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Mapping ICT use at home and telecommuting practices: A perspective from work/family border theory

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ABSTRACT

This study draws on the work/family border theory to investigate the role of information communication technology (ICT) use at home in shaping the characteristics of work/family borders (i.e. flexibility and permeability) and consequently influencing individuals' perceived work-family conflict, technostress, and level of telecommuting. Data were collected from a probability sample of 509 information workers in Hong Kong who were not self-employed. The results showed that the more that people used ICT to do their work at home, the greater they perceived their work/family borders flexible and permeable. Interestingly, low flexibility and high permeability, rather than the use of ICT at home, had much stronger influences on increasing, in particular, family-to-work conflict. As expected, work-to-family conflict was significantly and positively associated with technostress. Results also showed that the telecommuters tended to be older, had lower family incomes, used ICT frequently at home, and had a permeable boundary that allowed work to penetrate their home domain. The theoretical and practical implications are discussed.

1. Introduction

Information and communication technologies (ICTs) have largely freed employees from the restrictions of a fixed, central work place, enabling mundane tasks to be distributed across remote locations (Harrison et al., 2000). Telecommuting or telework, therefore, has become a prevalent and global practice (Davey, 2012). Telecommuting refers to a flexible work arrangement that allows employees, usually with the aid of ICTs, to perform their tasks in various locations, primarily at home (Bailey and Kurland, 2002; Baruch, 2001). Studies on the effects of telecommuting and work-related ICT use at home, however, have yielded mixed results. Some contended that the flexibility in scheduling individual tasks led to increased productivity, improved job satisfaction, and work-family balance (Hill et al., 1998; Tremblay, 2002); while others argued that the connectivity of communication technologies blurred the boundaries between work domain and home domain, inducing work-family conflict and negative cognitive responses such as stress and anxiety, which is termed "technostress" (Brod, 1984; Felstead and Jewson, 2000).

The mixed results were partly due to the fact that ICT use may not have a direct influence on individuals' work and family lives, but exert effects by altering the scope of activities and performance of duties in different domains. Previous research has found that role stress, triggered by role overload and role conflict, was the most significant cause of work-family conflict and technostress (Ayyagari et al., 2011; Tarafdar et al., 2007). Individuals find it hard to balance their work and family roles

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due to the excessive workload and intrusion of personal lives brought about by ICTs, which may result in job burnout, marriage breakdown, physical and mental health problems, and life dissatisfaction (Ford et al., 2007; Frone et al., 1992). Therefore, balancing work and family roles, while working at home, has become extremely crucial for telecommuters (Thatcher and Zhu, 2006).

Although role stress and reliance on technology have been identified as the primary antecedents of work-family conflict and technostress (Arnetz and Wiholm, 1997; Tarafdar et al., 2010), the mechanism through which ICTs exert impacts on work-family interface is largely unknown. The present study, therefore, fills this gap and extends previous literature by incorporating the boundaries around work and family domains into analysis. Drawing on the work/family border theory (Clark, 2000), this study investigates the role of work-related ICT use in shaping the characteristics of work/family border—flexibility and permeability—and its subsequent impact on individuals' perceived work-family conflict and technostress. The status quo and antecedents of telecommuting adoption in Hong Kong are also delineated. Understanding how ICT use shapes the border of work and family domains provides insights into the process by which conflict occurs and the way individuals navigate their work and family lives and manage the borders between them in order to strike a balance.

We now turn to review of the literature covering telecommuting and ICT use at home, work/family border theory, work-family conflict, and technostress in Section 2. Section 3 presents methodology, which includes sample and sampling procedure and measurement for each variable. Section 4 reports the results followed by a thorough discussion in Section 5 and conclusion of the study in Section 6.

2. Literature review

2.1. Telecommuting and ICT use at home

The need to foster productivity has led to the adoption of ICT in the workplace (Davey, 2012). By diminishing the spatial and temporal boundaries among different activities, ICTs largely support multitasking behaviors and aid employees in coordinating different tasks, speeding up work processes, and accomplishing projects efficiently (Cardona et al., 2013). ICT-based practices have also given rise to flexible work arrangements, such as flextime and telecommuting, which increase the amount of autonomy that employees have in their work (Hill et al., 2003).

Telecommuting, also known as telework or remote work, is a flexible work arrangement that allows employees, usually with the aid of electronic communication devices, to accomplish their work in various locations instead of a fixed, central worksite (Bailey and Kurland, 2002; Baruch, 2001). Telecommuting can be either full time or part time, with the latter prevailing in recent years (Leung, 2004; Standen et al., 1999). According to the Gallup's Annual Work and Education Poll conducted in 2015, 37% of U.S. workers say they have telecommuted, up slightly from 30% last decade but four times greater than the 9% found in 1995. The poll also showed that average worker telecommutes two days per month and 46% of telecommuters do so during the workday (Jones, 2015).

