Individual, social and situational determinants of telecommuter productivity

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Abstract

Productivity of remote workers is of critical concern to organizations and managers contemplating telecommuting arrangements. Here we suggest a general theoretical framework for understanding telecommuter productivity, and then report on a two-phased research study. In the first phase, semi-structured interviews with 32 telecommuters were conducted in one organization, and individual, social, and situational factors associated with telecommuter productivity were qualitatively explored. The second phase involved a survey of 100 telecommuters in two organizations, followed by predictive discriminant analyses to identify factors that might usefully distinguish between telecommuters exhibiting low and high levels of productivity. Results indicate that telecommuter beliefs and attitudes, and the quality of their social interactions with managers and family members, were strongly associated with productivity. Furthermore, telecommuters' social interactions with colleagues, managers, and family members had a strong influence on their beliefs and attitudes about telecommuting.
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1. Introduction

Telecommuting – working outside the conventional workplace [38] – has become a standard work arrangement for 15% of all corporate employees in the United States and Canada [51,58], and approximately 9% in European Union nations [19]. In recent years, a sizeable body of research has emerged regarding the individual, organizational, and societal drivers and outcomes of telecommuting, yet relatively little research to date has explored telecommuter productivity, arguably among the most critical factors of concern to organizations that are considering "sending their employees home." Thus, the research question addressed here is: *What factors influence telecommuter productivity?* An answer to this question could help managers identify suitable candidates, as well as those who may be particularly unsuited to remote work arrangements. We proposed seven main hypotheses, drawn from various theories of social psychology, as well as available empirical research on telecommuting.

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2. Telecommuter productivity: a literature review

Research on telecommuting may be broadly organized according to three levels of analysis: societal (e.g., traffic congestion, shift to offshore labor, teledemocracy, opportunities for the disabled) [28,39,63], organizational (e.g., cost savings, employee morale, staffing, communication, control) [10,13,52,61], and individual (e.g., flexibility, satisfaction, work–family balance, productivity) [7,9]. We focused on individual-level telecommuter productivity and its associated factors.

Productivity is traditionally defined as the ratio of outputs to inputs. More specifically, it refers to the relationship between what comes out of a system and what is consumed [48]. At the individual level, productivity is the effectiveness with which a worker applies his or her talents and skills to perform work, using available materials, within a specific time [45]. Such individual productivity has been associated with group and organizational level productivity (e.g., [5,11,25]). Although telecommuting may involve a shift in an employee's work schedule, basic job tasks and responsibilities generally do not change.

Individual productivity has been identified as an important individual outcome for telecommuters [12,26], although this phenomenon has not been examined closely. Some researchers have reported or predicted that increased productivity may occur due to reduced work interruptions and use of optimally efficient hours [27,35]. However, productivity reductions may occur due to inaccessible IT resources and reduced opportunities for interaction [50,56].

3. Determinants of telecommuter productivity

Agarwal's [1] integrative research framework provided a broad synthesis of the core constructs of individual IT acceptance research; she also noted that individual first order effects on user satisfaction and productivity, though not shown explicitly, were implied. Her model was adapted to create the exploratory one shown in Fig. 1, by substituting individual productivity for individual acceptance as the final dependent variable in order to allow explicit examination of first order productivity outcomes.

Beliefs and attitudes are included as important antecedents in each of the major theoretical paradigms that explain use and acceptance behavior. *Beliefs* are an individual's cognitive evaluation of the consequences of a particular behavior (e.g., ''What will happen if I adopt this innovation?''), while *attitudes* reflect an affective response to the behavior in question (e.g., ''I want to adopt this innovation.''). Three dimensions have repeatedly emerged in innovation research: relative advantage (is the innovation perceived as an improvement?), compatibility (is the innovation consistent with past approaches?), and complexity (how easy is the innovation to adopt?) (e.g., [36,43,57]). These dimensions appear highly relevant to the telecommuting context.

The relationship between beliefs and attitudes and work productivity has been studied for many years; for example, studies have reported a positive relationship between individuals' attitudes to computer use and their computer usage performance [30,37,44]. According to the theory of reasoned action [4], behaviors or outcomes can be best predicted by attitudes that specifically relate to them. Individuals who hold favorable beliefs and attitudes are more likely to practice and learn skills. This leads to our first hypothesis:

Hypothesis 1. Telecommuter beliefs and attitudes (i.e., relative advantage, complexity and compatibility) are positively associated with telecommuter productivity.

