Associate Professorship of Travel Behavior
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A New Workplace for A New Change

Understanding How Life Events Affect Preferences of Alternative Work Locations

Master Thesis

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Abstract

Life events are increasingly shown to affect travel behaviour and thus there is interest to study how such events change an employee's perception of alternative work locations besides the company's office and one's home. This thesis aims to explore how major life events shift telecommuting preferences as well as study how these events influence employee perceptions of non-home-based telecommuting (NHBTC) as an attractive work arrangement, both in the context of Singapore. In the first half of the thesis, an ordinal logistic regression (OLR) model was developed to relate the occurrence of life events to shifts in telecommuting preference. Subsequently, an integrated choice and latent variable (ICLV) model was constructed to predict work location choices, considering attitudinal factors regarding non-work activities and work productivity. An online survey was conducted to collect responses for the data set, garnering 219 complete responses. The OLR model results, for both the short-term and midterm changes, show that changes to telecommuting preferences persisted for a number of events. However, other events only showed shifts in one time frame or the other. Additionally, life events do not shift preferences and dispreferences equally, impacting the extremes lesser. Meanwhile, the ICLV model demonstrated that integrating attitudes improved model performance slightly, as compared to a multinomial logit model. The model also found relationships between work location choice and post-life-event shifts to telecommuting preferences and experiences. The significance of the thesis is lastly highlighted through its theoretical contributions to literature and practical implications to different stakeholders.

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Acknowledgements

"*Sedikit-sedikit, lama-lama jadi bukit*"

(Bit by bit, eventually it becomes a hill)

- Malay proverb

Firstly, I would like to convey the heartiest of thanks to Dr Ana Moreno whose insights have been extremely valuable in co-shaping the form and function of this master thesis. Her support and guidance have immensely motivated me to think outside the box and consider alternative points of view that I might have overlooked.

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MASTER'S THESIS

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Topic: **A new workplace for a new change: Understanding how life events affect preferences of alternative work locations**

The observed persistence of telecommuting preferences in the post-pandemic era (Mohammadi et al., 2022) presents a corporate mobility strategy that can reduce overall commuting distances. Employees can be encouraged to work at locations other than the employer's office and at home, such as at co-working spaces, usually located nearer their homes. Often, this arrangement moderates the disbenefits of solely working at home or at the office (Mokhtarian & Bagley, 2000), especially when an employee has had a recent change in lifestyle. Thus, this is an opportune moment to bridge the gap in understanding of how the allure of such alternative work locations can be enhanced in order to improve corporate mobility and employee well-being.

This study models the impacts of major life events on a Singaporean employee's perceived value of telecommuting and the resultant shifts in personal acceptance of non-home-based telecommuting (NHBTC) as a potential alternative work arrangement. Two research questions are founded for the purpose of this thesis. The first explores whether major life events have a profound influence in shifting one's telecommuting preferences whereas the second investigates how the resultant lifestyle changes affect their perception of NHBTC as an attractive work arrangement.

A latent variable model will be constructed to examine the relationships between the key themes in the study using the results of a survey administered on employees in Singapore that are able to telecommute. A special focus will be placed on employees that have recently experienced major life events and the changes to their opinions of telecommuting, of different work locations and of their desire to choose such locations.

The student will present intermediate results to the mentor (Dr Ana Tsui Moreno Chou) in the fifth, tenth, 15th and 20th week.

The student must hold a 20-minute presentation with a subsequent discussion at the most two months after the submission of the thesis. The presentation will be considered in the final grade in cases where the thesis itself cannot be clearly evaluated.

Muhammad Sofian Bin Mohamed Tahir	Dr. Ana Tsui Moreno Chou

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List of Abbreviations

CWS	Co-working space
DCM	Discrete choice modelling
HBTC	Home-based telecommuting
ICLV	Integrated choice and latent variable
LV	Latent variable
NHBTC	Non-home-based telecommuting
OLR	Ordinal logistic regression
OR	Odds ratio
SEM	Structural equation modelling
SP	Stated preference

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1. Introduction

1.1. Background

In the post-pandemic era, the observed persistence of telecommuting (or remote working) preferences (Mohammadi et al., 2022) signals the emergence of several possibilities aimed at sustainable travel, especially in substituting physical travel to work with the use of available telecommunication technologies (Olszewski & Lam, 1996). In essence, this presents a corporate mobility strategy to eliminate or reduce commuting distances by encouraging employees to work remotely. For instance, around eight in ten employees in Singapore desire to work from home either partially or in full (Lai, 2020), a strong indication of the perceived benefits of telecommuting. However, the author also mentioned some of the concerns regarding working from home including distractions from children or family members that might jeopardise the trust that managers have towards their employees' productivity.

In view of this, alternative work locations, such as co-working spaces (CWSs) and shared offices, are usually located nearer their homes and might serve as the middle ground between the employer's office and the home. While some commuting might still be necessary, accessible locations of such near-home work locations could potentially connect employees to activities done before and after work hours, minimising travel in that aspect as well. Non-home-based telecommuting (NHBTC) also moderates the disbenefits of solely working at home or at the office (Mokhtarian & Bagley, 2000). This is especially pertinent when there has been a change in life context brought about by recent life events. Such events disrupt former attitudes and perceptions, potentially serving as an impetus for changes to travel behaviour and work location preferences. Thus, this is an opportune moment to bridge the gap in understanding how the allure of such alternative work locations can be enhanced.

1.2. Motivations for research

As employer and employee perspectives towards telecommuting develop after the COVID-19 pandemic, understanding the changes in attitudes towards commuting and working from home is increasingly crucial. In several studies examining the impact on human resource management, these changes have been demonstrated to influence job satisfaction (Schall, 2019) and corporate culture (Pavetic et al., 2023). Hence, this period in time serves as a crossroads for the development of both transport policy and human resource management strategies. This study aims to shed light on the thought process of an employee deciding where to work by uncovering their perceptions of different work locations.

Furthermore, the impact of life events on travel behaviour have been well-studied in the literature as will be discussed later. However, such studies have not yet explored how life events impact attitudes and perceptions of different work locations, especially in view of increasingly attractive alternatives like CWSs. In this study, it is hypothesised that life events disrupt existing routines, affecting one's telecommuting preferences. In adapting to new routines, these in turn shape their perceptions towards different work locations.

This research, therefore, furthers the work done by Mokhtarian and Bagley (2000) on the preferences of work location alternatives by offering new insights into how contexts have since changed. While they have solely adopted a discrete choice analysis in their study, this study aims to integrate attitudinal factors into the model to better complete the understanding of this decision-making process of choosing one's work location.

1.3. Objectives and scope

The objectives of this study are to:

1. explore whether major life events have a profound influence on shifting one's telecommuting preferences; and
2. investigate how the resultant lifestyle changes affect their perception of NHBTC as an attractive work arrangement.

Several considerations were made in scoping this thesis for the findings to represent the target group more accurately. Firstly, to better target the demographic suitable for NHBTC, only those that are working in jobs where remote working is possible are considered. In doing so, this leaves out workers in jobs that require physical presence such as food and beverage (F&B) sales workers and manufacturing workers. This is a reasonable ground for exclusion as telecommuting is not a feasible work arrangement for these workers.

Within the limited scope of this master thesis, spatial boundaries were drawn to include only employees in Singapore. This city-state suitably presents opportunities for the development of NHBTC due to its economic, geographical and technological circumstances. As mentioned earlier, the prevalence of telecommuting and the continued desire to telecommute among employees in Singapore (Lai, 2020) further justify why Singapore makes for an apt case study area to explore how alternative work locations might be attractive. According to a survey conducted by Singapore's Urban Redevelopment Authority (n.d.-a) on lifestyle preferences, 38% of respondents preferred a flexible work arrangement for more than half the time, bolstering the case for this study to be conducted in Singapore.

Other factors that would lend relevance to the choice of this city-state in this study include:

1. a large proportion (61.9%) of tertiary-educated employees (Ministry of Manpower, 2022) that are employed in high-skill industries where the jobs have a high likelihood of being able to be done remotely;
2. the development of regional centres favouring mixed-use development that houses workplaces, commercial activity and residences in proximity to one another in the east, west and north of Singapore to complement the central business district (CBD) in the south as seen in Figure 1 below; and

