Empirical Article

The contribution of office design to the appraisal of job control: A longitudinal study

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The appraisal of control over work intensity and decisions at the workplace is a well-established determinant of health and well-being among employees. Building on job design theories, the overarching aim of this study was to determine office layout as a predictor of perceived job control. Specifically, we investigated between-group differences in control by contrasting employees in cellular offices with employees in shared/open offices, as well as effects on control among employees transitioning from one office design to another. This is a longitudinal study with three survey points across 48 months comprising 3,415 Norwegian office employees. Data were analyzed with latent growth curve analyses, adjusted for gender, age, leadership responsibility, and teleworking. Employees in cellular offices reported significantly higher control over work intensity and control over decisions when compared with employees in shared/open workspaces. Transitioning from a shared/open workspace to a cellular office led to a significant increase in perceived control regarding work intensity. As the experience of control may buffer the negative impact of job demands, organizations that rely on shared or open office solutions may benefit from identifying tools that can contribute to enhancing their employees' perceived control.

Key words: Workspace, activity-based work, cellular office, decision latitude, work intensity.

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INTRODUCTION

The experience of control, the subjective perception of availability and freedom of choice between alternatives, is fundamental to human well-being. Several theorists have posited a basic motivation to exert control. White (1959) proposed that play and exploratory behavior may be explained by an intrinsic need to deal with the environment. Brehm's psychological reactance theory (Brehm, 1966) proposed that if behavioral freedom is reduced or threatened with reduction, the individual will be motivationally aroused to regain it. Lack of control has been shown to produce several serious effects on health in experimental animal experiments (Seligman, 1971; Weiss, 1968). In the context of the workplace, a large body of evidence suggests that low levels of perceived job control are associated with several negative outcomes, including job strain (Karasek, 1979; Stansfeld & Candy, 2006), neck pain and headache (Christensen & Knardahl, 2010, 2012), and disability retirement (Knardahl *et al*., 2017).

In broad terms, job control can be described as a person's perceived ability to influence what happens in their work environment. In a more specific definition, Karasek (1979) explained control as a composite of two empirically related, but theoretically distinct, constructs, namely the worker's authority to make decisions on the job and the breadth of skills used by the worker on the job. The importance of control in a workplace setting was highlighted already in pioneering theoretical models on job design. For instance, the influential job characteristics model (Hackman & Oldham, 1975, 1976) defined five core job characteristics—skill variety, task identity, task significance, autonomy (a similar concept to control that describes how much freedom employees have to do their jobs), and feedback—and suggested that these factors should determine the motivation, satisfaction, performance, absenteeism and turnover, and satisfaction of employees. Taking both challenges at work (job demands placed on the worker) and control (the discretion permitted the worker in deciding how to meet these demands) into account, the job demand–control model further substantiated the importance of job control by showing that well-being and mental health outcomes depend on the interaction between job demands and perceived control (Karasek, 1979). In addition to having direct positive effects on health and well-being, control is assumed to buffer potentially negative impacts of high levels of job demands (Bond & Bunce, 2001) and can contribute to an increase in employees' job satisfaction with the prospect of engaging in challenging tasks and acquiring new skills (Kain & Jex, 2010).

Due to the beneficial effects of job control, identifying job designs that increase the employees' experience of control will be an important work reorganization initiative. Previous research on job redesign has focused mainly on the systematic and purposeful allocation and design of tasks to individuals and groups within an organization. However, the physical context of the work (e.g., boundaries, openness, density) is also likely to shape some characteristics of jobs (Oldham & Fried, 2016). Based on a longitudinal survey of Norwegian workers, the overarching aim of the current study was to determine how different office designs (cellular, shared, and open), as well as transitions between these office designs, influence perceived job control among employees.

Office type as a control-enhancing work reorganization initiative

Job design refers to the process and outcomes of how work is structured, organized, experienced, and enacted (Grant, Fried &

Juillerat, 2011). Finding ways to effectively balance the requirements of the organization with the requirements of the person holding the job is considered to be one of the most important aspects of human resource management. One predominant trend of physical job redesign in contemporary working life is the move of office workers from cellular offices to shared or open-plan workspaces (Nielsen, Emberland & Knardahl, 2020; Ohrn *et al*., 2021), often with "shared seating" (i.e., no fixed allocation of place). While reducing space needs per employee – and thereby the infrastructure costs of office space – is an obvious motivator for this change, there is still a shortage of knowledge about how such redesigns of physical work characteristics impact the psychological job characteristics of the employees, including their appraisal of control (Oldham & Fried, 2016; Van Hootegem & De Witte, 2017).

The physical characteristics of a job can refer to the physical features of tasks as well as the broader physical environments in which employees perform their tasks. One defining aspect of the physical environment is office type. According to De Croon *et al*. (2005, p. 119), "office types can be described according to three dimensions: (1) the office location (e.g. telework office versus conventional office); (2) the office lay-out (e.g. open lay-out versus cellular office); and (3) the office use (e.g. fixed versus shared workplaces)." In a conceptual model of the relations between office concepts and employee health and well-being that combines the main features of the job characteristics model and the job demands–resources model, De Croon, Sluiter, Kuijer, and Frings-Dresen (2005) proposed that these physical characteristics of the job have a direct impact on the control of those employed. The same authors further suggested that control will mediate the effect of the physical characteristics on employee health. However, it is still unclear whether and how different office designs should influence control.