Central to telecommuting practice is ICT use, whereby telecommuters interact with their central office and other colleagues (Nilles, 1994). In particular, using ICT to work at home has become indispensable to telecommuters because, compared to remote offices and telework centers, home is the primary location where they perform their tasks (Davis and Polonko, 2001). Telecommuting has its merits in different aspects. At the individual level, telework saves on travel time and the cost of commuting, clothing, food, and day-care for children. Working mothers can fulfill their dual role when working at home. At the organizational level, telework saves overhead costs such as parking, office space, and supplies. At the societal level, telework can cut commuter traffics, and, in turn, save energy, create less air pollution, less wear in transportation systems, and reduce environmental costs.

Although telecommuting has been lauded for increasing productivity and work-family balance (Apgar, 1998), some scholars have expressed concerns about the negative outcomes of pervasive ICT use (Goldstein, 2003). It has been argued that the connectivity of communication devices blurs the boundaries between the domains of work and home, leading to the invasion of work into private lives and inducing negative cognitive responses, such as stress, anxiety, and mental fatigue among users (Brod, 1984; Tarafdar et al., 2010). For employers, ICT can also be used to monitor employees as well. Consequently, teleworkers might encounter career stagnation, marital discord, and life dissatisfaction (Baruch and Nicholson, 1997).

Previous studies on telecommuting and work-family balance has primarily focused on developed countries, such as the United States, Canada, and England (Greenhaus and Parasuraman, 2005), while research on telecommuters in developing countries are still scarce (Nafishah, 2013). In 2004, Leung surveyed 623 information workers in Hong Kong and found that less than three percent were teleworkers, partly due to the low Internet adoption rate at that time. Ten years later, however, the penetration of mobile phones (2.5G and 3G/4G) and household broadband has grown to 228.8% and 83.2%, respectively (Hong Kong Communications Authority, 2015), providing a different scenario of telework practice in Hong Kong. However, to the best of our knowledge, since Leung's study, no follow-up research has been conducted since then. Thus, a primary objective of the present study is to provide an update about the telecommuting situation in Hong Kong and fill the gap between the East and the West in the telecommuting literature. Thus, our first research question is as follows:

RQ1. How widespread is the adoption of telecommuting in Hong Kong and who are the telecommuters?

2.2. Work/family border theory

One of the well-accepted theoretical frameworks for examining social effects of telecommuting is work/family border theory (Clark, 2000). Work/family border theory investigates the way people navigate the work and family domains and manage the borders between them in order to strike a balance. The borders between work and family can reinforce unique characteristics by blocking outside influences and, at the same time, allowing a controlled amount of flow between the two domains (Clark, 2000). Three main forms of the border between work and family domains have been explored in the previous literature: temporal, physical, and psychological (Clark, 2000). The temporal and physical borders define when and where domain-relevant behaviors take place, which are mainly marked by the division of time and space (e.g., defined working hours, walls, and doors). The psychological borders are largely self-created rules that indicate different thinking patterns, emotions, and behaviors. Following disparate rules and behaviors in the workplace and at home, telecommuters are daily border-crossers who constantly shift between the two spheres. Hence, they are challenged by the need to balance the roles of work and family (Clark, 2000).

In Clark's (2000) theory, borders are primarily characterized by their permeability and flexibility. Permeability refers to the extent to which the boundary between work and family allows the psychological or behavioral aspects of one domain to enter another. In other words, permeability means that someone is physically located in one domain, but psychologically or behaviorally involved in another role, such as working at home or taking care of family affairs in the workplace. Permeations often take place when the physical and temporal separation is obscure, which is often the case for telecommuters. Negative emotions and creative ideas can be transmitted from one domain to another (Evans and Bartolome, 1980). Flexibility indicates the extent to which a domain may contract or expand to accommodate the demands of another domain (Clark, 2000). In fact, flexibility involves the malleability of the boundary between two or more role domains (e.g., the ability of a role domain such as *professor* to expand or contract to accommodate the demand of another role domain such as *parent*, and vice versa). When the work/family border is flexible, individuals tend to have more freedom in choosing their work hours and locations (Clark, 2000). When the borders are flexible and permeable, they are blended, leading to the integration of work life and family life (Clark, 2000).

The proliferation of ICT has largely increased the flexibility and permeability of work-family boundaries (Lewis and Cooper, 1999; Valcour and Hunter, 2005). With the availability of a range of mobile communication devices (in particular, the smartphone and the tablet), employees are now embracing flexible work schedules, which allow their work life and family life to overlap and integrate (Valcour and Hunter, 2005). In their study of IBM employees, Hill et al. (2003) found that working from a variety of venues via ICTs gave employees increased flexibility in scheduling their tasks. While the tradeoff is that using ICTs to do work could interfere with people's personal lives, creating excessive workloads and work-family conflicts (Kurland and Bailey, 1999; Mirchandani, 1999). A phone call or WhatsApp message from one's boss or colleagues may orient an individual away from his or her family toward tasks at hand, leading to dissatisfaction of family members. Given these impacts, especially facilitated by the work-related use of ICT at home, on the borders between work and family, we propose the following hypotheses:

H1. The more that people use ICT to do their work at home, the greater they perceive the flexibility of the border around (a) the work domain and (b) the home domain.