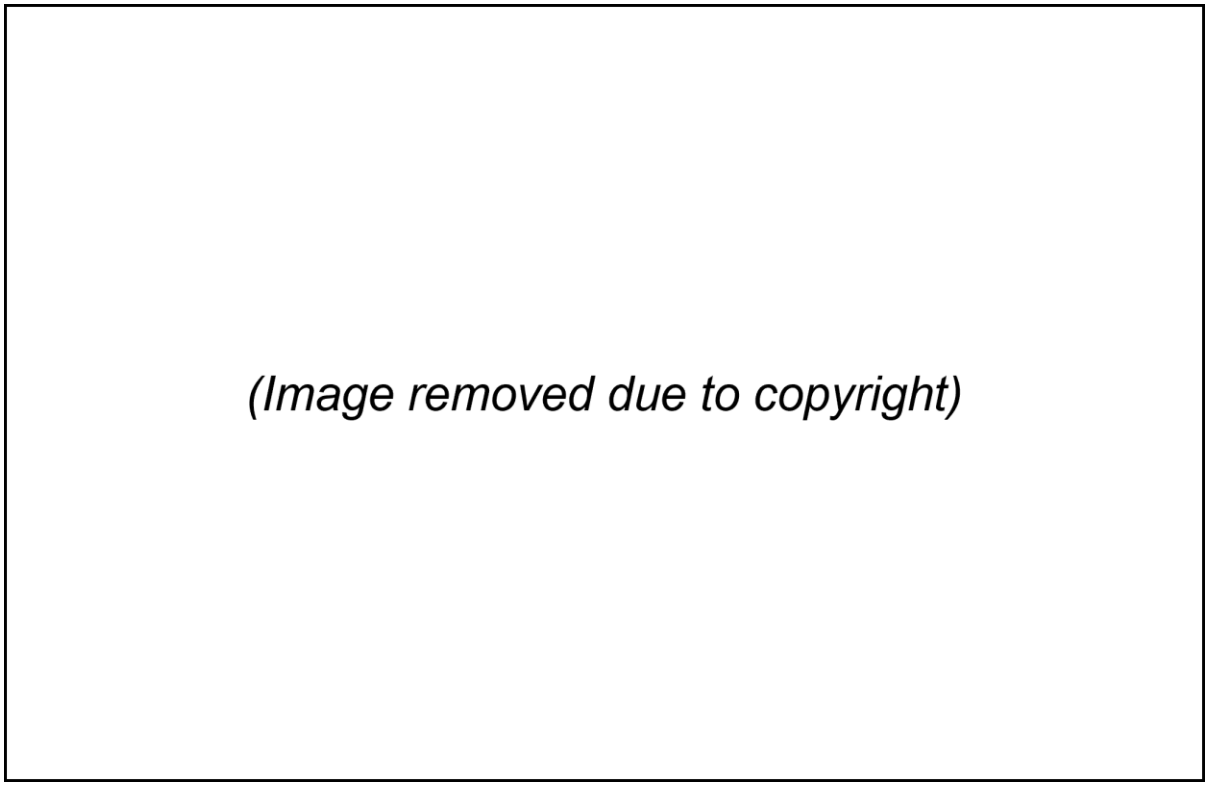

Figure 1. Regional centres in Singapore (Urban Redevelopment Authority, n.d.-b).

3. a well-developed telecommunication network that allows for remote working due to the access to reliably strong internet connections from various public and private buildings around the country.

1.4. Structure of the thesis

This thesis report has been structured as shown in Figure 2. The first chapter that is being closed up here has set the research up in terms of the background and research motivations. A thorough literature review then ensues in Chapter 2 to explore the gaps in research and the progress made in contributing to the current understanding in this field. Following that, in

Chapter 3, the methodological approach is described in detail to first gather data using an SP survey and then develop the conceptual framework for both the ordinal linear regression (OLR) and integrated choice and latent variable (ICLV) models. The survey data analysis in Chapter 4 subsequently brings attention to the descriptive statistics and valuable insights derived from the results of the administered survey. The results of the OLR model is discussed in Chapter 5 in terms of how different life events affect telecommuting preferences. In Chapter 6, the results of the ICLV model sheds light on who would prefer working at each work location. Lastly, Chapters 7 and 8 close out the thesis by discussing potential limitations and future research directions as well as summarising the key takeaways drawn from this study.

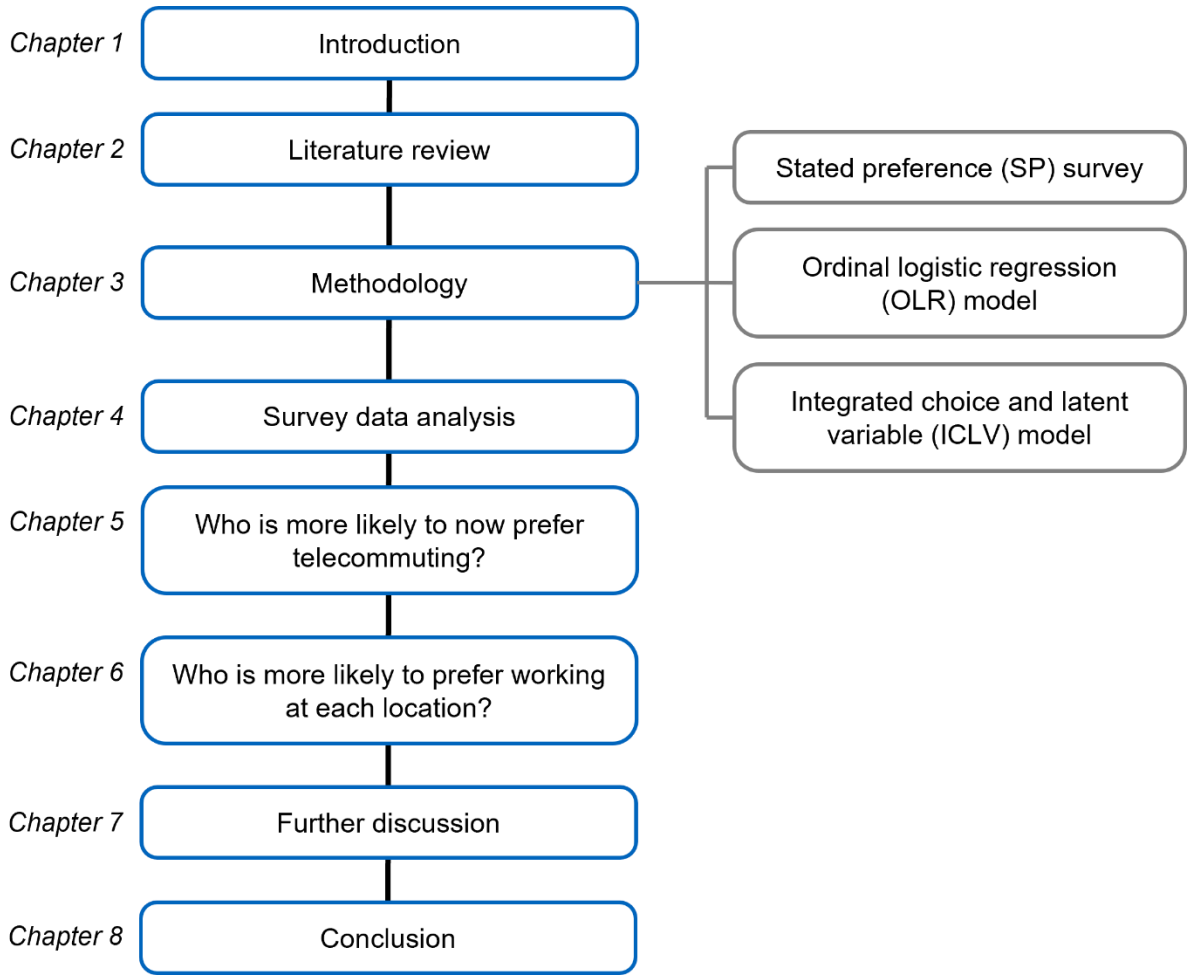

Figure 2. Overview of the structure of the thesis.

2. Literature review

2.1. Impact of life events on travel behaviour

A number of transport studies have explored how life events have influenced travel behaviour. Some studies (Ahmed & Moeckel, 2023; Beige & Axhausen, 2012; Clark et al., 2014; Lin et al., 2018) employ longitudinal data to show the occurrence of life events across tracked persons and draw relationships to observed travel patterns across the years. The study by Schoenduwe et al. (2015), for instance, used mobility biographies to show that shifts in mode choice among the Swiss population were accompanied by life events such as changes to household structure and the number of cars owned.

Meanwhile, Adhikari et al. (2020) analysed travel diary and survey data from a recruited "pre-post" sample to show shifts in preferences of neighbourhoods and travel modes after household income, work status or location, marital status, household size or household structure and residential location changed. Another study found that the changes in cycling behaviour were caused by a contextual change triggered by life events (Chatterjee et al., 2013). While the authors showed that external changes to the environment facilitated the change, intrinsic motivations mediated the process.

Essentially, these studies agree that shifting attitudes and perceptions had resulted in changes to travel behaviour. This is elaborately discussed by Verplanken et al. (2008) in their study of how contextual changes shift travel mode choices. The habit discontinuity and self-activation hypotheses were used to explain why life events caused people to deliberately reconsider their behaviours based on their attitudes and perceptions. In their study, participants who had recently moved and who showed high levels of environmental concern commuted less using their car, reinforcing their hypotheses about the influence of intrinsic tendencies.

To the author's best knowledge, there have yet to be studies that address how life events evoke contextual changes that affect attitudes and perceptions of different work locations. Therefore, further work has to be undertaken to better grasp the influence of changing contexts on activity patterns surrounding the work schedule and on the resultant decision-making process of work location choice. In doing so, there will be a better understanding of how employees might decide on their work location arrangements.

Table 1 summarises the categories of life events considered in recent travel behaviour studies. Such life events will be explored in this thesis as they have been demonstrated in those studies to be associated with changes to travel behaviour. Thus, the potential for these life events to shift work location preferences, as a form of change in commuting patterns, becomes relevant.

Table 1. Life events studied in recent travel behaviour research.