An assumption underlying the work of many practitioners advocating the use of open-plan offices is that removing physical barriers will facilitate autonomy and exercise of skill through increased opportunities for social interaction and communication (Otterbring, Pareigis, Wastlund, Makrygiannis & Lindstrom, 2018). Sociological theory supports the argument that removing physical boundaries to facilitate more contact between people should increase collaboration since proximity predicts social interaction (see Bernstein & Turban, 2018). Following this reasoning, one may expect that removing physical boundaries in offices should increase the number of available options, and in turn increase the perception of control. However, some scholars have suggested a contrasting view in which working in a shared or open-plan office environment may actually reduce the presence of the factors that promote control (Oldham & Fried, 2016). The argument is that configurations that facilitate unwanted interpersonal intrusions (e.g., few barriers) are likely to enhance levels of monitoring and disruptions at work that, in turn, reduce the autonomy of the workers. Specifically, removing physical spatial boundaries may decrease perceived privacy since other people may be watching or listening and increase the perception of complexity and ambiguity (Bernstein & Turban, 2018). Indeed, in two intervention-based field studies of corporate headquarters transitioning to open office spaces, it was found that employees seemed to respond by reducing the number of face-to-face contacts in open-space landscapes (Bernstein & Turban, 2018). Furthermore, the level of distractions from voices and coworker ambulation and movements is higher in open-space offices (Seddigh, Berntson, Danielson & Westerlund, 2014). Distractions and interruptions are externally imposed and may be perceived as outside of one's control in addition to presenting challenges to one's concentration. In addition, predictability of daily routines may be affected. Taken together, one may argue that lower control of privacy, challenging sense-making, together with increased distractions may attenuate the perception of control in open-space offices.

This latter perspective, i.e., that working in a shared or open-plan office environment reduces the presence of the factors that promote control, finds support in some studies. A literature review by De Croon, Sluiter, Kuijer, and Frings-Dresen (2005) concluded that "working in open workplaces reduces the office worker's privacy and job satisfaction" (p. 119) and "the lack of acoustic and visual isolation in open workplaces diminishes the control over interaction with others and hinders workers in discussing personal topics in confidence" (p. 129). Furthermore, a later study that followed employees during a transition from private to open-plan offices found that the relocation had significant negative effects for several factors related to control, including increased distraction, reduced privacy, increased concentration difficulties, and increased use of coping strategies (Kaarlela-Tuomaala, Helenius, Keskinen & Hongisto, 2009).

Although the above studies indicate that there may be an indirect association between office design and job control, the evidence for a direct association is limited and inconsistent (De Croon, Sluiter, Kuijer & Frings-Dresen, 2005). Nonetheless, the few studies that exist point to the fact that working in shared and open offices is likely to have negative effects on the experience of control. For instance, a cross-sectional study from Belgium, which included 801 employees, found that working in open offices was associated with an increased occurrence of distractions, and this reduced the perception of control. A study of 96 US employees moving to a new office building showed that employees who transitioned from a low- to a high-density office reported lower levels of control (Szilagyi & Holland, 1980). Finally, a longitudinal study that examined the transition from own office space to activity-based workspaces found that control and possibilities for professional development decreased (Van Steenbergen, van der Ven, Peeters & Taris, 2018). However, a limitation of the latter two studies was that all respondents transitioned to a higher density office, and it is therefore not known if moving from an open plan solution to another office design (e.g., cubicle) will influence control.

Following the pronounced trend of moving to open office designs, there is an urgent need for knowledge of specific features of the physical context, including openness or flexible workspaces, that enable employees to most effectively complete their work (Oldham & Fried, 2016). The current longitudinal study will extend the existing literature by examining how cellular and shared/open office designs, as well as the transition from one office design to another, influence two aspects of job control, namely control regarding work intensity and decisions. Control over intensity refers to the perceived autonomy over pace, scheduling of work, intensity of effort, time demands, emotional and physical workloads, tight deadlines, role overload, and

additional characteristics of the psychosocial environment (Burke, Singh & Fiksenbaum, 2010). Control over decisions refers to the worker's potential control over his/her tasks and his/her conduct during the working day (Karasek, 1979). Using data from a three-wave survey with a total duration of 4 years, we examined between-group difference and within-group fluctuations in levels of control among (1) employees working in private cellular offices, (2) employees working in shared or open offices, (3) employees changing from cellular to shared/open offices, and (4) employees changing from shared/open offices to cellular offices. Based on the theories and the findings from previous research presented above, we propose and test the following hypotheses:

Hypothesis 1a: Employees working in shared or open office layouts experience lower levels of control of work intensity compared with employees working in a cellular office.

Hypothesis 1b: Employees working in shared or open office layouts experience lower levels of control of work decisions compared with employees working in a cellular office.

Hypothesis 2: Transitioning from a cellular office to a shared or open office layout will lead to a decrease in perceived control among employees.

Hypothesis 3: Transitioning from a shared or open office layout to a cellular office will lead to an increase in perceived control among employees.

Extending previous research on office design, the study examines transitions between office designs with longitudinal data and by assessing control with a fine-grained indicator that provides information about specific facets of this important job resource. Hence, this study informs about differences in control between cellular and open-plan offices, as well as whether changing office type influences levels of control.