As acknowledged in social psychology [20], the theory of planned behavior [2], and TAM [14], demographic characteristics may influence formation of individual beliefs and attitudes. In particular, family status and gender have been associated with belief and attitude formation [28,62]; i.e., parents with children at home may perceive telecommuting as a means of better managing competing role demands of their work and family lives. Furthermore, because mothers are particularly susceptible to work–family role conflict, females may form more positive beliefs and attitudes toward telecommuting than males. This leads to the second hypothesis about telecommuters:

Hypothesis 2. Telecommuter beliefs and attitudes are positively associated with (a) family status and (b) gender.
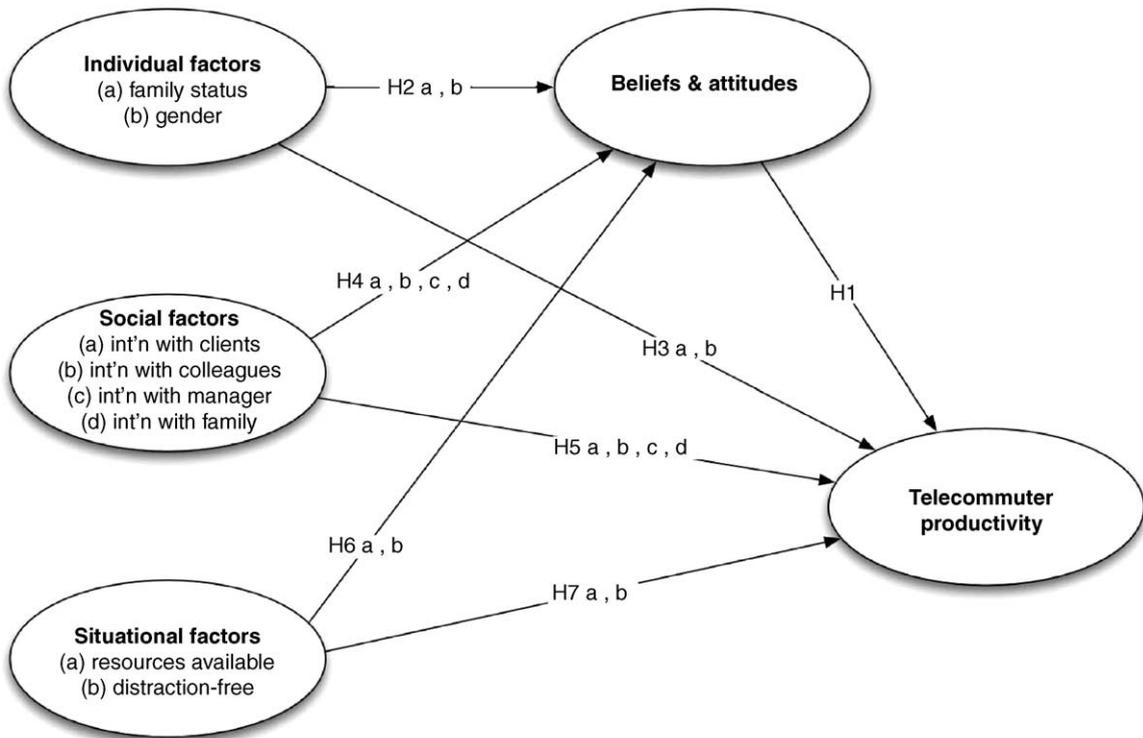
Fig. 1. Exploratory research model.

Although telecommuting parents may form positive beliefs and attitudes, it does not follow that their work productivity will increase. Several empirical studies have found that telecommuters with young families experience increased role conflict, which may lead to a *reduction* in productivity [17,29,60]. Furthermore, since mothers are traditionally the primary childcare providers in the home, gender has also been linked with increased role overload and negative work outcomes [55]. Thus:

Hypothesis 3. Telecommuter productivity is negatively associated with (a) family status and (b) gender.

Individuals are strongly influenced by the attitudes and reactions of those who surround them [8]. Social information processing theory asserts that technology adoption is determined by behavioral modeling and information sharing within groups [21,46]. Social learning theory states that an individual's cognitive and behavioral responses are influenced by the beliefs, attitudes, and emotional reactions of others [6]. Likewise, the theory of reasoned action, the theory

of planned behavior and the decomposed theory of planned behavior [53] address the relationship between behavioral outcomes and social influence. Thus, we expect that the beliefs and attitudes and productivity outcomes of telecommuters will be directly associated with the extent to which telecommuters interact with relevant others.