Author/s (Year)	Categories of life events						
	Household/ partnership/ family change	Education/ job change	Driving licence acquisition	Change in ownership of cars	Childbirth or parenting of a child	Residential/ workplace relocation	Other life events
Adhikari et al. (2020)	X	X			X	X	
Beige and Axhausen (2012)		X		X		X	
Beige and Axhausen (2017)		X		X		X	
Chatterjee et al. (2013)	X	X			X	X	X
Clark et al. (2014)	X	X	X	X	X	X	
Clark et al. (2016)	X	X	X		X	X	
Davison and Ryley (2013)		X			X		
Kroesen (2014)		X				X	
Lanzendorf (2010)	X	X	X	X	X	X	X
Lin et al. (2018)	X	X		X		X	
Mohamed Tahir and Wong (2022)						X	
Oakil et al. (2011a)	X	X			X	X	
Oakil et al. (2011b)	X				X	X	
Scheiner and Holz-Rau (2012)						X	
Scheiner and Holz-Rau (2013)	X	X	X	X	X	X	X
Schoenduwe et al. (2015)	X	X	X	X	X	X	
Sharmeen et al. (2013)	X	X				X	
Sharmeen et al. (2014)	X	X		X		X	
Sprumont and Viti (2018)						X	
Verhoven (2010)	X	X		X		X	
von Behrena et al. (2018)						X	

2.2. Modelling changing preferences of telecommuting and work locations

Literature in the field of modelling telecommuting options, choice and frequency are extensive, especially in the 1990s (Bagley & Mokhtarian, 1997; Mokhtarian & Salomon, 1994, 1996, 1997; Stanek & Mokhtarian, 1998; Varma et al., 1998), mapping household and individual characteristics to telecommuting preferences. These early studies employed regression techniques to establish significant predictors of preferences. Likewise, Peters et al. (2004) revisited those themes in their later study of Dutch employees to arrive at similar conclusions.

NHBTC was also rigorously explored in several studies, especially on its impact to transportation. Balepur et al. (1998) investigated the shifts in commute modes and trip characteristics among participants in the California Neighborhood Telecenters Project, a program to evaluate the effectiveness of telecommuting centres. Work was then continued by Mokhtarian and Bagley (2000), who proceeded to model employees' perceptions of work locations along four aspects: personal benefits, work effectiveness, autonomy, and supervisor comfort. A multinomial logit model was used to predict preferences based on socio-demographics and job contexts. This approach, unfortunately, only captures preferences at a single point in time and is unable to capture the changing preferences needed to reflect the impact of life events. A better approach to address the first research question would be to investigate how telecommuting preferences among those who have recently experienced such events vary from those who have not.

Furthermore, developing on the understanding that attitudes and perceptions might possibly influence work location choices, subjective factors can be integrated using structural equation modelling. One recent work done by Lee and De Vos (2023) zoomed in on attitudes to understand the motivations behind telecommuting. Separately, Mohamed Tahir and Wong (2022) posited that increased convenience of out-of-home activities and a better commute experience made employees less inclined to telecommute when workplaces were made closer to their homes. Latent variables can thus be introduced into the choice analysis using an ICLV model. While ICLV models (sometimes called hybrid choice models) have been used in assessing both conventional public transport modes (Efthymiou & Antoniou, 2017; Saeidi et al., 2020) and emerging mobility technologies (Li & Kamargianni, 2020; Politis et al., 2012), they have yet to be used in modelling work location preferences.

2.3. Defining non-home-based telecommuting (NHBTC)

In order to appreciate why there might be changing preferences of work locations, it is imperative to first understand the characteristics of NHBTC and why it has been increasingly popular, especially in Singapore. In the case of Singapore, a working paper published by the Institute of

Policy Studies by Mathews et al. (2022) revealed persistent preferences for hybrid work arrangements even after the pandemic restrictions have been cut back. Surveyed employees cite missed opportunities for collaboration with colleagues (78%) and lack of a dedicated or conducive working space (76%) as reasons why they might return to the office.

As a form of NHBTC, CWSs bridge these gaps by providing collaborative spaces alongside the standard suite of office facilities, thus explaining their increased popularity as part of the post-pandemic work arrangement. Improved managerial trust in employee productivity and integrated facilities (such as childcare services) further strengthen the case for CWSs as viable work locations (Ceinar & Mariotti, 2021). Berbegal-Mirabent (2021) reiterate the value of CWSs in creating a work environment that fosters collaboration and community spirit, differentiating it from working from home. Meanwhile, other public spaces such as cafes, libraries and community centres are less the focus of this study as they are often opted as one-off choices and are not long-term alternatives to working at the company's office, home or CWSs.

2.4. Examining the benefits of NHBTC over home-based telecommuting

Drawing on the characteristics of CWSs that might make them attractive work locations, the following sub-section hypothesises two ways in which life events might result in employees perceiving such characteristics as being more desirable. These changes arise from how such events shift priorities in life, changing one's perception of and attitudes towards NHBTC. In turn, NHBTC might be opted over home-based telecommuting (HBTC).

2.4.1. Proximity to activities done outside work hours

Firstly, it is hypothesised that one's attitude towards proximity to activities done outside work hours is an influential factor in determining work location choice. The study by Mohamed Tahir and Wong (2022) sheds light on the benefit of being in proximity to such activities. In Singapore's case, the development of regional centres that places commercial activity around the work location enhances the convenience of engaging in non-work activities that include shopping, dining and recreation (Bishop et al., 2004). An analysis of the Tampines Regional Centre in Singapore affirmed the significance of the relative attractiveness of different work locations as determinants in the choice-making process (Malone-Lee et al., 2001). Similarly, Tang et al. (2011) arrived at the conclusion that convenient and diversified activity opportunities around the neighbourhood did influence work location choices. As Singapore continues to decentralise, attitudes towards working at these regional centres might shift, potentially popularising NHBTC.

On the theme of life events, some life events might affect the perceived value of having activities close by. It might be valuable to evaluate the effects of life events on non-work activities, similar to the work done by Gropper et al. (2020). They identified life events that negatively impacted physical activity, most of which made it less convenient for people to engage in physical activity. Separately, Bell (1991) discussed how reduced opportunities in the suburbs of Melbourne after workplace relocation lowered the frequency of shopping and leisure undertaken. All in all, they reiterate how attitudes towards activity accessibility evolve due to the occurrence of life events.

2.4.2. Enhanced work productivity

Separately, it is hypothesised that one's attitude towards their work productivity also contributes to their choice of work location. The relationship between work productivity and work location has been extensively discussed in the literature. In her doctoral thesis, Martinez-Amador (2016) demonstrated that employees who enjoyed their work location showed higher levels of productivity. As discussed earlier by Lai (2020) and Mathews et al. (2022), employees appreciate the autonomy of the work schedule when working from home but this comes with significant productivity losses in terms of work achieved. Oftentimes, managers attribute this to the poor work environment at home. On the contrary, with regard to CWSs, the study by Bueno et al. (2018) affirmed how the working space environment and social interactions in those spaces improve work productivity.

Along this vein of studying the effects of life events, life events disrupt former household routines and require working adults in the household to readjust to new arrangements, resulting in a change in context for the household. This context change with respect to working from home might serve as the impetus for a change in work productivity. Working at the office spatially separates duties at work and duties at home with minimal chances of overlap. However, when working from home, these duties begin to overlap and family-work conflicts arise (Galanti et al., 2021). For instance, changes to household composition might introduce more distractions to the work environment, affecting productivity.

In essence, the attitude one has towards the expected productivity of their work environment might influence their choice of work location and should be considered in the choice analysis. An employee who feels more strongly towards having a productive, professional work location might veer away from the distractions at home (Brown, 2017). Certain life events that might jeopardise their focus might be linked to the employee's reduced willingness to work from home. Hence, it is hypothesised that life events might shift the importance one places on various aspects of their work environment, affecting their choice of work location.

To summarise this sub-section on the benefits NHBTC offer over HBTC, Table 2 compares work locations in terms of the discussed benefits with NHBTC showing the greatest potential in terms of those benefits.

Table 2. Assumed benefits offered by the different work locations.

Benefits	Telecommuter		Non-telecommuter
	HBTC	**NHBTC (e.g., CWSs)**	**Company's office**
Proximity to activities	Medium	High	Low to medium
Work productivity	Low to medium	Medium to high	High

3. Methodology

3.1. Stated preference survey

A stated preference (SP) survey was designed for this thesis in order to capture attitudinal aspects of work location choice that are otherwise not captured in household travel surveys which merely capture trip and individual characteristics. As such, the survey aimed to understand the changes in employees' experiences and preferences towards telecommuting after the occurrence of life events. Later, it collected data for the explanatory variables. Given the complexity of the survey, its design and commissioning are described hereafter.

3.1.1. Pre-survey situation analysis

In order to have a sense of the life situation among employees in Singapore, a situation analysis was conducted. This helped to refine the main survey in terms of improving the descriptions of particular life events and understanding the current telecommuting situation in Singapore. A short online survey was administered on LimeSurvey, garnering 32 complete responses. In examining the occurrence of life events, except for stopping cohabitation with one's partner, other life events had recorded some degree of occurrence, albeit very low for some of them. This also surfaced the need to provide respondents who have not experienced any life events in recent years with hypothetical life events for them to consider.