METHOD

Procedure and participants

This study utilizes data from The New Workplace project, which is a prospective study of work factors contributing to health, work ability, absence, and exit from working life in Norway conducted between 2004 and 2015. This project surveyed workers employed in full-time or part-time positions in a Norwegian enterprise (Christensen & Knardahl, 2010; Finne, Christensen & Knardahl, 2014). Employees were invited to participate in a web-based survey containing questions on background information, psychological, social, and mechanical work factors, work organization, mastery of work, attitudes toward work, organizational change, personality, health behavior, coping strategies, mental health, health complaints, and work ability. Each employee received a letter containing information about the survey and a personalized code for logging in to the web-based questionnaire. A paper version of the questionnaire was made available upon request. Written information specified the strict confidentiality guidelines and informed employees about the license for data collection granted by the Norwegian Data Inspectorate. The organizations from which employees were recruited provided data on employees' departmental affiliation, home address, and occupational title according to the Norwegian standard classification of occupations (STYRK), a system developed by Statistics Norway based on the International Classification of Occupation (ISCO-88). In return for participation in the project, the organizations received written reports and oral presentations of results with the objective of supporting management and personnel in the process of monitoring their work conditions.

The study had a full-panel prospective design with all variables measured at three time points with 4 years from baseline to the third assessment. The average time lag between measurement points was 24 months (range: 17–36 months). Findings from a meta-analysis of longitudinal research suggest that a time lag of 2 to 3 years is ideal for detecting temporal occupational stressor-strain associations (Ford *et al*., 2014). Such a time lag is consistent with conservation of resources and allostatic load theories, which propose that cumulative exposure to chronic work stressors increases reactions to those stressors over time (Ford *et al*., 2014).

Using a convenience sampling procedure, the organizations either (1) contacted the project group on their own initiative and asked to be a part of the survey or (2) were invited to participate by the project group. Employees were recruited from 96 companies representing a broad spectrum of occupational sectors including health care, education, government and public administration, engineering, project management, industry, and non-profit organizations. Invited employees were given the opportunity to participate in the survey through an online electronic form or through answering a pen-and-paper questionnaire. After excluding workers that were on long-term absence (e.g., sickness absence, parental leave), all employees received a letter that included information about the survey, informed consent, ethical considerations, a personalized code for logging in to the online questionnaire, and the paper version of the questionnaire with a prestamped return envelope. It was highlighted that all responses would be treated confidentially.

By August 2015, a total of 32,793 employees had been invited to participate in the T1 assessment, with 16,442 responding (response rate 50.14%). Of those who participated at T1, 13,452 from 48 organizations were invited to participate at T2, with 7,521 (55.90%) responding. Some of the participating organizations agreed to participate in a third assessment, and 1,457 respondents were therefore invited to the T3 survey, with 909 (62.39%) responding. To be included in the current study, respondents had to provide information about the physical design of their workspace. A total of 11,604 respondents answered the question about workspace at T1 and 8,086 participants reported working in cellular, shared, or open-plan offices. Respondents with other workplace arrangements (e.g., working in a shop, service station, treatment institution, outdoor setting, and so on) and respondents who did not answer the question about workplace arrangements at all survey time points were excluded (N = 3,518). Of the remaining 4,568 respondents, 3,415 people participated at the T2 survey. Of these, 534 persons also participated in the T3 survey. Hence, as the current study models changes in control over time among office workers, we will analyze changes from T1 to T2 among 3,415 respondents, while changes from T2 to T3 will be analyzed among the 534 persons that provided data at T3.

Mean age in the T1–T2 sample was 45.58 (SD = 0.76) years with a range from 19 to 69. The sample consisted of 53.4% women and 46.6% men. Ninety-nine percent had regular full-time employment. Altogether 26.1% had a leadership position at their workplace. About 11% had home office work at least 1 day per week. Attrition analyses of dropouts from T1 to T2 and T3 indicated that both the T1–T2 and the T1–T2–T3 samples were representative of the overall baseline sample of office workers with regard to the study variables.

Ethical approvals

Consistent with the requirements for health research in Norway, the project was endorsed by the Regional Committees for Medical and Health Research Ethics (REC) in Norway (REC South East), had approval from the Data Inspectorate of Norway, and was conducted in accordance with the World Medical Association Declaration of Helsinki.

Instruments

A single item question was used to assess office design: "Do you work. . .." (1) "alone in your own office," (2) "In a shared office with one

or more colleagues," (3) "In an open-plan workspace," (4) "In a shop/service station, etc.," (5) "Treatment institution," or (6) "Outdoors." Respondents who reported alternatives 4 through 6 were excluded from this study as they did not conduct office work.

Job control was assessed with a previously validated scale from the General Nordic Questionnaire for Psychological and Social Factors at Work (QPSNordic; Dallner *et al.*, 2000; Wannstrom, Peterson, Asberg, Nygren & Gustavsson, 2009). The scale included items that assessed the respondents' experience of control over decisions (i.e., influence on decisions regarding work tasks and choice of coworkers) and control over work intensity (i.e., influence on time, pace, and breaks). Sample items are "Can you influence the amount of work assigned to you?" and "Can you set your own work pace?" The response scale was "1 = very seldom or never," "2 = somewhat seldom," "3 = sometimes," "4 = somewhat often," and "5 = very often or always." Both subscales had satisfactory internal consistency at all three time points as indicated by Cronbach's alpha (decision control scale: 0.77/0.71/0.72; control over work intensity: 0.78/0.83/0.82).