The closer a referent source of influence is to the potential user of a technology, the greater the influence. As in the traditional work context, colleagues and clients of telecommuters are relevant others who interact with and influence the telecommuter. The literature has many studies linking managerial involvement to IT implementation success (e.g., [22,34,54]), and several studies have linked managerial involvement with telecommuting adoption and success (e.g., [15,16,18,41,49]). Finally, in the case of home-based telecommuting, the most common form [32,40], family members may be physically close to the telecommuter during the work day, and thus may exert influence. Thus, we expected that social interaction with clients, colleagues, managers,

and family members will influence beliefs and attitudes, as well as productivity outcomes, resulting in the following hypotheses:

Hypothesis 4. Telecommuter beliefs and attitudes are positively associated with social interaction with (a) clients; (b) colleagues; (c) manager; and (d) family members.

Hypothesis 5. Telecommuter productivity is positively associated with social interaction with (a) clients; (b) colleagues; (c) manager; and (d) family members.

Situational factors, as defined by Agarwal, represent the idiosyncratic combination of the person and the situation in which the person operates. They influence work productivity and have been identified and discussed from the perspectives of behavioral intentions [3] and individual self-efficacy [23]. The resources and opportunities available, among the most important situational factors impacting individuals, may support or interfere with successful performance. Similarly, the task environment can be negatively impacted by distractions (noise, interruptions, etc.), which increase anxiety and reduce self-efficacy through thoughts of failure and stress [33]; thus performance may be negatively affected.

For telecommuters, situational factors can include any resources that are required to perform their jobs. According to the theory of planned behavior, constraints on resource access may inhibit the development of behavioral achievements. Thus, the two hypotheses:

Hypothesis 6. Telecommuter beliefs and attitudes are positively associated with (a) resource availability and (b) a distraction-free environment.

Hypothesis 7. Telecommuter productivity is positively associated with (a) resource availability and (b) a distraction free environment.

4. Phase one: the qualitative study

Semi-structured qualitative interviews were conducted with home-based telecommuters in one organization to surface and delve into important issues [47]. This study was conducted in the Canadian division of a large multinational corporation that had implemented a national telecommuting program six months previously. Telephone interviews were requested from 41 employees and 32 in-depth interviews (78%) were completed. Of the respondents, 75% were male and 25% were female; 80% were married and 20% were either single or separated/ divorced. Respondents worked from home an average of 32 h per week. Following a semi-structured interview instrument the interviewer prompted and encouraged subjects to provide additional information when answering each question (see Table 1 for sample questions).

Each interview lasted 30–45 min and was audio taped and subsequently transcribed. This data collection effort yielded a large volume of empirical materials, as is common in qualitative research. Interview responses were coded and analyzed using Atlas/TI, a qualitative data coding and analysis software tool. First, subjects were classified into low- or high-productivity categories based on a subjective review of their interview responses. Employees were asked if they felt that their productivity was higher or lower while working remotely compared with that when working at the office. For example, subjects who made a comment such as "I think it's supposed to make me more productive but I don't see that it could by adding more responsibilities in terms of clerical stuff. You know, all it does is just add more time after hours to do that, because you have to spend the time, 8 till 5, with the customers" were coded into the low productivity group. In contrast, subjects who made comments like "I find it really productive. I get so much more done, and we've been busy and we've had more job responsibilities put on us, so it's really been a savior because I can do more work in less time" were coded into the high productivity group.

Next, subjects were coded into negative- or positive-attitude categories, using a similar analysis. For example, the following comment was reflective of those made by subjects who were coded into the negative attitude group: "I don't like it [telecommuting]. I don't really find that I have a lot of family time—I feel like I'm rushing all the time to try to get the kids away, to try to get up early before they get up." On the other hand, subjects coded into the positive attitude group made statements like: "Oh I

Table 1
Semi-structured interview questions

Productivity
    Has working from home changed your productivity at work?
    Which tasks have you been able to do more productively from home?
    Which tasks have you NOT been able to do more productively from home?

Beliefs and attitudes
    Overall, how do you feel about working from home?
    Have there been any significant work-related [personal] advantages [disadvantages] for you from working from home?

Individual factors
    Gender? [coded by interviewer]
    Do you have any children? How many?

Social factors
    How do you feel about your home office in terms of interaction with others?
    Has working from home changed your colleagues' [customers'/family's/manager's] attitudes towards you?
    Has working from home changed your manager's attitudes towards you or expectations of you? Communication with your manager?

Situational factors
    What important work tools have you needed to do each work task? Which of these tools do you currently NOT have access to at home?
    How do you feel about your home office in terms of space? Lighting? Windows? Furniture? Privacy?

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love it [chuckling]. 100%. I don't have the commute . . . I can pick my youngest one up from school, I'm home when my oldest one gets home . . . I'm a lot less stressed out [chuckling again].'' Beliefs and attitudes were further coded into three sub-themes: relative advantage, complexity, and compatibility.