H2. The more that people use ICT to do their work at home, the greater they perceive the permeability of the border around (a) the work domain and (b) the home domain.

2.3. Work-family conflict

What concerns telecommuters most is work-family conflict arising from work-related ICT use at home. Work-family conflict is a form of inter-role conflict in which the demands of work and family roles are incompatible so that participation in one role becomes more difficult because of the involvement in the other role (Greenhaus and Beutell, 1985). According to the role theory (Marshall et al., 1991), the responsibilities in different domains compete for limited amounts of time, physical energy, and psychological resources. Conflict occurs when the demands of work and family interfere with each other and limit the performance of work/family duties. Therefore, work-family conflict is bidirectional (Greenhaus and Beutell, 1985), encompassing both work-to-family conflict (work interfering with the family domain) and family-to-work conflict (family interfering with the work domain). Those conflicts can lead to job and family dissatisfaction, overall life stress, major depression, alcohol abuse, etc. (Ford et al., 2007; Frone et al., 1992; Parasuraman et al., 1992).

Given the deleterious outcomes of work-family conflict, research has attempted to determine the factors that contribute to it (Frone et al., 1997; Grzywacz and Marks, 2000; Leung, 2011). Greenhaus and Beutell (1985) identified three sources of work-family conflict: the *strain* engendered by a role, the *time* devoted to a role, and the *behavior* required in a role. Building on their assumption, studies in subsequent decades have identified job/family involvement, role stress, hours spent at work/home, and supervision mode as the potential antecedents of work-family conflict (Byron, 2005; Kossek and Ozeki, 1999). However, few studies have attended to the characteristics of work/family border in causing work-family conflict (Clark, 2002a; Lambert et al., 2006). According to the work/family border theory, increased border permeability makes it easier

for people to carry over their emotions and behaviors from one domain to another, while high flexibility are likely to mitigate work-family conflict by giving individuals more autonomy in performing their duties (Clark, 2000; Goldstein, 2003). Therefore, the lowest levels of work-family conflict were found in those who had high flexibility but low permeability (Clark, 2002a). In a study examining the effects of ICT connectedness (ICTC), which refers to the scope, breadth, and centrality of ICTs in a person's everyday life, Leung (2011) found that high permeability at work and at home and low flexibility at work were strong indicators of work-family conflict, while ICTC only had a marginal influence on increasing negative spillover. Therefore, we propose the following hypotheses and research question:

H3. The greater the flexibility of the borders between work and home, the lower the amount of (a) work-to-family conflict and (b) family-to-work conflict.

H4. The lower the permeability of the borders between work and home, the lower the amount of (a) work-to-family conflict and (b) family-to-work conflict.

H5. The higher the intensity of telecommuting, the greater the amount of (a) work-to-family conflict and (b) family-to-work conflict.

RQ2. In what way(s) can demographics, ICT use at home, permeability, and flexibility predict work-family conflict?

2.4. Technostress

Apart from work-family conflict, people's increasing dependence on technology has also been found to induce negative cognitive responses, such as stress, anxiety, and mental fatigue, which are known as technostress (Brod, 1984; Tarafdar et al., 2010). Coined by Brod in 1984, technostress is defined as "a modern disease of adaptation caused by an inability to cope with new computer technologies in a healthy manner" (Brod, 1984). Arnetz and Wiholm (1997) examined this phenomenon through the lens of psychosociology and found technostress to be a state of mental and physiological arousal resulting from the struggle in dealing with technologies, especially experienced by people who are heavily dependent on technology to perform their work.

Contributing factors of technostress—stressors or stress creators—have been found to include technology complexity, information overload, multitasking, and pervasive connectivity (Ayyagari et al., 2011; Sellberg and Susi, 2014; Tarafdar et al., 2007). Cognitive factors such as (*lack of*) self-efficacy can also elicit technostress (Shu et al., 2011). Tarafdar et al. (2007) categorized technostress creators into five dimensions: *techno-overload, techno-invasion, techno-complexity, techno-insecurity, and techno-uncertainty*. *Techno-overload* refers to situations where ICTs compel users to work faster and longer, whereas *techno-invasion* describes the situations where workers can be contacted anywhere and anytime facilitated by invasive effect of ICTs. *Techno-complexity, -insecurity,* and *-uncertainty* are engendered by complex and ever-evolving computer systems and gadgets, which force employees to upgrade their knowledge and skills for fear of being left out. Therefore, the five technostress creators can be further grouped into two dimensions: one is pertinent to role stress; the other concerns the efficacy involved in managing ICTs. As individuals become increasingly tech-savvy, the insecurity and uncertainty facilitated by ever-changing ICTs will be overshadowed by the stress of accommodating different roles in their social systems.