Covariates

Previous research has shown notable age and gender differences in job control (Hertel, Rauschenbach, Thielgen & Krumm, 2015; Petrie & Roman, 2004). Reactions to changes in the work environment vary with organizational position (Zalesny & Farace, 1987). In addition, due to the formal power and degree of control that is associated with the leadership position, leaders have more latitude to make decisions. Superiors should therefore be more likely to experience control than subordinates (Slemp, Kern, Patrick & Ryan, 2018). Finally, findings indicate that teleworkers perceive more work autonomy as compared with office workers in the conventional office (Lundberg & Lindfors, 2002). Hence, due to their associations with autonomy, age, gender, leadership position, and teleworking were included as covariates in this study.

Information about gender, age, and leadership position was assessed with single item questions. Response categories for leadership position were "no" and "yes." Teleworking/remote work was assessed with a single item asking about how many hours per week the respondents worked at home. Response categories were "0 h," "1–2 h," "3–5 h," "6–15 h," and "more than 15 h." In this study, respondents with telework of less than 6 h were coded as 1 "Non-regularly teleworkers," whereas those with 6 h or more were coded as "Regularly teleworkers."

Statistical analyses

Data were analyzed with SPSS 25.0. The level of significance was set to $p < 0.05$. Cross-sectional between-level differences between office categories and control were examined with one-way ANOVA with Bonferroni post hoc analyses. Eta squared (η^2) was used as an indicator of effect size. The following thresholds were used to interpret values for eta squared: 0.01, small effect size; 0.06, medium effect size; 0.14 or higher, large effect size.

To model the mean levels of control and their change over the three time points, latent growth curve (LGC) analysis was employed (A-Malek, Mearns & Flin, 2004; Duncan, Duncan, Strycker, Li & Alpert, 1999; Muthen & Khoo, 1998), using MPLUS Version 8.7. The LGC model is a latent variable structural equation model, conceptualizing change over time as an underlying process not directly observable but inferred from patterns in observed data.

Compared with more traditional longitudinal data analysis approaches (e.g., difference scores, repeated measures, panel regression), examining change with LGC provides several advantages (Byrne, Lam & Fielding, 2008). For this study, an important advantage is that LGC provides within-person and between-person models of individual growth within the same framework. Therefore, LGC models can be used to identify predictors of change and thereby explain individual differences in change. In addition, LGC models account for measurement error and model different residual structures.

Two central parameters of the model are the intercept and slope, which correspond to the initial level of the variable and the change of the variable over time, correspondingly (see Fig. 1). In this case, change was modeled as a linear process over the three time points, meaning the slope reflected the mean change of control for each additional time point (i.e., 2 years). Values for skewness and kurtosis were all within the threshold for a normal distribution (between −1 and +1), thus indicating that a generalized linear model was adequate for the analysis. Both intercept and slope were allowed to vary in order to capture individual variability in the initial level and subsequent change of control over the study period and were regressed on change of office concept. Hence, we sought to determine whether the change from the different office concepts to another concept was associated with (1) the individual workers' initial level of control and (2) the individual workers' change in level of control.

We adopted the recommended two-step process (Bollen & Curran, 2006) for building our LGC model. First, we tested the unconditional latent growth curve model. In this within-individual stage, intercept and slope "constructs" are fit to the repeatedly measured variable to model intraindividual change (Jaramillo & Grisaffe, 2009). At the same time, between-individual variability in change can be determined because intercept and slope are modeled as random effects (Byrne, Lam & Fielding, 2008). Second, we built a conditional growth model (Bollen & Curran, 2006). This between-individual stage focuses on explaining interindividual differences in change by implementing explanatory variables (Lance *et al.*, 2000).

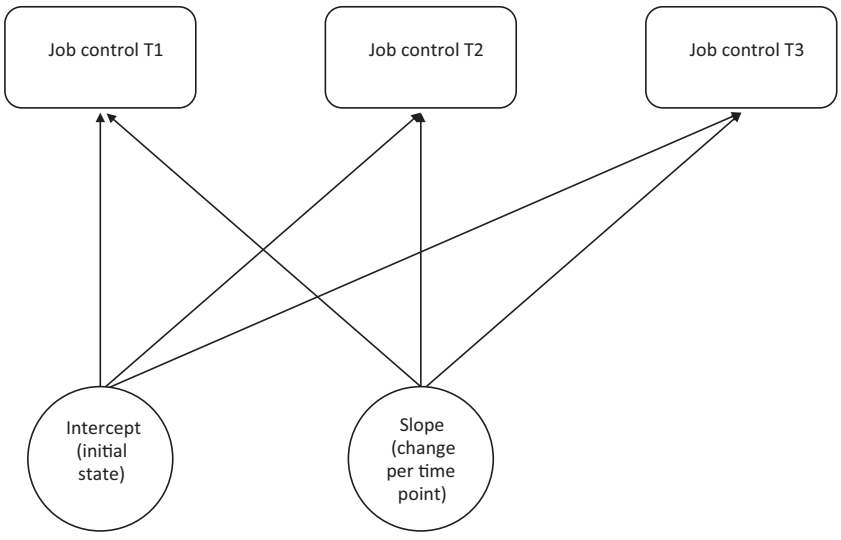

Fig. 1. Latent growth curve model.