Individual factors of interest (family status and gender) were captured by direct measures (e.g., ''Do you have any children at home?''). Social factors were coded according to interactions with beliefs and attitudes from four groups—colleagues, clients, manager, and family members. Situational factors were coded according to perceived resource availability, technology availability, and distractions.

Because a respondent's answer to one question was frequently related explicitly or tangentially to a previous or subsequent one, each interview was evaluated as a holistic ''text unit.'' For instance, in response to the question ''Which tasks have you been able to do more productively from home?'' one subject responded as follows:

''Well, probably the number crunching . . . I don't get the interruptions that I had when I was downtown. I have all the tools of the trade here [at home] to be able to look at information. I'm actually set up far better here than I was when I was working downtown. The addition of a PC, a laser printer, fax machine, copier— I can really conduct my business by just swiveling around my chair. In the office I spent a lot of time running all over the place.''

Although the interviewer asked only about telecommuting productivity, the subject also mentioned factors such as increased technical resource availability and reduced distractions. Thus, we assigned productivity and situational codes to this comment.

To evaluate Hypothesis 1 we computed a simple cross-tabulation of attitudes by productivity using our categorical assignments and tested group differences using nonparametric statistics; we then qualitatively explored similarities and differences in specific beliefs and attitudes between telecommuters with low versus high perceived productivity. We followed this approach to test Hypotheses 2–7—that is, we cross-tabulated our coded individual, social, and situational factors by beliefs and attitudes and productivity, computed nonparametric statistics to test for group differences, and then further explored the textual content for group similarities and differences.

Table 2
Beliefs and attitudes → productivity (Hypothesis 1)

| | Productivity | |
	Low ($N = 13$)	High ($N = 19$)
Beliefs and attitudes		
Negative ($N = 15$)	12 (92%)	3 (16%)
Positive ($N = 17$)	1 (8%)	16 (84%)
Group difference	$\chi^2 = 18.1$, $p = 0.000$; Fisher's $p = 0.000$	
Relative advantage	Less communication with peers	Get everything done in one place
	Reduced access to resources (equipment, technical assistance)	Spend less time travelling
	Family time has not increased	Fewer work interruptions
	Inadequate/loss of home space	Less stressed, more relaxed
	Others question if I am actually working; ''working in pajamas''	Easier to balance my personal life
		Peers and/or clients are interested or attracted to it
Complexity/ease of use	Technology setup/use is challenging and frustrating	Increased flexibility in setting work and personal schedule
	Difficult to get hold of colleagues	
	Forces me to deal with trivial details	
Compatibility	Not well-suited to my personal work style or schedule	Well-suited to my personal work style and schedule

5. Phase one: results

Beliefs and attitudes were strongly associated with telecommuter productivity ($\chi^2 = 18.1$, $p < 0.001$) (see Table 2). Among 13 telecommuters reporting low productivity, 12 (92%) also reported negative/hesitant attitudes towards telecommuting, whereas 16 out of 19 (84%) reporting high productivity telecommuters also reported positive attitudes.

Those in the low-productivity group felt that telecommuting left them worse off than before (relative advantage), created work difficulties (complexity), and did not fit well with their work and/or family life (compatibility). For example, the following comment from a low-productivity telecommuter demonstrated a perceived relative disadvantage:

''Now that I don't have a secretary I have to spend more time preparing for the job, and the filing and the typing and everything that used to be done for me is now my own responsibility. So that's added probably an hour, hour and a half, two hours to each day.''

Those in the high-productivity group responded very differently. They felt that telecommuting left

them relatively better off, made their work easier, and was highly compatible with their work and/or family life. For example, the following subject felt that telecommuting left her relatively better off:

''I'm always here for my family ... With the cell phone and the pager for example, I [can] take my daughter to the orthodontist now – I never did that with my first daughter but I do it with this one—and it's just time for us to be together. And I mean, we're not gone for that long, and I bring her back and drop her off at school, so the personal side of it I couldn't give any higher marks.''

Both low- and high-productivity groups reported similar result demonstrability, visibility and trialability. Interestingly, subjects in both groups indicated a strong desire to have had more time to ''try out'' telecommuting prior to its implementation.

Hypotheses 2 and 3 were not supported (see Table 3). Telecommuting beliefs and attitudes were not associated with either family status ($\chi^2 = 0.01$, n.s.) or gender ($\chi^2 = 0.38$, n.s.), and telecommuting productivity was not associated with either family status ($\chi^2 = 0.28$, n.s.) or gender ($\chi^2 = 3.50$, n.s.).