Drawing on role theory, Tarafdar et al. (2007) found a positive correlation between technostress and role stress, including role overload and role conflict. This finding was echoed by Ayyagari et al. (2011), who identified work overload and role ambiguity as the dominant causes of technostress. Work-family conflict, as the primary role conflict, was also found to be a leading cause of ICT-created stress (Ayyagari et al., 2011; Middleton and Cukier, 2006). Therefore, the two technostress creators related to role stress—techno-overload and techno-invasion—can be mapped into the framework of work/family border theory, thus falling into the scope of our research. Although little research has explored technostress in the light of work-family interface, the recent telecommuting literature has provided some insights. In studying telework-enabled stressors, Weinert et al. (2015) found that autonomy in the workplace such as flexile scheduling significantly reduced work overload and role ambiguity, thus mitigating telework-related stress. Nevertheless, the permeable border between work and home is likely to give rise to negative spillover, leading to augmented technostress and job burnout (Leung, 2011). Therefore, the following hypotheses are proposed:

H6. The greater the flexibility of the borders between work and home perceived at (a) the work domain and (b) the home domain, the lower the amount of technostress individuals will experience.

H7. The greater the permeability of the borders between work and home perceived at (a) the work domain and (b) the home domain, the higher the amount of technostress individuals will experience.

H8. The greater the (a) work-to-family conflict and (b) family-to-work conflict, the higher the amount of technostress individuals will experience.

H9. The higher the intensity of telecommuting, the greater the amount of technostress individuals will experience.

This study also explores the roles of ICT use, characteristics of work/family borders, work-family conflict in predicting technostress, and consequently affect telecommuting in the context of Hong Kong. Thus, the following research questions are proposed:

RQ3. In what way(s) do demographics, ICT use at home, permeability, flexibility, and work-family conflict predict technostress?

RQ4. In what way(s) do demographics, ICT use at home, permeability, flexibility, work-family conflict, and technostress predict telecommuting?

3. Methodology

3.1. Sample and sampling procedure

The data used in this study were collected from a telephone survey with a probability sample of 603 information workers aged 18 years and above. The participants, who were randomly chosen from the latest edition of the Hong Kong telephone directory, had jobs that required the use of a computer to accomplish the tasks of their works. All calls were made from a central location during the evening hours with close supervision by trained, advanced undergraduates at the Survey Research Laboratory who used the Computer-Assisted Telephone Interviewing (CATI) system. Non-eligible respondents (i.e., younger than 18 and older than 65), nonworking numbers, and numbers that were not answered after five attempts were excluded. The next-birthday method was used to select a respondent if more than one individual within the household satisfied the criteria for participating in the study. Before the fieldwork was conducted, the survey instrument was pilot tested between 24 March and 8 April 2015. The response rate was 50%, and 603 interviews were completed. However, because seven respondents did not answer all the questions, and 87 respondents were self-employed, the final sample for analysis comprised 509 respondents. Self-employed workers and workers who do overtime at home were not considered telecommuters. In the sample, 47.3% of the respondents were male, and the median age was 40–49 years. The median monthly household income was in the range of US $3226 and US $3870. Of the respondents, 34.9% were high school graduates or below, 12.4% had professional training beyond high school, and 52.6% had graduated with a bachelor's degree or higher.

3.2. Measures

3.2.1. Telecommuting

The respondents were asked: "How many days in a typical week do you work at home rather than in the office?" A five-point scale was used in which 1 = none, 2 = one day a week, 3 = two days a week, 4 = three days a week, 5 = four days a week, and 6 = five days or more a week.

3.2.2. Work-related ICT use

Eight kinds of ICT were employed to assess the level of work-related ICT used at home. A four-point scale in which 1 = never, 2 = rarely, 3 = sometimes, and 4 = often was used. The eight ICTs included: 1) personal computer; 2) facsimile machine, copier, or scanner; 3) e-mail; 4) instant messaging such as WhatsApp and WeChat; 5) intranet provided by the company; 6) cloud storage using Dropbox and/or Google Drive; 7) social media such as Facebook; and 8) search information on the World-Wide-Web. The reliability alpha was high at 0.86.

3.2.3. Flexibility

Flexibility of the borders around *work* was measured using the following three items ($\alpha = 0.61$), which were adopted from Clark (2002b). A four-point scale was used in which 1 = never and 4 = always: "I can arrive at and depart from work when I want"; "I can easily take a day off work when I want to"; and "My employer lets me perform non-work projects during spare time at work." The flexibility of the borders around *family* was measured by similar items ($\alpha = 0.78$): "I can arrive at and depart from home when I want"; "I can easily work an extra day when I want to"; and "My family lets me perform work projects during spare time at home."

3.2.4. Permeability

The permeability of the boundary between the work domain and family was assessed using the following four items ($\alpha = 0.71$), which were adopted from Clark (2002b) and used a four-point scale in which 1 = never and 4 = always: "My family contacts me while I am at work"; "I have family-related items at my workplace"; "I think about my family members when I am at work"; and "I stop in the middle of my work to address a family concern." Similarly worded items ($\alpha = 0.81$) measured the family domain's permeability to work, such as "I receive work-related calls while I am at home" and "I stop in the middle of my home activities to address a work concern."

