experiment was also conducted at a real workplace in the same manufacturing company. An ordinary office was used as the laboratory. Upon arrival, each participant was informed that the experiment included a number of unrelated tasks. First step, each participant was told that "today they were supposed to change a workroom", and was instructed that later s/he would be tested on their ability to recall a paragraph sentence after s/he read and memorized a description of the new workroom cleanliness condition. In the group primed with the concept of clean / dirty environment, participants need to read a card that the workroom and its interiors are described as very clean / dirty, and try to remember it. For example, the card read "The workroom: everywhere is exceptionally clean / extremely dirty; the floor is as clear as a mirror / filthy, ...; the tools, equipment and instruments were wiped as new without a trace of dirt and dust / covered with oil and dust, ...". Then participants needed to fill the blanks in the sentences "The workroom: everywhere is ____; the floor is _____, ...; the tools, equipment and instruments were _____, ...". While performing the task, participants were allowed to review the card twice. The participants in the control condition did not engage in the above tasks. Second, participants were told to rate immoral workplace behavior items (that were the same as study 2).

4.3. Results and discussion

Consistent with Study 2, the participants rendered harsher moral judgment on immoral workplace behaviors in the group primed with the concept of clean environment ($M = 1.43$, $SD = 0.32$) than both in the group primed with the concept of dirty environment ($M = 2.69$, $SD = 0.80$, $t(118) = 11.34$, $p = 0.00 < 0.001$) and in the control group ($M = 2.49$, $SD = 1.15$, $t(118) = 6.83$, $p = 0.00 < 0.001$); however, there was no significant difference between the group primed with the concept of dirty environment and the control group ($t(118) = -1.14$, $p = 0.26 > 0.05$) (see Figure 5). Therefore, when people perceive the environment to be clean, it will make moral judgments more severe. On the contrary, it will make moral judgments less severe.

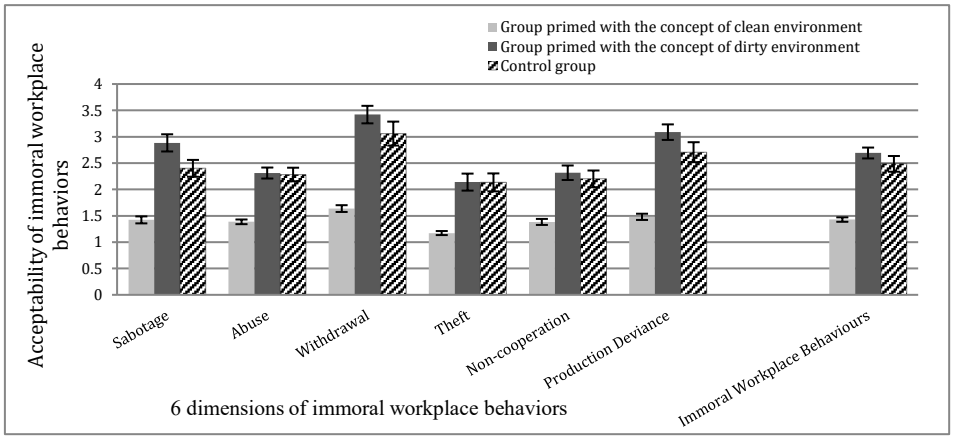

Figure 5. Moral judgment of immoral workplace behaviors. Higher score means more acceptability of the immoral workplace behaviors

Source: *Authors own work*

The result confirmed that there was a metaphorical link between the physical concept of environmental cleanliness and the concept of higher mental moral norm.

5.General discussion

Results from all three studies showed that improved workplace environmental cleanliness can reduce disciplinary violations in workplace (for example, through the practice of 5S workplace management), and clean workplace environment rendered harsher moral judgments on immoral workplace behavior. Meanwhile, the results of Study 2 revealed that the Big-Five factors moderated the relationship between workplace environmental cleanliness and moral judgment: conscientiousness trait can weaken the influence that environmental cleanliness render harsher moral judgment, whereas neuroticism trait can strengthen this influence. Thus, the physical state of environmental cleanliness can be metaphorically linked to the concept of abstract public moral norm and then a clean state of environment makes individuals experience an enhanced awareness of public moral norms, leads to harsher moral judgment, and demonstrates more normalized behavior. The results showed the extent to which human public moral consciousness is structured by the environmental cleanliness, and environmental cleanliness can lead to moral metaphorical effects [21-23].