Table 3
Individual factors (Hypotheses 2 and 3)

	Beliefs and attitudes		Productivity	
	Negative ($N = 15$)	Positive ($N = 17$)	Low ($N = 13$)	High ($N = 19$)
Family status				
Kids at home	9 (60%)	10 (59%)	7 (54%)	12 (63%)
No kids at home	6 (40%)	7 (41%)	6 (46%)	7 (37%)
Group difference	$\chi^2 = 0.01$, $p = 0.95$; Fisher's $p = 0.62$		$\chi^2 = 0.28$, $p = 0.60$; Fisher's $p = 0.44$	
Gender				
Male	12 (80%)	12 (71%)	12 (92%)	12 (63%)
Female	3 (20%)	5 (29%)	1 (8%)	7 (37%)
Group difference	$\chi^2 = 0.38$, $p = 0.54$; Fisher's $p = 0.42$		$\chi^2 = 3.50$, $p = 0.06$; Fisher's $p = 0.07$	

Social interaction with clients (Hypothesis 4a) was unassociated with beliefs and attitudes ($\chi^2 = 0.11$, n.s.) (see Table 4). However, social interactions with colleagues, manager and family members were each positively associated with beliefs and attitudes, as summarized in Table 4.

Social interaction with colleagues (Hypothesis 4b) was positively associated with beliefs and attitudes ($\chi^2 = 4.03$, $p < 0.05$), such that individuals with positive beliefs and attitudes reported more positive interactions with colleagues (e.g., "... as a matter of

fact, it might be better—in the office there'd be more personal [time] talking ... now we just touch bases usually by speaker phone while we're doing something else"). However, those with negative beliefs and attitudes reported weaker colleague interactions (e.g., "... a disappointing part of it is you don't see your colleagues as much, so there's not as much interaction. You lose a lot of free flow of information").

Social interaction with managers (Hypothesis 4c) was also positively associated with beliefs and attitudes ($\chi^2 = 6.43$, $p < 0.05$). Individuals with

Table 4
Social factors (Hypotheses 4 and 5)

	Beliefs and attitudes		Productivity	
	Negative ($N = 15$)	Positive ($N = 17$)	Low ($N = 13$)	High ($N = 19$)
Client interaction				
Negative or neutral	13 (87%)	14 (82%)	12 (92%)	15 (79%)
Positive	2 (13%)	3 (18%)	1 (8%)	4 (21%)
Group difference	$\chi^2 = 0.11$, $p = 0.74$; Fisher's $p = 0.56$		$\chi^2 = 1.05$, $p = 0.31$; Fisher's $p = 0.31$	
Colleague interaction				
Negative or neutral	15 (100%)	13 (77%)	13 (100%)	15 (79%)
Positive	0 (0%)	4 (23%)	0 (0%)	4 (21%)
Group difference	$\chi^2 = 4.03$, $p = 0.05$; Fisher's $p = 0.07$		$\chi^2 = 3.13$, $p = 0.08$; Fisher's $p = 0.11$	
Manager interaction				
Negative or neutral	14 (93%)	9 (53%)	13 (100.0%)	10 (52.6%)
Positive	1 (7%)	8 (47%)	0 (0.0%)	9 (47.4%)
Group difference	$\chi^2 = 6.43$, $p = 0.01$; Fisher's $p = 0.01$		$\chi^2 = 8.57$, $p = 0.003$; Fisher's $p = 0.003$	
Family interaction				
Negative or neutral	13 (87%)	8 (47%)	12 (92%)	9 (47%)
Positive	2 (13%)	9 (53%)	1 (8%)	10 (53%)
Group difference	$\chi^2 = 5.54$, $p = 0.02$; Fisher's $p = 0.02$		$\chi^2 = 6.91$, $p = 0.01$; Fisher's $p = 0.01$	

Table 5
Situational factors (Hypotheses 6 and 7)

	Beliefs and attitudes		Productivity	
	Negative ($N = 15$)	Positive ($N = 17$)	Low ($N = 13$)	High ($N = 19$)
Resources available?				
Yes	7 (47%)	14 (82%)	5 (38%)	16 (84%)
No	8 (53%)	3 (18%)	8 (62%)	3 (16%)
Group difference	$\chi^2 = 4.50$, $p = 0.03$; Fisher's $p = 0.04$		$\chi^2 = 7.16$, $p = 0.007$; Fisher's $p = 0.01$	
Distraction-free?				
Yes	7 (47%)	17 (100%)	6 (46%)	18 (95%)
No	8 (53%)	0 (0%)	7 (54%)	1 (5%)
Group difference	$\chi^2 = 12.09$, $p = 0.001$; Fisher's $p = 0.001$		$\chi^2 = 9.72$, $p = 0.002$; Fisher's $p = 0.003$	

positive beliefs and attitudes reported stronger manager interactions (e.g., ''... even when I worked at the office [he] kind of empowered me to get done whatever I have to get done'' and ''It worked out quite well cause he was a believer in it and really encouraged us to get involved in the home office. I think we're finding the relationship is better''). On the other hand, individuals with negative beliefs and attitudes reported weaker interactions with their manager (e.g., ''... now we mostly communicate by electronic voice [voicemail] ... before we used to [communicate] at least every day in the office—you interact a lot less'', and ''... it's a lot harder to get hold of each other'').