The models were estimated with robust maximum likelihood (the MLR estimator of MPLUS; Muthén & Muthén, 1998–2015). Using the cut off criteria described by Kline (1998), the fit of the model was judged by the comparative fit index (CFI; values >0.95 indicate good fit), the root mean square error of approximation (RMSEA; values <0.06 indicate good fit), and the Tucker-Lewis index (TLI; values >0.96 indicate good fit).

RESULTS

Descriptive data

Altogether 56.3% of the participants worked in a cellular office at both T1 and T2, whereas 30.2% worked in a shared/open office at both time points. Between T1 and T2, 7.8% moved from a cellular office to a shared/open office, while 5.7% moved from a shared/open office to a cellular office. Mean scores and standard deviation between the office groups at the three time points are presented in Table 1.

Cross-sectional analyses

To test the first two study hypotheses, cross-sectional comparisons between office categories were conducted with one-way ANOVA analyses at each time point (see Table 1 for means, standard deviations, and test statistics). The findings showed significant differences between the office groups at all three time points both for control over work intensity (Hypothesis 1a) and for control over decisions (Hypothesis 1b). Eta squared values showed that the effect sizes for control over work intensity ranged from medium to large, whereas the effect sizes for control over decisions ranged from small to medium. Bonferroni post hoc tests for differences at T1 and T2 showed that respondents working in shared/open offices reported significantly lower control over work intensity compared with all other office categories. Similarly, respondents in cellular offices reported significantly higher control over work intensity compared with all other categories. At T3, respondents who worked only in cellular offices reported higher control than respondents who worked only in shared/open offices. There were no differences regarding the transition categories at T3. As for control over decisions, there were significant differences between respondents who worked only in cellular offices and respondents who worked only in shared/open offices at all three time points, whereas no clear patterns emerged for the transition groups.

Analyses of longitudinal data

Unconditional latent growth model. To provide a preliminary test of patterns of change of job control in the sample, we first specified unconditional latent growth curve models (i.e., without predictors, Table 2). The unconditional models should be considered as only initial investigations of the processes of change in the outcome variables for the total sample (i.e., analyses of change without considering office design as a conditional factor). The resulting latent growth models for control over work intensity ($\chi^2(1) = 0.329$; comparative fit index [CFI] = 1.00; RMSEA = 0) and control over decisions ($\chi^2(1) = X119$; CFI = 1.00; RMSEA = 0) produced perfect overall fit statistics. It should be noted that these two latent growth curve models, with three time points, have only one degree of freedom and are therefore almost saturated. Hence, a perfect fit is not surprising (Duncan & Duncan, 2009). Table 3 reports the estimated values for all parameters of our two unconditional models. Inspecting the means of intercept and slope of work intensity, the intercept (i.e., the average initial level at baseline) was 3.74 ($p < 0.001$), and the mean slope was 0.01 ($p = 0.61$). A non-significant slope indicates lacking support for change over time. The variances for the intercept and slope were 0.57 ($p < 0.001$) and 0.01 ($p = 0.45$), respectively. The covariance between intercept and slope was −0.01 ($p = 0.80$). For control over decisions, the intercept (i.e., the average initial level at baseline) was 3.25 ($p < 0.001$), and the mean slope was −0.02 ($p = 0.1$). As for control over work intensity, the intercept variance was statistically significantly different from 0 (0.37, $p < 0.01$), while the slope variance was not (0.02, $p = 0.17$), indicating interindividual differences in the initial level of control, but not in change over time. The covariance between intercept and slope for control over decisions was −0.01 ($p = 0.43$).

Conditional latent growth model. The unconditional models indicate no changes in levels for the indicators of job control in the total sample. However, this does not rule out the possibility for changes within subgroups in the sample. To detect potential within-group changes and between-group differences for office categories, a conditional latent growth model was tested with office design serving as the conditional variable. Hence, in the second analytical step, we added office design and potential confounders as predictors to the LGC model to determine whether

Table 1. *Levels of job control across time points for office type categories (mean scores with standard deviations in brackets)*

	Control of work intensity				Control over decisions			
Office category	*N* for groups T1–T2	T1	T2	T3	*N* for groups T1–T2	T1	T2	T3
Cellular T1 and T2	1,884	3.98 (0.70)	3.99 (0.69)	4.00 (0.68)	1,867	3.39 (0.75)	3.37 (0.72)	3.35 (0.73)
Cellular T1 to shared/open T2	261	3.79 (0.70)	3.68 (0.79)	3.83 (0.78)	257	3.25 (0.76)	3.15 (0.78)	3.41 (0.69)
Shared/open T1 and T2	192	3.69 (0.89)	3.85 (0.74)	3.93 (0.90)	184	3.24 (0.74)	3.30 (0.73)	3.29 (0.73)
Shared/open T1 to cellular T2	1,009	3.29 (1.05)	3.30 (1.06)	3.55 (0.99)	1,001	3.08 (0.76)	3.08 (0.76)	3.16 (0.76)
F between groups		151.89	152.54	11.53		36.60	35.66	2.87
p between groups		<0.001	<0.001	<0.001		<0.001	<0.001	0.036
Welch robust test		119.66	119.03	9.17		36.40	34.69	2.78
p Welch robust test		<0.001	<0.001	<0.001		<0.001	<0.001	.045
η^2		0.120	0.121	0.057		0.032	0.031	0.015