Telecommuting is also still prevalent as seen in Figure 3 with 62% of sampled respondents reporting at least some level of telecommuting as part of their current work arrangement. Close to half (43%) of the respondents even telecommute more than half the time, reiterating its popularity. One last question in the survey then asked for additional life events that respondents felt were relevant in shaping their work location choice. Based on the responses, a new life event which was having one's child(ren) starting a new stage of their education was added.

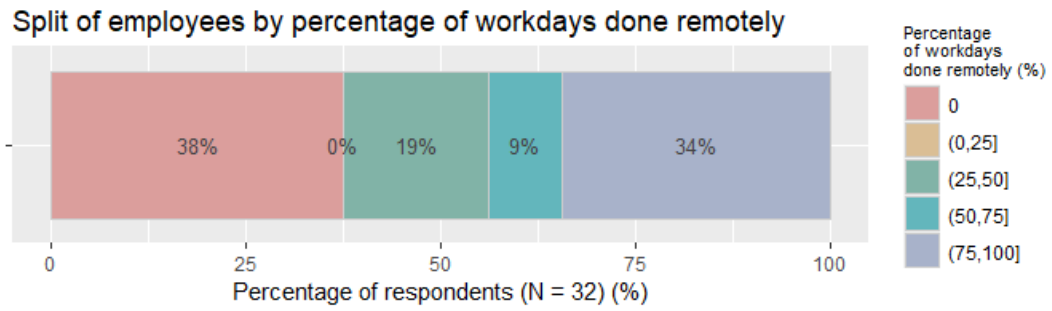

Figure 3. Occurrence of remote workdays in the situation analysis.

3.1.2. Questionnaire design

An extensive questionnaire was developed to provide an in-depth understanding of the decision-making process in work location choice. Sections in the survey included data collection for the explanatory variables in the models, the occurrence of life events as well as perceptions towards different work locations. Prior to the survey proper, one section was included to screen out unemployed respondents and those who are not able to telecommute (such as employees working in sales and manufacturing).

Subsequently, for the life event analysis, the 15 life events considered in this study are shown in Table 3 below and are coded as '1' if the employee has experienced them over the past two years (or '0' otherwise). For respondents that have not experienced any of them, two life events that were appropriate based on their demographic were randomly selected and presented to them. These two events would be what such respondents would evaluate in terms of changes to their experiences and preferences of telecommuting for the OLR.

Table 3. Life events considered in this study.

Category of life events	Life event
Household, partnership or family change	• Began living in the same house as your partner • Stopped living in the same house as your partner • Increased number of adults in your household • Decreased number of adults in your household • Child(ren) started a new stage of their education
Job change	• Changed jobs • Started a job from having no job • Increased number of mandatory work hours • Decreased number of mandatory work hours
Residential or workplace relocation	• Residence is now closer to your company's office • Residence is now further from your company's office
Driving licence acquisition	• Received your driving licence
Change in ownership of cars	• Increased number of cars owned by your household • Decreased number of cars owned by your household
Childbirth or parenting of a child	• Gave birth to or parented a child

Alongside collecting modelling data, questions about their opinions regarding CWSs and shared offices were also integrated into the questionnaire. This served two functions: to introduce the uninitiated to CWSs and shared offices as well as to understand general sentiments towards

such work locations. Figure 4 shows the infographic that was included in the survey questionnaire when introducing NHBTC. These features were synthesised from the study by Weijs-Perrée et al. (2018). One question further asked respondents what improvements could be made to make NHBTC more attractive to them.

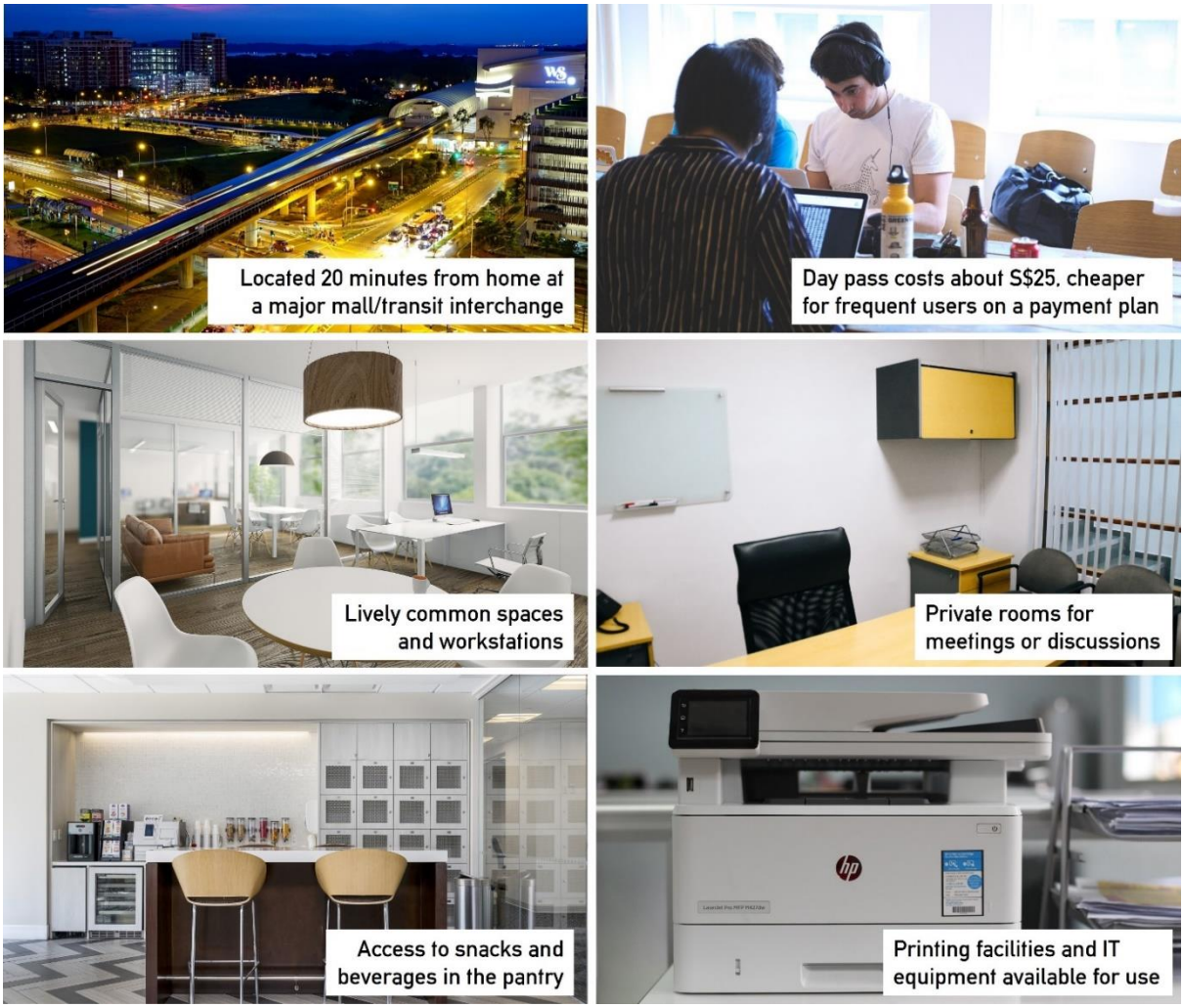

Figure 4. Features of coworking spaces and shared offices as described in the survey.

Lastly, in the work location choice section, respondents were asked to choose both a location to work in for a particular workday as well as the number of workdays that they preferred to work at each location during their work week.

The complete survey questionnaire can be found in Appendix A.

3.2. Development of ordinal logistic regression (OLR) model

To understand the relationships between life events and the consequential changes to one's telecommuting preferences, an ordinal logistic regression (OLR) model was developed. In this regression technique, the error terms are logistically distributed. While there are minimal statistical differences between logit and probit models, a logit model allows for the derivation of odds ratios (as explained later) which can be easily interpreted.

In OLR, for each of the *J* ordered categories of the predicted variable, $P(Y \leq j)$ is the cumulative probability of *Y* less than equal to a specific category $j = 1, \dots, J-1$, as seen in Equation (1). The *polr* command in the MASS package in R was used in the OLR analyses.

$$\log \frac{P(Y \leq j)}{P(Y > j)} = logit\left(P(Y \leq j)\right) \quad (1)$$

The OLR model is hence parameterised in R's *polr* as seen in Equation (2).

$$logit\left(P(Y \leq j)\right) = \beta_{j0} - \eta_1 x_1 - \cdots - \eta_p x_p \quad (2)$$

The list of life events was converted to binary variables and was regressed to the change in telecommuting preference. Preference changes were rated in terms of a five-point scale in the survey (much less preferred, slightly less preferred, no change, slightly more preferred, much more preferred). For the OLR model development, the predicted variable was retained as an ordinal variable with five levels.

To explain the theory behind the odds ratio (OR), assume that an OLR model with a single explanatory variable x is defined by the regression equation $Odds_x = exp(\beta_0 + \beta_1 x)$. The determination of OR is shown in Equation (3).

$$OR = \frac{Odds_{x+c}}{Odds_x} = \frac{exp\left(\beta_0 + \beta_1 (x+c)\right)}{exp(\beta_0 + \beta_1 x)} = exp(c\beta_1) \quad (3)$$

The OR is therefore the odds of a success change by $exp(c\beta_1)$ times for every c-unit increase in x (Bilder & Loughin, 2015). Reducing the five-level ordinal variable to three levels (i.e., less preferred, no change and more preferred) simplifies the interpretation of OR to compare the odds of achieving the highest level as compared to the two lower levels. In essence, for any employee who experienced a life event x, the odds of a greater preference to telecommute now is $exp(c\beta_1)$ times that of an employee who did not experience that life event.