Similarly, social interaction with family members (Hypothesis 4d) was positively linked with beliefs and attitudes ($\chi^2 = 5.54$, $p < 0.05$). Individuals with positive beliefs and attitudes reported stronger family interactions (e.g., ''They like the fact that dinner is on the table sooner than before, and that we can spend a little more time with the children''), while those with negative beliefs and attitudes reported weaker family interactions (e.g., ''I mentioned my wife's saying that, uh, you're spending too much time down there'' and ''They don't appreciate [that] you're working when you're at home'').

Telecommuter productivity was not significantly associated with either H5a, social interaction with clients ($\chi^2 = 1.05$, n.s.), or H5b, social interaction with colleagues ($\chi^2 = 3.13$, n.s.) (see Table 4). However, interactions with manager and family members were each positively associated with telecommuter productivity. Specifically, manager interaction (Hypoth-

esis 5c) was positively associated with telecommuter productivity ($\chi^2 = 8.58$, $p < 0.01$). Individuals with high perceived productivity also reported positive manager interactions, whereas those with low perceived productivity reported weak social interactions with their manager.

Social interactions with family members (Hypothesis 5d) was positively linked with telecommuter productivity ($\chi^2 = 6.91$, $p < 0.01$). Individuals reporting high productivity also reported positive family interactions, and those with low productivity reported negative family interactions.

Resource availability (Hypothesis 6a) was positively associated with beliefs and attitudes ($\chi^2 = 4.50$, $p < 0.05$) (see Table 5). Individuals reporting positive beliefs and attitudes also commented positively about resource availability (e.g., ''I got everything I need; I got a pc, a printer and a fax ...''), whereas those with negative beliefs and attitudes were critical (e.g., ''I need a computer, I need a printer ... I don't have access to a fax right now which I find a little bit of a pain ...'' and ''... we all feel that they [the company]'re not doing a lot to support us, they could provide us with office furniture, they could arrange technical supports to better fit our needs, but they are yet to be ready ...'').

A distraction-free environment (Hypothesis 6b) was also positively associated with beliefs and attitudes ($\chi^2 = 12.09$, $p < 0.001$). Individuals reporting positive beliefs and attitudes were positive about their work environment (e.g., ''I think the non interruptions and the concentrated effort you can put into something really works great for me ...''),
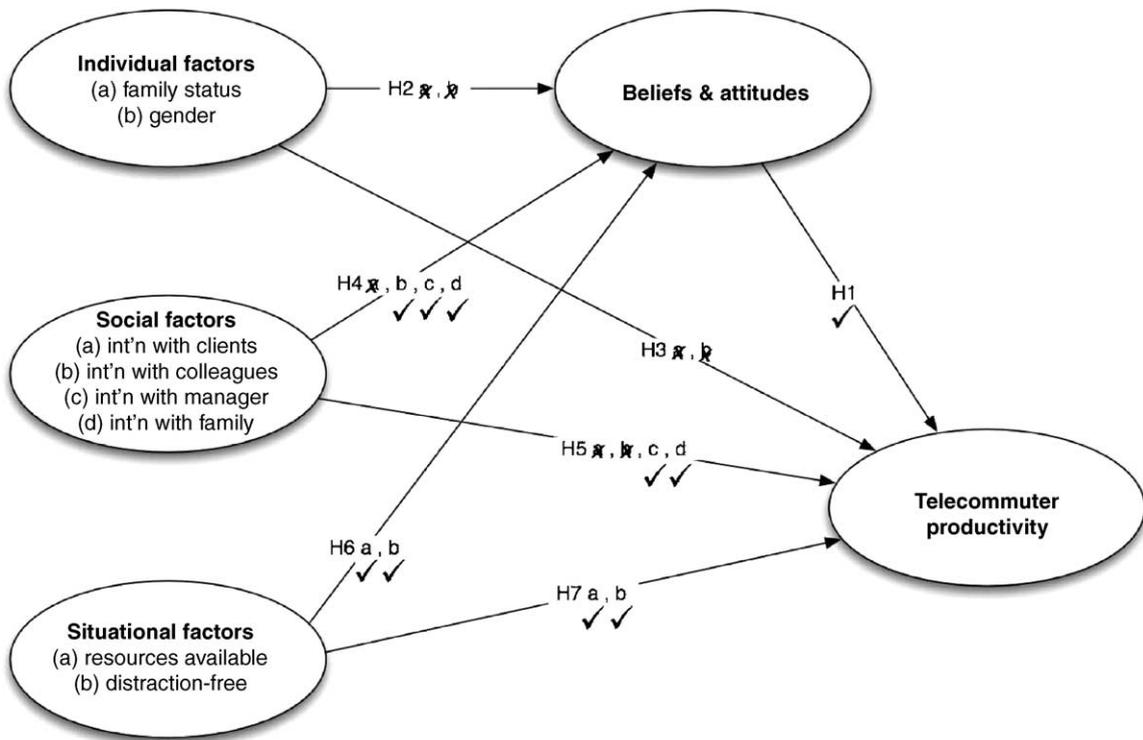
Fig. 2. Exploratory research results summary.