Table 2. *Parameter estimates for unconditional latent growth curve models*

	Control over work intensity[a]		Control over decisions[b]	
	Mean	*p*-value	Mean	*p*-value
Means				
Intercept	3.74	0	3.27	<0.001
Slope	0.01	0.61	−0.02	0.1
Variances				
Intercept	0.57	0	0.37	<0.001
Slope	0.01	0.45	0.02	0.17

[a]Model fit: $\chi^2(1) = 0.33$, TLI = 1, CFI = 1, RMSEA = 0.
[b]Model fit: $\chi^2(1) = 0.12$, TLI = 1, CFI = 1, RMSEA = 0.

there were differences in intercept and slope between the different office concepts (Table 3). The results of these analyses revealed that change of office concept was associated with intercepts of both growth curve models, meaning that the initial levels of control over work intensity and control over decisions were different for the different office concepts. For control over work intensity, all three comparison groups were associated with lower initial levels of control when compared with employees who worked in a cellular office at T1 and T2, showing that employees who worked in shared office spaces at least at one of the time points reported lower control than those who worked in cellular offices at both time points ("move from cellular office to shared/open office": $b = -0.217$, $p < 0.001$; "move from shared/open office to cellular office": $b = -0.293$, $p < 0.001$; and "Shared open/office at T1 and T2" $b = -0.689$, $p < 0.001$).

As for the slopes (i.e., the change of control over the three time points), comparisons with "cellular office at T1 and T2" showed that "move from shared office to cellular office" was statistically significantly associated with an increased level of control over the three time points ($b = 0.13$, $p = 0.002$), while "move from cellular office to shared/open office" ($b = -0.07$, $p = 0.07$) and "Shared open/office at T1 and T2" ($b = 0.02$, $p = 0.42$) were not statistically significant slope predictors.

For control over decisions, the pattern was similar, with statistically significant, albeit weaker, associations with the intercept (compared with "cellular office at T1 and T2": "move from cellular office to shared/open office": $b = -0.11$, $p = 0.02$; "move from shared/open office to cellular office": $b = -0.14$, $p = 0.01$; and "Shared open/office at T1 and T2": $b = -0.26$, $p < 0.001$), but no statistically significant associations with the slope (compared with "cellular office at T1 and T2": "move from cellular office to shared/open office": $b = -0.03$, $p = 0.42$; "move from shared/open office to cellular office": $b = 0.07$, $p = 0.13$; and "Shared open/office at T1 and T2": $b = -0.002$, $p = 0.94$).

Table 3. *Effects of office concept change on intercepts and slopes from conditional latent growth curve models modeling job control over three time points*

	Control over work intensity[a]		Control over decisions[b]	
	B	*p*-value	*B*	*p*-value
Effects on intercept				
Cellular at T1 and T2	Ref	–	Ref	–
Cellular to shared/open	−0.22	0	−0.11	0.02
Shared/open to cellular	−0.29	0	−0.14	0.01
Shared/open at T1 and T2	−0.69	0	−0.26	<0.001
Effects on slope				
Cellular at T1 and T2	Ref	–	Ref	–
Cellular to shared/open	−0.07	0.07	−0.03	0.42
Shared/open to cellular	0.13	0.002	0.07	0.13
Shared/open at T1 and T2	0.02	0.42	−0.002	0.94

[a]Model fit: $\chi^2(8) = 3.38$, TLI = 1, CFI = 1, RMSEA = 0.
[b]Model fit: $\chi^2(8) = 14.21$, TLI = 0.992, CFI = 0.997, RMSEA = 0.015.

DISCUSSION

Control is considered to be a key factor regarding coping with challenges at the workplace (Bakker & Demerouti, 2007; Karasek, 1979, 2011). Knowledge about factors that determine levels of control among workers is therefore highly important for maintaining well-being and productivity among workers. The current three-wave longitudinal study examined the impact of office design, as well as redesign of office workspace over time, as predictors of perceived control at the workplace. We hypothesized that employees working in shared or open office layouts would experience lower levels of control of work intensity and decisions compared with employees working in a cellular office and that transitions between office type would have a direct impact on the experience of control. In support of Hypotheses 1a and 1b, employees working in shared/open workspaces reported significantly lower control over work intensity and control over decisions compared with employees working alone in cellular offices. Illuminating a potential causal relationship, the analyses of longitudinal data partially supported Hypothesis 3 by showing that transition from a shared/open workspace to a private cellular office led to a statistically significant increase in control of work intensity. The remaining hypotheses pertaining to the effects of transitions from one type of office design to another were not formally supported, as the effects on the slopes were statistically non-significant. However, it should be noted that the patterns of estimates for effects on slopes appeared consistent, although only the effect for a transition from shared/open office to cellular office on control over work intensity was statistically significant. Estimates for transitions from cellular office to shared/open office were suggestive of loss of control over time, and transitions from shared/open office to cellular office gained control over time (see Table 3). As revealed by Table 1, the number of employees who transitioned between office concepts was relatively small, hence these comparisons may suffer from diminished statistical power. Nevertheless, further research is necessary in order to draw any firm conclusion in that regard.