Separate regressions were conducted for both short-term changes (comparing their preferences 1-2 months after the events to their prior preferences) and midterm changes (comparing their preferences now to their prior preferences). By doing so, the coefficients of both models can be compared to assess if the changes brought about by effects of certain life events extended temporally. Final model structures were selected based on the Akaike information criteria (AIC) and Nagelkerke's R^2 values. They were then further analysed to derive ORs and tested for the validity of the proportional odds assumption which will be explained further in Chapter 5.

3.3. Development of integrated choice and latent variable (ICLV) model

3.3.1. Latent variable modelling

Through the use of latent constructs to describe unobserved variables, structural equation modelling (SEM) introduces psychometric concepts into the econometric approach of traditional multiple linear regression analysis. SEM typically includes a measurement model to specify those latent variables (LVs) as well as a structural model to identify the causal influences of explanatory variables (e.g., demographic variables) on latent variables and of latent variables on one another (Golob, 2003). Herein, integrating SEM into the classical discrete choice modelling approach provides the opportunity to capture attitudinal factors into the choice model.

One such form of SEM is a multiple-indicator, multiple-cause (MIMIC) model which establishes covariates in the measurement model structure. By means of a MIMIC model, the exogenous relationships between explanatory variables and LVs as well as the factor loadings in the measurement model are concurrently estimated (Chang et al., 2020). As visualised in Figure 5, the structure of a MIMIC model consists of both the measurement and structural aspects of SEM. The measurement model for each LV j and indicator h is described in Equation (4) while the structural model for each LV j and explanatory variable k is described in Equation (5) with ξ_i and ω_i being their respective error terms.

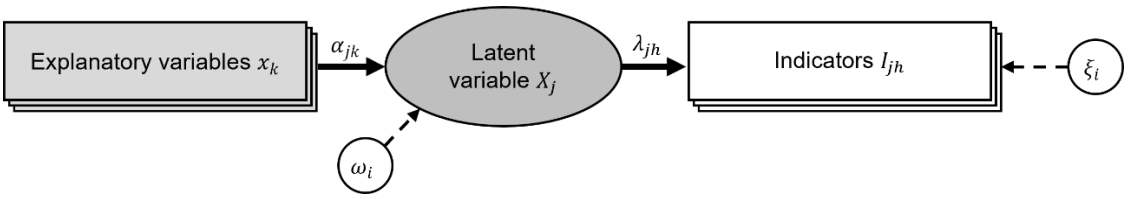

Figure 5. Structure of a MIMIC model.

$$I_{jh} = \lambda_{jh} X_j + \xi_i \quad (4)$$

$$X_j = \alpha_{jk} x_k + \omega_i \quad (5)$$

As the measurement model structure was unknown for the LVs, an exploratory factor analysis (EFA) was first conducted. EFA determines how many LVs should be in the MIMIC model and the suitable indicators that should be used to measure them. After the measurement model structure was established, a confirmatory factor analysis (CFA) was run to verify the performance of the measurement model based on the test statistics in Table 4.

The LVs are based on the two attitudes towards purported benefits of NHBTC discussed earlier, namely proximity to activities done outside work hours and enhanced work productivity. The indicators are measured in terms of:

- changes in the frequency of engaging in such activities and,
- shifts in their perceived value towards work productivity.

Quantifying the indicators in terms of post-life-event changes rather than current attitudes more accurately captures the effects of life events on one's attitudes towards those two benefits.

Indicators for the proximity to activities were synthesised from the three activities that benefitted from accessible locations in the study by Mohamed Tahir and Wong (2022), which are dining out, shopping and entertainment. Those activities were considered across three periods of non-work (before work, during break hours and after work), resulting in a total of nine indicators (in Q11-13 of the survey). Meanwhile, six productivity indicators were established based on the factors discussed by Asgari et al. (2022) in their study of future preferences toward telecommuting (in Q14 of the survey).

Lastly, the covariates were sequentially regressed to arrive at the structural model which best described the LVs in terms of the model fit indices in Table 4. The LV model analyses were implemented on *lavaan* in R (Rosseel, 2012).

Table 4. Performance indicators in latent variable model analyses.

Tests	Performance indicators used
Model fit	• Comparative fit index (CFI) • Tucker-Lewis fit index (TLI) • Standardised root mean square (SRMR) • Root mean square error of approximation (RMSEA)
Reliability and consistency	• Average variance extracted (AVE) • Composite reliability (CR) • Cronbach's alpha (CA) • Discriminant validity test

3.3.2. Discrete choice modelling

Furthering on the discrete choice model developed by Bernardino (2017) on work location preference as seen in Figure 6, the LV model structure constructed and verified from the earlier LV modelling process was integrated into his model. In his work, work location preference was based on the utility of each work location and these utility functions are piped into classical discrete choice modelling (DCM) to derive the work location split across the employees for a particular workday. In this choice model, it has been assumed that the employer gives their employee free choice of where they can work and that the employee does not have any in-person matters to attend to at their company's office.

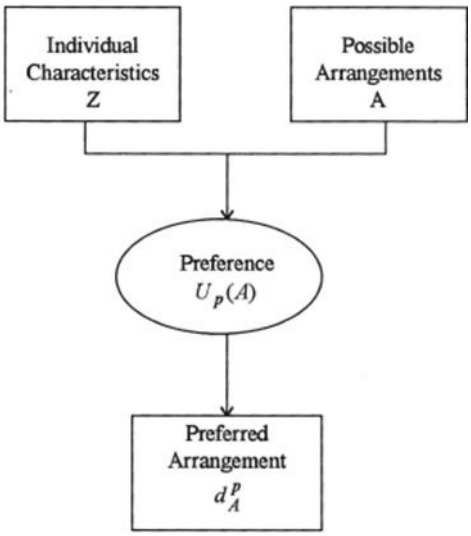

Figure 6. Model of employee's preferred arrangement (Bernardino, 2017).

Expanding on his model, Figure 7 shows the ICLV model structure that combines both SEM and DCM. Using estimates from the MIMIC model analysis, least squares regression is used to calculate the expected values of each LV for each individual. This allows for the LVs to be integrated into the choice model as continuous explanatory variables (Atasoy et al., 2013).

To identify the predicting variables in DCM, a classical sequential selection procedure was used whereby alternative models were tested and compared based on the likelihood ratio test and AIC (Albaladejo & Díaz-Delfa, 2020). The model structure with the best performance in these two aspects is subsequently retained. Weights were not applied as there was no data that could be used to extrapolate the responses to the whole working population. The *mlogit* package in R was used for DCM implementation (Croissant, 2020). Three different model structures are compared: the classical multinomial logit (MNL) model, the ICLV model and the ICLV model with interactions between explanatory variables and LVs.

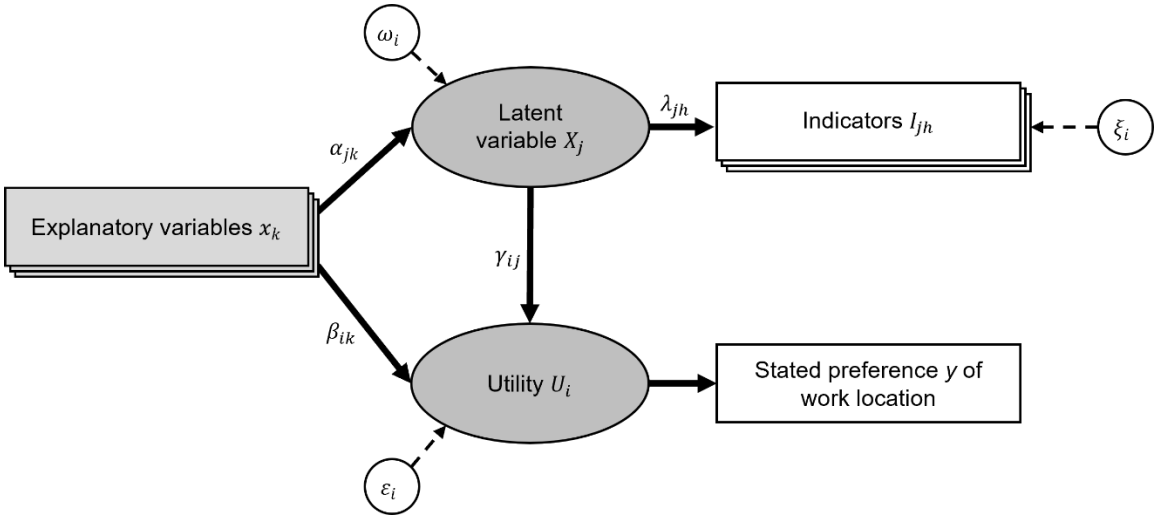

Figure 7. Structure of the ICLV model.