3.2.5. Work-family conflict

Two separate measures were used distinguish two negative forms (or consequences) of spillovers: *work-to-family conflict* and *family-to-work conflict*. These measures were abbreviated forms of a similar three-item measure used in the National Survey of Midlife Development in the United States (Dilworth, 2004). The work-*to-family conflict* ($\alpha = 0.72$) measured the extent to which a person's job left that person feeling "too tired to do the things that need attention at home"; "You wish you had more time to do things for your family"; and "Your job keeps you away from your family too much." The *family-to-work conflict* measure ($\alpha = 0.75$) captured the extent to which "worries and problems at home cause you to spend less time at work than you need or want to"; "personal and family worries and problems distract you when you are at work"; and "activities and chores at home prevent you from getting the amount of sleep you need to do your job well."

3.2.6. Technostress

Three items were used to assess the techno-overload dimension of technostress: "I work with very tight time schedules due to ICT"; "I have to change my work habits to adapt to new technologies"; and "I have a higher workload because of increased technology complexity." Similarly, techno-invasion was assessed using four items: "I spend less time with my family due to ICT"; "I have to be in touch with my work even during my vacation due to ICT"; "In have to sacrifice my vacation and weekend time to keep current on new technologies," and "I feel my personal life is being invaded by this technology." A five-point Likert scale was used in which 1 = strongly disagree and 5 = strongly agree. The reliability alphas for techno-overload and techno-invasion were 0.75 and 0.78, respectively.

3.2.7. Demographics

Gender, age, education, and household income were used as control variables in the analyses.

4. Results

4.1. Telecommuting adoption in Hong Kong

To answer the first research question regarding how widespread is the adoption of telecommuting in Hong Kong, the results show that the penetration of telecommuting among information workers has grown to 25% (specifically those who admitted that they work at least one day or more a week at home). Compared to a similar study conducted 15 years ago, this figure has increased dramatically when only 3% of information workers considered themselves teleworkers in 2000 (Leung, 2004). In terms of who telecommute, the study found that majority of the telecommuters (24.6%) were managers or administrators and 23.8% were professionals (such as lawyers, computer programmers, accountants, and designers). Of all the telecommuters, 37.3% telecommuted one day a week, 26.2% two days a week, and 17.5% telecommuted three days or more a week away from the office.

4.2. Hypotheses testing

H1 proposed that the more that people used ICT to do their work at home, the greater the flexibility of the borders they perceived around (a) the work domain and (b) the home domain. The results presented in Table 1 showed that correlations of all key variables in which relationships between work-related ICT use at home and flexibility in the work domain ($r = 0.18$, $p < 0.001$) and the home domain ($r = 0.13$, $p < 0.01$) were both positive and significant. However, the regression results presented in Table 2 showed that work-related ICT use at home significantly predicted only the flexibility of the border perceived in the work domain ($\beta = 0.19$, $p < 0.001$). The regression result for flexibility at the home domain was insignificant. Therefore, H1a was fully supported, and H1b was not supported.

H2 proposed that the more people used ICT to do their work at home, the greater the permeability of the border they would perceive between (a) the work domain and (b) the home domain. The results of the multiple regression analyses pre-

Table 1
Zero order correlation of all key variables.

	2	3	4	5	6	7	8	9	10
1. Work-related ICT use at home	0.40***	0.18***	0.13**	0.08	0.62***	0.40***	0.26***	0.14**	0.41***
2. Telecommuting		0.18***	0.12*	0.04	0.42***	0.19***	0.11*	0.11*	0.20***
3. Flexibility at work			0.20***	0.34***	0.22***	−0.06	0.08	−0.14**	−0.08
4. Flexibility at home				0.03	0.23***	0.12*	−0.05	0.04	0.07
5. Permeability at work					0.18***	0.16***	0.38***	−0.07	−0.01
6. Permeability at home						0.52***	0.38***	0.22***	0.44***
7. Work-to-family conflict							0.35***	0.32***	0.49***
8. Family-to-work conflict								0.19***	0.33***
9. Techno-overload									0.54***
10. Techno-invasion									

Notes: ***$p < 0.001$; **$p < 0.01$; *$p < 0.05$; N = 509.

Table 2
Regression analyses of permeability and flexibility.

	Flexibility		Permeability	
	At work domain β	At home domain β	At work domain β	At home domain β
Demographics				
Gender (male = 1)	0.05	−0.16**	−0.05	−0.05
Age	−0.06	0.00	0.01	0.04
Education	0.02	0.17**	−0.10	0.08
Family income	0.08	0.05	0.11	0.09
Occupation (managerial = 1)	0.08	0.01	0.04	0.04
Work hours	−0.30***	0.05	−0.08	0.16***
Work-related ICT use at home	0.19***	0.10	0.10*	0.57***
R^2	0.13	0.08	0.03	0.46
Adjusted R^2	0.12	0.06	0.01	0.45
F	9.72***	4.40***	2.00	55.38***

Notes: ***$p < 0.001$; **$p < 0.01$; *$p < 0.05$; N = 509.

sented in Table 2 showed that the use of ICT to work at home was significantly linked to the permeability of the border they perceived around the domains at both work (β = 0.10, $p < 0.05$) and home (β = 0.57, $p < 0.001$). Thus, H2a and H2b were fully supported.