while those with negative beliefs and attitudes tended to be critical (e.g., "... Well, it is not always as private as you would like it to be ... you just can't get things right when kids pop in their heads ...").

Resource availability (Hypothesis 7a) was positively associated with productivity ($\chi^2 = 7.16$, $p < 0.01$). Individuals reporting high productivity also commented positively about resource availability, whereas those with low productivity did not. A distraction-free environment (Hypothesis 7b) was also positively associated with telecommuter productivity ($\chi^2 = 9.72$, $p < 0.01$). Those reporting high productivity were positive about their work environment, but those with low perceived productivity were more critical.

In summary, the major factors associated with telecommuter productivity identified in the first phase were beliefs and attitudes, social interactions with managers, social interactions with family members, resource availability, and a distraction-free working environment. The major factors associated with beliefs and attitudes were social interactions with colleagues, managers and family members, as well as resource availability and a distraction-free working environment (see Fig. 2).

6. Phase two: the quantitative study

The paper-and-pencil survey was conducted on employees in two Canadian organizations. The survey consisted of items that quantitatively assessed perceived productivity as well as potential determinants of productivity identified during the interview phase (see Table 6). Items were measured using five-point Likert scales. A total of 141 surveys were distributed and 100 useable surveys were returned, for a response rate of 71%. Of the respondents, 64% were male and 36% were female; 83% were married, 13% were single, and 4% were separated or divorced. On average respondents were 39 years old, had been in their organization for 12 years, and had been in their current job for 5 years. Their average telecommuting time at home was 22 h/week.

Table 6
Sample survey measures

Productivity (low/high)
I am very productive while telecommuting

Attitudinal factors
  Telecommuting has a favorable influence on my overall attitude toward my job
  Telecommuting encourages me to do my best
  I am dissatisfied with telecommuting
  Telecommuting has an unfavorable influence on my physical health

Social factors
  Telecommuting causes problems coordinating work with my co-workers [separate items for "manager" and "family members"]

Situational factors—resources
  I have enough information to get the job done
  I have enough authority to do my job
  My responsibilities are clearly defined
  My manager is very concerned about my welfare
  I receive enough help and equipment to get the job done

Situational factors—distractions
  How frequently are you unable to concentrate because of interruptions from your family?

Survey data were analyzed in several steps. First, a median split was used to generate low- and high-productivity groups, based on subject responses to the following survey item, "I am very productive under telecommuting" (1–5 scale, 1: strongly disagree, 5: strongly agree). Fifty-two subjects (52%) fell into the low-productivity group, and 48 were in the high-productivity group. A predictive discriminant analysis (PDA) was then conducted to identify the linear combination of independent variables best predicting group membership [24].

7. Phase two: results

The overall PDA result for telecommuter productivity was significant ($\chi^2 = 68.6$, $p < 0.001$) (Table 7). Three variables were useful in discriminating between low- and high-productivity telecommuters: beliefs and attitudes ($r = 0.94$, $F = 93.5$, $p < 0.001$), manager interaction ($r = -0.44$, $F = 20.7$, $p < 0.001$), and family interaction ($r = 0.22$, $F = 5.3$, $p < 0.05$) (because discriminating variables can be correlated

Table 7
Predictive discriminant analysis—productivity

Variable	Discriminant loading		*F*
	r	Rank	
Attitudes	0.94	1	93.5[***]
Manager interaction	−0.44	2	20.7[***]
Family interaction	0.22	3	5.3[*]
Resource availability	0.16	4	2.7
Distractions	0.05	5	0.3
Overall chi-square			68.6[***]

Classification		Predicted productivity		Total
		Negative	Positive	
Actual productivity	Low	43 (83%)	9 (17%)	52 (100%)
	High	4 (8%)	44 (92%)	48 (100%)
	Total	47 (47%)	53 (53%)	100 (100%)

Total cases correctly classified = 87/100 (87%).
  [*] $p < 0.05$.
  [***] $p < 0.001$.

with each other, structure correlations are commonly considered superior to standardized coefficients in determining the relative power of each discriminant variable and thus structure correlations are shown in the table [31]). Using this discriminant function, 87% of the cases were correctly classified into the high- and low-perceived productivity groups.