For each alternative i, the utility function U_i is defined as seen in Equation (6):

$$U_i = ASC_i + \sum_j \gamma_{ij} X_j + \sum_k \beta_{ik} x_k + \varepsilon_i \qquad (6)$$

where ASC_i is the vector of alternative-specific constants, X_j is the vector of latent variables with coefficient vector γ_{ij}, x_k is the vector of explanatory variables with coefficient vector β_{ik} and ε_i is the error term.

Explanatory variables x_k considered in the model, with survey questions referenced, include:

- socio-demographic data (Q3-4, Q27, Q29-33);
- mobility patterns (Q15-17);
- household structures (Q5-7, Q28);
- perceptions about their job (Q25) and,
- changes to telecommuting experiences and preferences after their life events (Q18-19).

As alternative-specific variables, travel times and costs related to commuting to the CWS and the office were derived based on reported commute times and modes and their derivations are elaborated further in Appendix B. No travel times and costs are associated with working at home as telecommuting completely substitutes travel. For the trip to the CWS, random times were generated using the normal distribution with a mean of 20 and a standard deviation (SD) that is proportional to the SD of the reported commute times. The sensitivity of the coefficients for travel time and cost are tested after DCM.

The complete list of explanatory variables and their coding can be found in Appendix C.

4. Survey data analysis

4.1. Descriptive statistics

4.1.1. Data collection

The survey questionnaire was implemented on LimeSurvey with screen-out questions (Q1-2) programmed into the online platform. For this thesis, the survey was administered from April 27, 2023, to July 1, 2023. It was distributed online via social media and the author's connections. Face-to-face intercepts were not feasible as the author was still in Munich, limiting further response collection. In all, a total of 312 responses were captured on LimeSurvey. Invites to CWSs were also sent out to gather responses among their users but did not return any responses. Table 5 describes the breakdown of captured responses, which includes screened-out responses and dropout rates across the survey sections.

Table 5. Breakdown of captured responses.

Responses	Number	Proportion (%)
Total responses recorded	312	100
Screened-out responses	19	6.1
Dropped out before end of survey	64	20.5
Incomplete socio-demographic profiles	10	3.2
Total responses for OLR/ICLV modelling	219	70.2

4.1.2. Socio-demographic distribution

The socio-demographics of the complete responses are shown in Table 6 below. Due to the narrowed focus towards working adults in the study, the representativeness of the sample cannot be compared to census data that captures the entire Singapore population. For instance, the proportion of employees who have never married is much higher than the 31.5% in the 2020 Census (Singapore Department of Statistics, 2021). This might be because Singaporeans are more inclined to prioritise career development over settling down (National Population and Talent Division, 2022). Other socio-demographic trends characteristic of knowledge-based work that should be noted include the high proportion of tertiary-educated (71.6%), and full-time (96.8%) employees.

Table 6. Socio-demographic profiles of complete responses (N = 219).

	Frequency	Proportion (%)*
Gender		
Male	123	56.2
Female	96	43.8
Age (years old)		
18-24	16	7.3
25-34	110	50.2
35-44	61	27.9
45-54	22	10.0
55-64	9	4.1
65 or older	1	0.5
Marital status		
Never married	123	56.2
Married	90	41.1
Widowed/Divorced/Separated	6	2.7
Highest educational level		
Secondary	1	0.5
Post-secondary (non-tertiary)	4	1.8
Diploma or other professional qualifications	57	26.1
Bachelor's degree or equivalent	131	60.1
Master's degree or equivalent	22	10.1
Doctorate	3	1.4
Monthly income (S$) [1]		
2,001 – 4,000	51	23.3
4,001 – 6,000	76	34.7
6,001 – 8,000	54	24.7
8,001 – 10,000	22	10.0
10,001 or more	16	7.3
Employment type		
Full-time	212	96.8
Part-time	2	0.9
Self-employed	5	2.3
Position in company		
Regular employee	173	79.0
Manager	39	17.8
Board or owner	2	0.9
Self-employed	5	2.3
Dwelling type		
HDB [2] 1- and 2-room flats	7	3.2
HDB 3-room flats	37	16.9
HDB 4-room flats	108	49.3
HDB 5-room flats/executive flats	40	18.3
Condominiums and other apartments	18	8.2
Landed properties	9	4.1
Household car ownership		
Yes	83	37.9
No	136	62.1

* Might not sum up to 100% due to rounding errors

Note: [1] Income in Singapore dollars (S$) where S$1 = €0.68 (as of July 12, 2023) are reported before Central Provident Fund (CPF) deduction. The median monthly income in Singapore in 2022 is S$5,070 (Dayani, 2023); [2] Housing and Development Board (HDB) is the statutory board in Singapore that is responsible for public housing.

4.1.3. Choice of work location

Figure 8 shows the choice of work location for a single workday among the respondents. The majority of respondents (60%) chose to work from home with a close split of 17% and 23% choosing the CWS and the office, respectively.

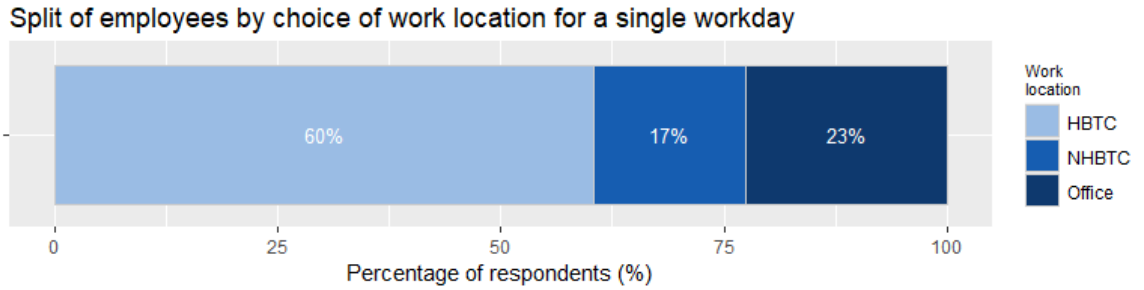

Figure 8. Choice of work location for a single workday.

Meanwhile, for the work locations chosen across the entire workweek as seen in Figure 9, clear trends can be seen in the preferences of conventional work locations (i.e., at home or in the office). The mean number of preferred workdays is 2.5, 0.8 and 1.6 for HBTC, NHBTC and the office, respectively. Half of the respondents did not want to pursue NHBTC at all.

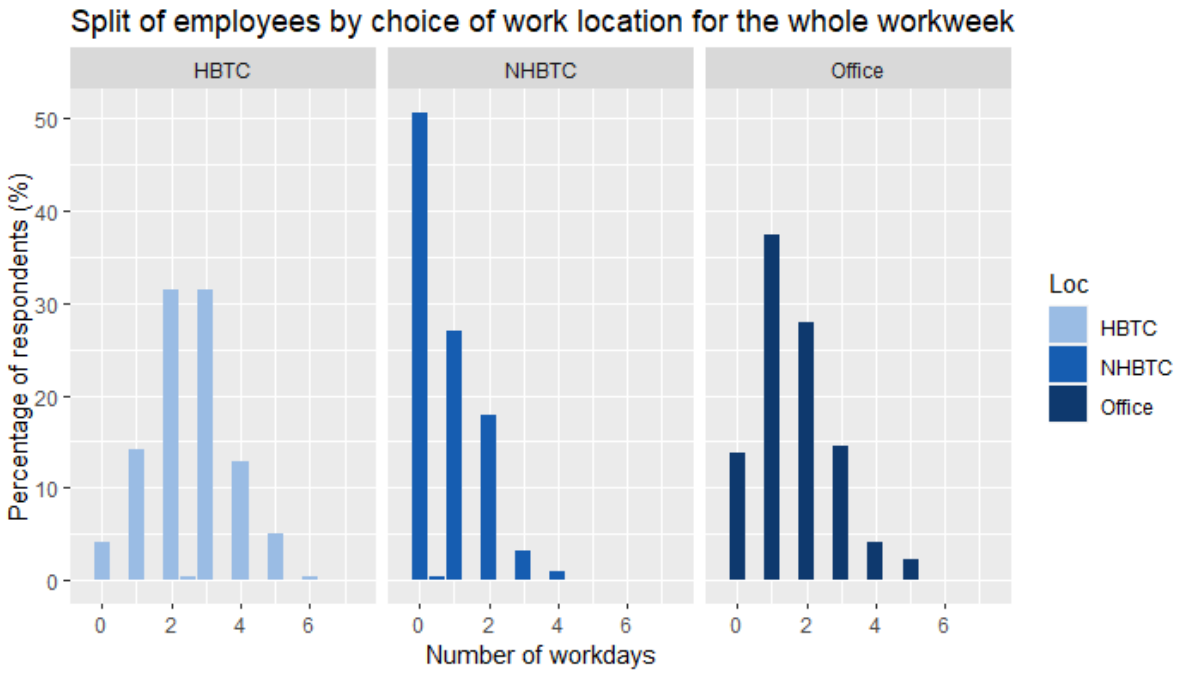

Figure 9. Choice of work locations for the entire workweek.

4.2. Perceptions of NHBTC

The perceptions that respondents had regarding CWSs on the two benefits that NHBTC offered are shown in Figure 10. More than half (62%) felt that their work productivity at a CWS would be higher than that at home whereas more than a third (38%) felt that they could more easily engage in activities outside work hours from a CWS than at home. However, opinions regarding the differences between NHBTC and working at their company's office were minor with about 70% of respondents perceiving no difference in terms of both criteria.