H3 proposed that the greater the flexibility of the borders between work and home (i.e., both the work domain and the home domain), the lower the level of (a) work-to-family and (b) family-to-work conflicts. The multiple regression results presented in Table 3 showed that the flexibility at work domain was significantly and negatively linked to work-to-family conflict (β = −0.18, $p < 0.001$) but was insignificant for family-to-work conflict (β = −0.06, p = n.s.). Similarly, flexibility in the home domain was significantly and negatively linked to family-to-work conflict (β = −0.12, $p < 0.05$) but was insignificant for work-to-family conflict (β = 0.02, p = n.s.). Therefore, H3a and H3b were only partially supported.

H4 proposed that the greater the permeability of the borders between work and home (i.e., both the work domain and the home domain), the higher the level of (a) work-to-family and (b) family-to-work conflicts. The regression results presented in Table 3 showed that the permeability of the work domain positively and significantly predicted work-to-family (β = 0.15, $p < 0.01$) and family-to-work conflict (β = 0.39, $p < 0.001$). However, permeability of the home domain significantly predicted work-to-family conflict (β = 0.28, $p < 0.001$) but was insignificant for family-to-work conflict (β = 0.11, p = n.s.). Therefore, H4a was fully supported and H4b was partially supported.

H5 hypothesized that the higher the intensity of telecommuting, the greater the amount of (a) work-to-family conflict and (b) family-to-work conflict. The results presented in Table 1 showed that work-to-family and family-to-work conflicts and intensity of telecommuting were significantly and positively related (r = 0.19, $p < 0.001$ and r = 0.11, $p < 0.05$, respectively). However, the results of the regression analysis presented in Table 4 showed that work-family conflicts were not sig-

Table 3
Regression analyses of work-family conflict.

	Work-family conflict	
	Work-to-family conflict β	Family-to-work conflict β
Demographics		
Gender (male = 1)	−0.09	−0.06
Age	−0.04	0.07
Education	0.05	0.08
Family income	0.02	−0.08
Occupation (managerial = 1)	−0.05	−0.01
Work hours	0.23***	0.13*
Work-related ICT use at home	0.18**	0.09
Flexibility		
At work domain	−0.18***	−0.06
At home domain	0.02	−0.12*
Permeability		
At work domain	0.15**	0.39***
At home domain	0.28***	0.11
R^2	0.31	0.21
Adjusted R^2	0.29	0.18
F	14.34***	8.27***

Notes: ***$p < 0.001$; **$p < 0.01$; *$p < 0.05$; N = 509.

Table 4
Regression analyses of telecommuting.

	Telecommuting β
Demographics	
Gender (male = 1)	−0.08
Age	0.15*
Education	0.05
Family income	−0.10*
Occupation (managerial = 1)	−0.05
Work hours	0.06
Work-related ICT use at home	0.22***
Flexibility	
At work domain	0.10
At home domain	0.00
Permeability	
At work domain	−0.09
At home domain	0.32***
Work-family conflict	
Work-to-family conflict	−0.05
Family-to-work conflict	−0.01
Technostress	
Techno-overload	0.03
Techno-invasion	−0.02
R^2	0.25
Adjusted R^2	0.21
F	7.42***

Notes: ***$p < 0.001$; **$p < 0.01$; *$p < 0.05$; N = 509.

nificantly linked to the intensity of telecommuting. Thus, H5a and H5b were supported at the bivariate level but not at the multivariate level.

H6 proposed that the greater the flexibility of the borders between work and home perceived in (a) the work domain and (b) the home domain, the lower the amount of techno-stress experienced. As presented in Table 5, the results of the multiple regressions showed that the flexibility at work domain was a significant and negative predictor of both techno-overload ($\beta = -0.12$, $p < 0.05$) and techno-invasion ($\beta = -0.11$, $p < 0.05$). However, no significant relationship was found between the flexibility at home domain and technostress. Therefore, H6a was fully supported, but H6b was rejected.

Table 5
Regression analyses of technostress.

	Technostress	
	Techno-overload β	Techno-invasion β
Demographics		
Gender (male = 1)	0.07	0.06
Age	0.17**	0.05
Education	0.00	0.10
Family income	0.08	−0.14*
Occupation (managerial = 1)	−0.15**	−0.10
Work hours	−0.07	0.03
Work-related ICT use at home	−0.01	0.16**
Flexibility		
At work domain	−0.12*	−0.11*
At home domain	0.00	0.01
Permeability		
At work domain	−0.16**	−0.10*
At home domain	0.16*	0.23***
Work-family conflict		
Work-to-family conflict	0.24***	0.24***
Family-to-work conflict	0.05	0.09
R^2	0.19	0.33
Adjusted R^2	0.16	0.30
F	6.31***	12.75***

*$p < 0.001$; **$p < 0.01$; *$p < 0.05$; N = 509.