The finding that moving from shared and open office designs to cellular offices is likely to increase the perceptions of control extends previous cross-sectional research on office design and job control (Van Hootegem & De Witte, 2017) and is in line with longitudinal studies reporting more negative working conditions and more health problems among employees in shared and open

workspaces (Bergstrom, Miller & Horneij, 2015; Brennan, Chugh & Kline, 2002; Nielsen, Emberland & Knardahl, 2020). Allowing workers to decide their own working hours, choose their work location, and organize their tasks autonomously are important for enhancing the experience of control (Bailey & Kurland, 2002; Mann *et al*., 2000). Previous research shows that working in open workspaces increases the risk of exposure to auditory and visual disturbances (Haapakangas, Hongisto, Eerola & Kuusisto, 2017; Pierrette, Parizet, Chevret & Chatillon, 2015). One explanation for the established differences in control between cellular offices and shared/open offices may therefore be that the higher levels of distractions and noise may reduce the experience of autonomy over factors such as pace, scheduling of work, time demands, and deadlines among employees (Kaarlela-Tuomaala, Helenius, Keskinen & Hongisto, 2009; Van Hootegem & De Witte, 2017). As it has been shown that open office designs may impair communication (Bernstein & Turban, 2018) and a sense of community and also increase perceived work demands (Bernstein & Turban, 2018; Haapakangas, Hallman, Mathiassen & Jahncke, 2019), another explanation may be that reduction of these factors lessens employees' perceptions of control and that they, therefore, report lower levels compared with employees working in private cellular offices.

Appraisal of factors at the workplace may vary depending on an employee's organizational level and work status. An alternative explanation for our findings may therefore be that employees working in open workspaces have different job descriptions and conduct other kinds of work tasks than employees in cellular offices. The differences in levels of control over work intensity could thereby reflect the content of the job tasks rather than restrictions produced by the office design. Due to the limited sample size in this study, it was not possible to adjust for occupational task, and we were unable test and rule out this explanation in the analyses of between-group effects. However, we did adjust for whether the respondents had a formal leadership position, thus including occupational level as a potential confounder.

The analyses of effects of transition from one office design to another may shed some light on the causal effects of office designs on reports of control. Our findings showed that a redesign of the office situation that involved a move from an open/shared office to a private cellular office was associated with a significant increase in control of work intensity after the transition (T1 to T2). In addition, there was a trend, albeit non-significant by statistical convention ($p = 0.07$), indicating that employees transitioning from cellular to open/shared offices experienced a decrease in control. These findings indicate that office type has some impact on employees and show that employees who move from open and shared workspaces to cellular offices experience a better ability to influence what happens in their work environment, and especially their pace variation. This corresponds to a previous longitudinal study from the United States on office transition that showed negative effects regarding appraisal of the physical environment, physical stress, coworker relations, and perceived job performance after moving from cellular to open offices (Brennan, Chugh & Kline, 2002), as well a study from Sweden that found that employees who relocated to activity-based workplaces experienced reduced productivity (Bergsten, Haapakangas, Larsson, Jahncke & Hallman, 2021). Nonetheless, due to the limited statistical power for office transition in our study and in previous research studies, the findings of effects of changes in office situation are ambiguous and should be interpreted with caution. More research is therefore needed to determine how office changes may influence perceptions of control among employees.

We found significant differences between cellular and open-plan offices regarding changes in control over work intensity and control over decisions. However, it should be noted that there may also be important differences between different types of open-plan office solutions that could not be captured by our rather crude measure of office layout. For instance, compared with traditional open-plan designs, activity-based workspaces (ABWs), if properly implemented, include several features that are intended to compensate for the typical problems in open-plan offices such as having a choice of settings that support a variety of tasks throughout the workday (Haapakangas, Hongisto, Varjo & Lahtinen, 2018). A review of the literature on ABWs found that although ABWs are unfavorable for concentration and privacy, this kind of open office solution could be beneficial regarding levels of interaction, communication, control of time and space, and satisfaction with the workspace (Engelen *et al*., 2019). However, as other studies have provided contrasting findings (Bernstein & Turban, 2018), more research, including longitudinal evidence, is needed in order to establish the potential merits of ABWs regarding job control (see Gjerland, Soiland & Thuen, 2019 for a review of ABWs).

Methodological limitations

The current study has several strengths and limitations that should be considered. The design was longitudinal with three time points. This allowed for examining both between- and within-group effects. The response rate was higher than the current trend in survey research (Stedman, Connelly, Heberlein, Decker & Allred, 2019). The non-random recruitment of organizations limits the external validity of the findings. However, the organizations were not invited based on office type, and research questions pertaining to office type were not communicated prior to participation, hence selection bias due to "successful" or "challenging" office environments should be negligible. Furthermore, at the level of the individual, the sample used a probability mechanism as all employees in the participating organizations were invited to participate in the survey (Ilies, Hauserman, Schwochau & Stibal, 2003).