Humans often use the structure inherent in fundamental aspects of their physical worlds to develop higher-level concepts [33]. Scaffolding processes simultaneously broaden the scope of human thought while tethering those thoughts to the physical environment in which they occur[4]. Concepts such as time, temperature, distance, weight and position, along with physically-based goals highlight the processes by which sensorimotor resources can structure higher-order cognition. Further, incidental activation of these concepts and goal structures reveals the extent to which human thought is structured by the environment even in domains that are abstracted from or unrelated to the physical environment, and outside of explicit intent or awareness [34-36]. Therefore, the three studies provide new evidence for physical factors of environment affecting people's moral behavior, just like brightness, temperature, smell, and even air cleanliness [9-15, 22, 23].

Though it seems our results contradict with Schnall, Benton & Harvey's conclusion that cleanliness lessens the severity of moral judgment [38], their Study 1 just primed cleanliness related concepts abstractly. It remains unclear what target of cleanliness concept was primed and whether the prime implicated the environment or other target.

On the other hand, previous research seems to show that emotions play a substantial role in moral judgment, particularly incidental disgust can influence various moral judgments and make them more severe [37, 38]. However, in the studies, it remained unclear whether the participants reported their feelings toward the experimental stimuli or toward moral issues. In addition, Schnall, Haidt, Clore, & Jordan's Experiment 2 result showed that the disgust condition did not differ from the control condition in terms of participants' self-reported disgust [38], even though the experience of physical disgust was manipulated, such as working in a disgusting room (the workspace was set up to be dirty, untidy, and to look rather disgusting). Their experiments 2-4 showed that the role of disgust in moral judgments depends on participants' sensitivity to their own bodily sensations [38]. In addition, Schnall, Benton & Harvey's Experiment 1 showed that the cleanliness priming (completing a scrambled-sentences task) did not induce disgust [37]. In view of this, we suggested that a state of environmental cleanliness may directly impact moral-perception through the metaphorical link between concrete concept of environmental cleanliness and the concept of abstract social moral norm. So currently, our studies did not introduce emotional variables such as disgust. Future research can separately rate the disgust toward environmental cleanliness and the disgust toward moral issues, to explore and clarify the role of disgust in the metaphorical effect of environmental cleanliness on moral judgment, since it was possible that

participants were reporting their feelings toward the experimental stimuli rather than toward the created physical setting [38].

The results suggest that improving environmental cleanliness can activate and strengthen individuals' awareness of social moral norms, thereby implicitly regulate people's moral behavior and further improve the public moral order. Meanwhile, it has been proved that workplace environmental cleanliness is an embodiment of factors that can influence immoral workplace behaviors such as counterproductive work behavior (CWB). It expands our understanding of the antecedents of immoral workplace behaviors, and helps enterprises take steps to decrease these behaviors in practice, although research on the antecedents of immoral workplace behaviors has been abundant [39]. Thus, in Study 1 of this research, the evidence from actual documentary disciplinary data further demonstrates the practical implication of 5S workplace management, which is known for emphasizing "to create a better workplace" by strengthening cleaning, neatness, and cleanliness at workplace environment.

In conclusion, these results highlight a metaphorical mental link between environmental cleanliness and social moral norm. Environmental cleanliness is not only a feature of objective physical phenomenon, but also has social significance. Conceptual metaphor and scaffolding of the human mind shape people's understanding of and reactions to the social world [4]. Just as environmental cleanliness can remind and strengthen our awareness of public moral norm, the moral metaphor effect of environmental cleanliness makes us restrain ourselves and regulate our public moral judgment and behavior. This work offers new insights by which the cleanliness features of the physical environment can influence public moral behaviors.

However, these findings still need more in-depth interpretation, it has limitations when only viewed from the perspective of metaphor theory. This is the direction of future research, for example, from multiple theoretical perspectives of assimilation and contrast effects [40] or grounded procedures of separation as a proximate mechanism underlying cleanliness effects [19]. In addition, is there a cross-cultural difference in this metaphorical effect of environmental cleanliness on morality? This issue needs to be discussed in the future, although Douglas put forward his theoretical perspectives not specifically referring to a particular national culture.

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Conflict of interest

The authors declared no potential conflicts of interest with respect to the research, authorship, or publication of this article.

Ethical approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent

Informed consent was obtained from all individual participants included in the study.

Data availability statement

The dataset analyzed during the current study is available from the OSF database using the following URLs:

Study 1: https://mfr.osf.io/render?url=https%3A%2F%2Fosf.io%2Ferquz%2Fdownload

Study 2: https://mfr.osf.io/render?url=https%3A%2F%2Fosf.io%2Fnekbw%2Fdownload

Study 3: https://mfr.osf.io/render?url=https%3A%2F%2Fosf.io%2Fzxt5j%2Fdownload

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