H7 proposed that the greater the permeability of the borders between work and home in (a) the work domain and (b) the home domain, the higher the level of techno-stress experienced. The results of the multiple regression analyses presented in Table 5 showed that technostress was significantly and negatively predicted by permeability in the work domain (with $\beta = -0.16$, $p < 0.01$ for techno-overload, and $\beta = -0.10$, $p < 0.05$ for techno-invasion) but significantly and positively predicted by permeability in the home domain (with $\beta = 0.16$, $p < 0.05$ for techno-overload and $\beta = 0.23$, $p < 0.001$ for techno-invasion). Thus, H7a was rejected, and H7b was supported.

H8 hypothesized that the greater the perceived (a) work-to-family conflict and (b) family-to-work conflict, the higher the techno-stress experienced. The results of the multiple regressions presented in Table 5 showed that only work-to-family conflict was a significant predictor for techno-overload ($\beta = 0.24$, $p < 0.001$) and techno-invasion ($\beta = 0.24$, $p < 0.001$). Family-to-work conflict had no effect on technostress. Therefore, H8a was fully supported, but H8b was rejected.

H9 proposed that the higher the intensity of telecommuting, the greater the amounts of (a) techno-overload and (b) techno-invasion people would experience. The correlation results presented in Table 1 showed that the intensities of telecommuting and techno-overload ($r = 0.11$, $p < 0.05$) and techno-invasion ($r = 0.20$, $p < 0.001$) were significant. However, as shown in Table 4, technostress was not significantly linked to telecommuting. Thus, H9a and H9b were supported only at the bivariate level; they were not supported at the multivariate level.

4.3. Predicting work-family conflict

As shown in Table 3, work-to-family conflict was significantly predicted, in order of their beta weights, by permeability in the home domain ($\beta = 0.28$, $p < 0.001$), hours worked ($\beta = 0.23$, $p < 0.001$), use of ICT at home ($\beta = 0.18$, $p < 0.01$), flexibility in the work domain ($\beta = -0.18$, $p < 0.001$), and permeability in the work domain ($\beta = 0.15$, $p < 0.01$). In contrast, family-to-work conflict was significantly predicted, in order of their beta weights, by permeability in the work domain ($\beta = 0.39$, $p < 0.001$), hours worked ($\beta = 0.13$, $p < 0.05$), and flexibility in the home domain ($\beta = -0.12$, $p < 0.05$). The amount of variance explained was between 18% and 29%.

4.4. Predicting telecommuting

A regression analysis was conducted to assess how demographics, ICT use at home, permeability, flexibility, and work-family conflict predicted telecommuting. The results presented in Table 4 showed that permeability in the home domain was the strongest predictor ($\beta = 0.32$, $p < 0.001$), followed by work-related ICT use at home ($\beta = 0.22$, $p < 0.001$), age ($\beta = 0.15$, $p < 0.05$), and family income ($\beta = -0.10$, $p < 0.05$). The amount of variance explained was 21%.

4.5. Predicting technostress

To examine how demographics, ICT use at home, flexibility, permeability, and work-family conflict predicted technostress, two parallel regression analyses were conducted using the dependent variables of techno-overload and techno-invasion. The results presented in Table 5 showed that work-to-family conflict ($\beta = 0.24$, $p < 0.001$) was the strongest predictor, followed by age ($\beta = 0.17$, $p < 0.01$), permeability in the work domain and the home domain ($\beta = -0.16$, $p < 0.01$ and $\beta = 0.16$, $p < 0.001$, respectively), occupation ($\beta = -0.15$, $p < 0.01$), and flexibility in the work domain ($\beta = -0.12$, $p < 0.05$) for techno-overload. Similarly, in order of beta weights, work-to-family conflict ($\beta = 0.24$, $p < 0.001$) was the strongest predictor, followed by permeability in the home domain ($\beta = 0.23$, $p < 0.001$), work-related ICT use at home ($\beta = 0.16$, $p < 0.01$), family income ($\beta = -0.14$, $p < 0.05$), flexibility in the work domain ($\beta = -0.11$, $p < 0.05$), and permeability in the work domain ($\beta = -0.10$, $p < 0.05$) were significant predictors of techno-invasion. The amount of variance explained ranged from 16% to 30%.

5. Discussions

Drawing on the work/family border theory, the present study explored the role of work-related ICT use at home in shaping the characteristics of work/family borders (i.e. flexibility and permeability), and consequently influencing individuals' perceived work-family conflict, technostress, and level of telecommuting. The results showed that the more people use ICTs to work at home, the greater they perceive their work/family borders flexible and permeable. This highlighted the paradoxical role of communication technologies—it can be liberating and constraining, creating new possibilities for autonomy and invasion. The results also suggested that low flexibility and high permeability of work/family borders, rather than ICT use at home, had much stronger influences on increasing work-family conflict and technostress (especially techno-invasion). This extended the previous literature by dissecting the mechanism through which ICTs exert impact on work-family interface. Thus, it is the individuals' control over what passes through the work-home boundary that determines the effects of ICT use on their work and family lives. By molding the parameters and the scope of activities in different domains, individuals have the ability to shape their environments and social lives (Clark, 2002a). Therefore, this study suggested a research agenda to examine the social and organizational effect of ICTs, which incorporates the characteristics of work/family borders into the analysis, and highlights the significance of human agency in shaping the outcomes.