The somewhat small sample size for the office-transition groups may have limited the reliability of the analyses as only 13.5% of participants reported changes in office design during the 4-year study period. It should be noted that the low number of respondents in the transition groups is in line with previous studies on office relocation (e.g., Gerdenitsch, Korunka & Hertel, 2018; Hodzic, Kubicek, Uhlig & Korunka, 2020; Kaarlela-Tuomaala, Helenius, Keskinen & Hongisto, 2009). Hence, providing high enough statistical power seems to be a major challenge within this field of research. Low statistical power is problematic since it reduces the chance of detecting a true effect, i.e., finding a statistically significant result. Low power

also reduces the likelihood that a statistically significant result reflects a true effect (Button *et al*., 2013). In addition, differences between participating organizations and changes in job content and/or status are a potential source of confounding in both between- and within-subject analyses. The limited sample size precluded multilevel analyses and analyses of interaction effects. The above findings should therefore be interpreted with caution, and further research is needed to provide evidence that is more conclusive. Nonetheless, when contrasting the findings from the latent growth curve analyses with the between-group findings, which showed a clear difference in levels of control over work intensity between cellular offices and open/shared offices, our findings do at least indicate that office design could have some impact on the experience of job control.

Due to the relatively few respondents who worked in shared and open office layouts, we had to collapse these two categories in the analyses. Consequently, even though the two layouts may have important differences regarding work environment, our study does not inform whether shared and open office solutions have a differential impact on control. Another important limitation is that the measure of office design was rather crude and did not differentiate between different sizes of open workspaces, fixed versus free seating (e.g., fixed seating, flex-office, activity-based offices, etc.). A more fine-tuned indicator of office design would have made it possible to determine the effects of the various dimensions and aspects of open offices. Yet, to achieve adequate statistical power, this would also require a much larger sample size.

Job control was assessed using a psychometrically sound measurement instrument (Wannstrom, Peterson, Asberg, Nygren & Gustavsson, 2009). As the study was based on self-reports, the findings may be influenced by problems that are common to self-report methodologies, such as response-set tendencies and the emotional state of the respondents. However, as the items pertaining to control were constructed with the aim of avoiding emotive content and social desirability bias, the measures should be rather insensitive to respondents' emotions or personality traits (Christensen & Knardahl, 2012). Furthermore, as control is a subjective experience, it would be difficult to measure the concept objectively; it can be determined only through self-reports, or extraordinarily well-controlled laboratory experiments (Burke, Singh & Fiksenbaum, 2010).

Conclusion and implications

Taking into consideration that past research has identified control as a main antecedent to work ability (Knardahl *et al*., 2017; Knardahl, Sterud, Nielsen & Nordby, 2016), our findings indicate that lower levels of control over work intensity may be one potential explanatory mechanism in the previously established relationship between office design and health outcome such as sickness absence/disability retirement (Nielsen, Emberland & Knardahl, 2020; Nielsen & Knardahl, 2019). As job demands are associated with job strain, exhaustion, and mental distress (Bakker & de Vries, 2021; Stansfeld & Candy, 2006), providing employees with an experience of control of work intensity could therefore be important with regard to sustaining health, well-being, and productivity when moving to an open-plan office workplace. Based on the findings of this study, office redesigns that involve the move of employees from cellular offices to shared and open-space offices may benefit from identifying and implementing measures that can maintain levels of control also in the new office situation. As lower levels of privacy, higher levels of complexity challenging sense-making, and higher levels of noise and distractions are possible causes of reduced control in open workspaces (Van Hootegem & De Witte, 2017), efforts should at least be taken to counteract such problem areas. Examples of potential measures are the use of partitioning walls, desk dividers, and noise-cancelling headphones, and having available quiet spaces. Nonetheless, acknowledging that some employees simply do not thrive in open-space workplaces (Hartog, Weijs-Perree & Appel-Meulenbroek, 2018), giving workers the opportunity to remain in cellular offices or choose other private workspaces may be the optimal approach to maintaining levels of control.

Promoting change-centered leadership may also be valuable in office transition processes. A study on the effects of relocation to activity-based workspaces on perceived productivity found that there was a significantly smaller decrease in perceived productivity among employees perceiving high change-oriented leadership before relocation (Bergsten, Haapakangas, Larsson, Jahncke & Hallman, 2021). Furthermore, as our results show that there is variation in the perception of control within the different office categories, this may indicate that some workers fare better than others within the same office type. Hence, as findings indicate positive relationships between ergonomic design and ergonomic training with perceptions of person–environment fit and control (Miles & Perrewe, 2011), matching workers to their physical environment (i.e., person–environment fit), as well as matching tasks to workspaces, should be beneficial. Consequently, to achieve a good fit between employees and workspaces, organizations should evaluate the characteristics of workers while simultaneously analyzing their jobs and tasks in order to design the physical space to fit the workers.

This study was limited to investigating the main effects of office design on control. Some of the most influential theories of occupational psychology, such as the effort-reward imbalance model (Siegrist, 1992), the job demands–control model (Karasek, 1979), the job demands–resources model (Bakker & Demerouti, 2007), and the job characteristics model (Hackman & Oldham, 1976), highlight that work factors are interrelated. Such factors should therefore be studied in combination in order to determine potential interactive effects (Christensen, Nielsen, Finne & Knardahl, 2018). In line with the job demands–control model, future research could extend this study by examining whether office design has an impact on the buffering effect of control on employee health and well-being. This would provide a more refined understanding of how office designs influence the well-being of employees.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

ETHICAL APPROVAL

The survey was approved by the Regional Committee for Medical Research Ethics for Eastern Norway.

INFORMED CONSENT

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

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