Table 8
Predictive discriminant analysis—attitudes

Variable	Discriminant loading		*F*
	r	Rank	
Colleague interaction	0.90	1	23.9[***]
Manager interaction	0.77	2	17.5[***]
Family interaction	−0.51	3	8.9[**]
Resource availability	−0.25	4	1.9
Distractions	0.04	5	0.1
Overall chi-square			24.7[***]

Classification		Predicted attitudes		Total
		Negative	Positive	
Actual attitudes	Low	30 (67%)	15 (33%)	45 (100%)
	High	14 (25%)	41 (75%)	55 (100.0%)
	Total	44 (42%)	56 (58%)	100 (100%)

Total cases correctly classified = 71/100 (71%).
  [**] $p < 0.01$.
  [***] $p < 0.001$.

The overall PDA result for telecommuter beliefs and attitudes was significant ($\chi^2 = 24.7$, $p < 0.001$) (Table 8). Three variables were useful in discriminating between telecommuters holding negative and positive beliefs and attitudes: colleague interaction ($r = 0.90$, $F = 23.9$, $p < 0.001$), manager interaction ($r = 0.77$, $F = 17.5$, $p < 0.001$), and family interaction ($r = -0.51$, $F = 8.9$, $p < 0.01$). Using this discriminant function, a more modest 71% of the cases were correctly classified into the negative- and positive-belief and attitude groups.

8. Discussion and conclusion

Taken together, results from the qualitative and quantitative studies suggested that the most important determinants of telecommuter productivity were beliefs and attitudes about telecommuting and social interactions with manager and family members. In turn, the most important determinants of telecommuter beliefs and attitudes – the most critical determinant of telecommuter productivity – were social interactions with colleagues, manager, and family members. Using these discriminant functions, 87% of the subjects were correctly classified (post hoc) into low and high productivity categories, and 71% of them were correctly classified into negative and positive belief and attitude groups.

These findings have implications for telecommuter selection, as well as program implementation. In particular, organizations that wish to promote effective telework should engage in activities that engender positive beliefs and attitudes among their employees (e.g., promotional campaigns that demonstrate relative advantage, compatibility, complexity; visible and verbal top management support; and programs to allow employees to experiment with telecommuting before committing to it). Individuals who hold negative beliefs and attitudes may not be suitable candidates, regardless of the potential objective benefits of the arrangement to the organization, such as real estate cost savings, workforce scheduling flexibility, employee retention, etc.

Furthermore, interaction with relevant others, at work and at home, influenced perceived productivity and beliefs and attitudes in both phases. Perceived productivity was higher and beliefs and attitudes were more positive for telecommuters whose social interactions were positively impacted as a result of their new work arrangement. Although individual and situational factors appeared to have some impact on beliefs and attitudes and productivity based on our qualitative analysis, these factors did not help to distinguish between high- and low-productivity telecommuters in the predictive discriminant analysis. Thus, while individual factors (family status, gender) and situational factors (resource accessibility, environmental distractions) may be associated with other important outcomes such as satisfaction or dissatisfaction with telecommuting, social factors appear to be the most important determinant of perceived productivity.

Integrating social psychology research with results from empirical telecommuting studies, this paper has examined factors associated with low and high perceived productivity, as well as positive and negative beliefs and attitudes. Results revealed that high and low productivity telecommuters differed in terms of beliefs and attitudes toward telecommuting, particularly in terms of social interactions with managers and family members.

Several important limitations should, however, be noted. First, because both interview and survey data collection was cross-sectional, we cannot attribute causality to relationships (e.g., while it appears that beliefs and attitudes had a positive impact on productivity, it is possible that our telecommuters' productivity influenced their beliefs and attitudes). Second, several survey measures were captured with a single item, though multi-item measures provide improved ability to make validity assessments. Third, although reliance on perceptual measures is common in studies of individual productivity (due to the difficulties usually associated with establishing objective assessments) [42,59], this may be a weakness in the study.

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