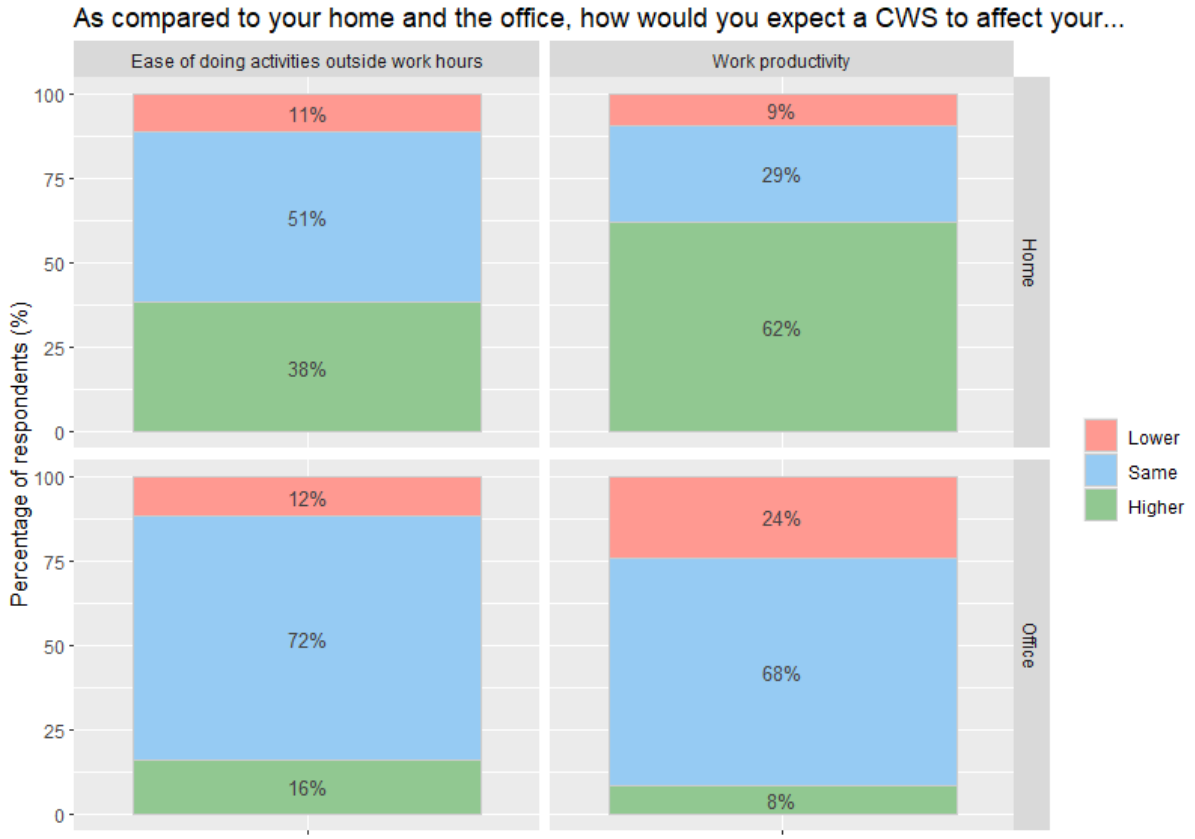

Figure 10. Personal perceptions of CWSs as compared to other work locations.

Regarding the improvements to CWSs, respondents were tasked to choose all improvements that can make CWSs more attractive to them. As seen in Figure 11, these potential improvements were grouped into three categories: accessibility, economic factors and work environment. Three out of four respondents felt that the CWSs should at least be partially paid for by their company and have better accessibility from home. Work environment factors were also deemed to be less important improvements as compared to accessibility or economic factors.

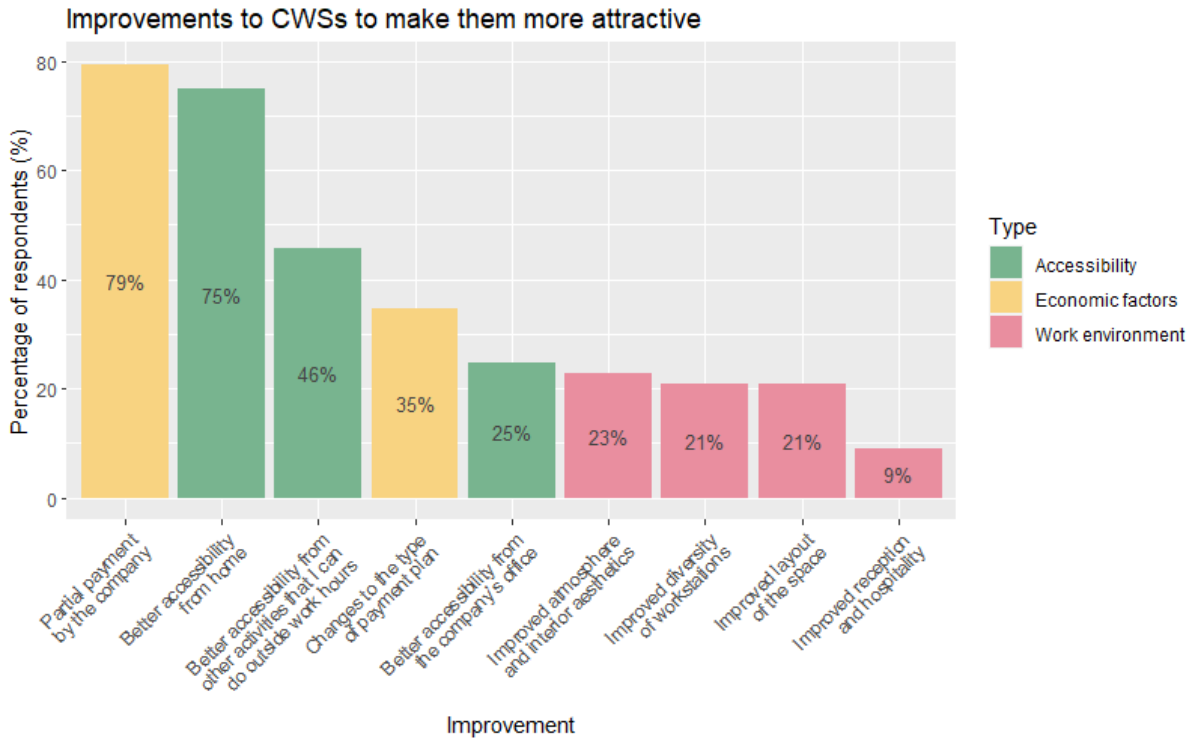

Figure 11. Desired improvements to CWSs.

4.3. Occurrence of life events

Across the 15 life events studied, the mean number of life events experienced by the sampled respondents in the past two years is 1.35 as seen in Table 7. As compared to the mean of 0.61 events among Germans sampled in the German mobility panel dataset (Ahmed & Moeckel, 2023), the higher frequency in Singapore might be attributed to the narrowing of the sampled population to working adults. This Singaporean sample excludes children and retired persons who might be less likely to experience changes. Separately, it should be noted that 27.9% of the respondents in the sample experienced no life events and were provided with the two hypothesised life events for their evaluation.

Table 7. Frequency of experienced life events (N = 219).

Number of life events experienced	Frequency	Proportion (%)
0	61	27.9
1	56	25.6
2	72	32.9
3	25	11.4
4	4	1.8
5	1	0.5

Meanwhile, Figure 12 shows the occurrence of each of the 15 life events among the respondents over the past two years. Except for changes in employment status (job change or first-time employment), other events do not occur in any more than 12% of respondents. The frequency of randomised life events among those who reported experiencing no life events is also shown in the figure below.