This study also showed that telecommuting penetration among information workers in Hong Kong has ballooned by 22% over the last 15 years, compared to a similar study conducted in 2000 when only 3% of information workers considered themselves teleworkers (Leung, 2004). This finding filled the gap in telework literature which primarily focused on the status quo of telecommuting practice in Western societies while overlooking the organizational impacts of information technologies in East Asian countries.

More specifically, this study supports the well-established relations between flexibility, permeability, and work-family conflict. The results demonstrated that flexibility at work was negatively related to work-to-family conflict, and flexibility at home was negatively associated with family-to-work conflict. These findings are in line with Goldstein (2003), who showed that high flexibility in work and home domains could mitigate work-family conflict. Therefore, a flexible workplace and reasonable family support are required for employees to maintain a positive balance between work and family. Conversely, permeability in the domains of work and home were positively correlated with work-family conflicts. Increased border permeability makes it easier for people to carry over their behaviors and emotions from one domain to another, thus catalyzing tensions between work and family by blending the different roles. Therefore, in line with Clark (2002a), the lowest levels of work-family conflict were found in those who had high flexibility but low permeability.

As expected, work-to-family conflict and family-to-work conflict were, at the bivariate level, significantly and positively associated with techno-overload and techno-invasion. This result is reasonable because negative spillover between the domains of work and family is likely to increase role stress, manifested by work-overload and family-intrusion. To investigate the process by which technostress take place, this study hypothesized that the flexibility and permeability of work/family borders were pertinent to techno-overload and techno-invasion. Specifically, the results showed that permeability in the home domain was positively related to techno-overload and techno-invasion, whereas flexibility at work domain was negatively correlated with both techno-overload and techno-invasion. These findings suggest that the permeable border around the home domain allows the behavioral and psychological aspects of the work domain to affect the family, thereby increasing the workload and intruding on leisure time.

Further, techno-overload and techno-invasion were primarily caused by work-to-family conflict, high permeability in the home domain, and low flexibility and low permeability in the work domain. These findings are reasonable because using ICTs to work at home invades individuals' private lives and erodes time spent with their families, thus leading to augmented stress. It is interesting to note that permeability at work was negatively related to technostress, suggesting that the permeable border around the work domain helps to mitigate stress. Therefore, technostress could be alleviated by flexible corporate policies that allow employees to arrange their work and deal with family concerns autonomously. These findings largely extend previous studies on technostress, which primarily focused on its causes and consequences, yet overlooked the characteristics of work-family interface in creating stress (Ayyagari et al., 2011; Shu et al., 2011).

At the bivariate level, the results also showed that the intensity of telecommuting was positively related to work-family conflict, techno-overload, and techno-stress. These findings support previous research on the negative outcomes of telecommuting (Felstead and Jewson, 2000; Weinert et al., 2015). The results of the multiple regression analysis further showed that the telecommuters tended to be older, had lower family incomes, used ICT frequently at home, and had a permeable boundary that allowed work to penetrate their home domain. Work-family conflict and technostress, however, were not significant predictors of telecommuting. This result suggests that telecommuters could prevent the negative effects of telecommuting from taking place by controlling their ICT use and its permeability in the home domain.

It is important to note that the number of work hours was a significant predictor of flexibility, permeability, and work-family conflict. Specifically, the number of work hours was negatively related to flexibility in the work domain and positively associated with permeability in the home domain and work-family conflict. This supports the notion that the number of hours spent at work/home was the potential antecedent of work-family conflict (Byron, 2005). Therefore, companies should reduce the number of work hours to allow for a flexible but impermeable boundary, which would help employees to strike a balance between their work and family responsibilities. Furthermore, a liberal corporate culture that allows employees to deal with family concerns while they are at work might counteract the stress caused by work overloads resulting from ICT use. In fact, flexible policies, such as flextime and flex-place, would be conducive to alleviating workloads by giving employees increased autonomy to maneuver and to act on their own.

6. Conclusion

To conclude, first, this study filled the gap, which focused mostly on Western telework literature, that telecommuting penetration among information workers in Hong Kong has ballooned to 25%. Second, it also found that the control over what passes through the work-home boundary by individual workers determines the effects of ICT use on their work and family lives. Third, those who had high flexibility but low permeability will experience the lowest levels of work-family conflict. Fourth, to alleviate technostress, corporations should have flexible policies that allow employees to arrange their work and family concerns autonomously.

Despite these contributions, this study has some limitations. First, because the data are cross-sectional, we cannot confirm the direction of causality implied in the regression model. Although the results of prior studies support the relationships found in this study, future research should conduct a longitudinal study to examine the model in cross-cultural settings. Future research would also benefit from incorporating techno-complexity, techno-insecurity, and techno-uncertainty into

the framework of analysis. By examining the five techno-stressors proposed by Tarafdar et al. (2007), future research could delineate a complete picture of the causes of technostress in the work-family interface.

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