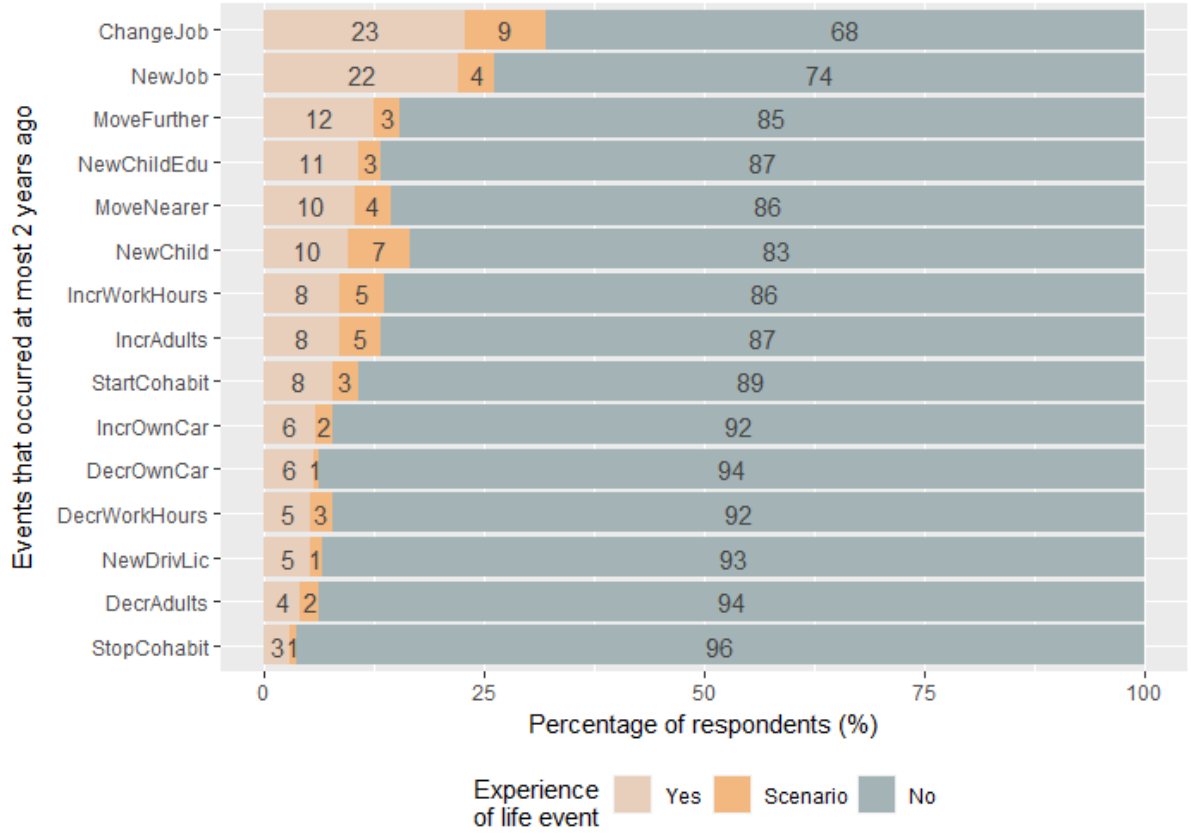

Figure 12. Occurrence of life events and frequency of hypothesised events in scenarios.

5. Who is more likely to now prefer telecommuting?

5.1. OLR model analysis

The regression results of the reduced OLR models are shown in Table 8 with the initial results provided in Appendix D. Six life events were found to influence short-term changes to telecommuting preferences whereas four life events were found to influence midterm changes. Of the seven events in total that were found to be significant, three events (starting cohabitation with one's partner, moving closer to one's office, increasing the number of cars owned) showed a tendency to reduce an employee's preference to telecommute. Meanwhile, four other events (starting a new job, increasing work hours, moving further from one's office, having a new child) resulted in an increased preference for telecommuting.

However, the temporal extent of the changes varied across life events. Only three events of the events that showed short-term changes (namely increasing work hours, moving further away from the office and increasing the number of cars owned) showed persistence in the midterm. A point worth noting is that their coefficients reduced in magnitude very slightly, indicating that the effects of those life events are slowly beginning to wane off and that employees are starting to reach a new norm with regard to their telecommuting preferences.

Separately, three events (namely starting cohabitation with one's partner, starting a new job and having a new child) had short-term effects on telecommuting preference change but were found to not be significant in impacting midterm changes. Aligned with the previous argument, employees who have experienced these events would have adjusted to the changes to their household or social arrangements that previously made telecommuting the preferred choice.

Meanwhile, Table 9 shows the OR values for each life event which had significant coefficients in the OLR models. For instance, in the short-term, the odds of a higher preference to now telecommute for an employee who moved further from their company's office is 4.279 times that of an employee who did not move further.

An interesting statistic to look at is the life event of owning more cars in the household which saw the largest coefficient. Their OR values are less than 1, which means it would be more meaningful to talk about the opposing situation. An employee who did not increase the number of cars in their household were 5.208 and 5.181 times in the short-term and midterm, respectively, to now show a higher preference to telecommute, as compared to employees who did increase the number of cars. It reiterates that changes to car ownership do strongly influence mobility patterns, especially the choice of whether to commute or not.

Table 8. Results of reduced models of changes to telecommuting preferences (N = 219).

		Model 1: **Short-term**		*Model 2:* **Midterm**	
Life event		**η**	**SE**	**η**	**SE**
Began living in the same house as your partner	*StartCohabit*	-0.775**	0.389		
Started a job from having no job	*NewJob*	0.597**	0.305		
Increased number of mandatory work hours	*IncrWorkHours*	1.472***	0.420	1.088***	0.399
Changed residence to one that is closer to your company's office	*MoveNearer*			-0.981***	0.380
Changed residence to one that is further from your company's office	*MoveFurther*	1.359***	0.368	1.111***	0.360
Increased number of cars owned by your household	*IncrOwnCar*	-1.718***	0.486	-1.643***	0.471
Gave birth to or parented a child	*NewChild*	1.193***	0.352		
Intercepts		**β**	**SE**	**β**	**SE**
much less preferred | slightly less preferred		-2.459	0.318	-3.332	0.368
slightly less preferred | no change		-1.121	0.229	-1.786	0.224
no change | slightly more preferred		-0.037	0.207	-0.120	0.175
slightly more preferred | much more preferred		1.950	0.252	1.902	0.233
Model performance					
Log-likelihood (zero coefficients)		-320.87		-310.78	
Log-likelihood (final)		-290.73		-289.09	
Residual deviance		581.47		578.18	
Akaike Information Criteria (AIC)		601.47		594.18	
Pseudo-R^2 of Nagelkerke		0.254		0.191	

* p-value < 0.1, ** p-value < 0.05, *** p-value < 0.01; SE = standard error

Table 9. Odds ratio for life events in the reduced models (N = 219).

		Model 1: **Short term**	*Model 2:* **Midterm**
Life event		**Odds ratio (OR)**	**Odds ratio (OR)**
Began living in the same house as your partner	*StartCohabit*	0.509 (1.965)	
Started a job from having no job	*NewJob*	1.817 (0.550)	
Increased number of mandatory work hours	*IncrWorkHours*	4.779 (0.209)	2.969 (0.337)
Changed residence to one that is closer to your company's office	*MoveNearer*		0.375 (2.667)
Changed residence to one that is further from your company's office	*MoveFurther*	4.279 (0.234)	3.038 (0.329)
Increased number of cars owned by your household	*IncrOwnCar*	0.192 (5.208)	0.193 (5.181)
Gave birth to or parented a child	*NewChild*	3.773 (0.265)	

Note: OR = odds ratio; reciprocal values in brackets

5.2. Verification of proportional odds assumption

In OLR, it is assumed that the relationships between each pair of outcome groups are consistent. In essence, the single set of coefficients generated can explain the relationships to the response variable across the different categorical levels. The log odds of being greater than or equal to each value of the five-level response variable of telecommuting preference change Y was calculated in R using the *qlogis* function as seen in Table 10 which has been done for the midterm model. Note that for the *IncrWorkHours* and *MoveFurther* life events, none of the responses reported the lowest level (i.e., much less preferred) when those events occur and thus the values of the log odds are infinity.

Next, binary logistic regressions were run for each life event for all $k - 1$ levels of the response variable using the *glm* function to determine the intercepts and coefficients for each life event. The differences in the intercepts for each comparison of the Y value are labelled under each "No" row in Table 10 below.

Table 10. Difference in log odds of Y in the midterm model.

			Difference of Y values			
Life event		**N**	**2 & 1**	**3 & 2**	**4 & 3**	**5 & 4**
IncrWorkHours	No	193	-Inf	-1.400	-1.497	-1.784
	Yes	26	[1]	-Inf	-1.784	-2.246
MoveNearer	No	189	-Inf	-1.724	-1.615	-1.748
	Yes	30	-Inf	-1.062	-1.094	-2.820
MoveFurther	No	183	-Inf	-1.337	-1.569	-1.836
	Yes	36	[1]	-Inf	-0.977	-2.114
IncrOwnCar	No	201	-Inf	-1.889	-1.469	-1.868
	Yes	18	-Inf	-0.504	-2.531	-0.754
Overall		219	-Inf	-1.414	-1.470	-1.782

Note: [1] Infinity (Inf) recorded for Y ≥ 2 hence the subtraction of infinities leads to errors.

If the values for "Yes" and "No" for each pair of levels are similar, the proportional odds assumption would hold. However, the life events do not show similar values when comparing the occurrence and non-occurrence across both the short-term and midterm models. This implies that the assumption may not hold and that there are differences in the effect of each life event on transitioning from "slightly less preferred" to "no change" as compared to from "no change" to "slightly more preferred" and so forth.

5.3. Theoretical contributions

The findings from the OLR model analysis reposition the current understanding of telecommuting preferences in several ways. Firstly, it revisits the conclusions made by Hergeth (2020) who was exploring whether the choice to telecommute was affected by point-in-time socio-demographic factors. Unlike her findings that, for instance, showed no significant relationship to household size, the results here demonstrate that life events can shift telecommuting preferences. Thus, it can be hypothesised that while long-equilibrated household structures might not predict telecommuting preference, life events might be sources of disturbance that could disrupt household routines and influence that choice.

Consequently, telecommuting might confer the flexibility one needs to reach a new equilibrium. This is reflected in some life events (such as having a new child) only shifting preferences in the short-term but having their effects wane in the longer term. In particular, this might explain why Hergeth (2020) found no relationship between household size and telecommuting choice. The minority of employees who have just welcomed a new family member and are more likely to choose to now telecommute might have been overshadowed by the majority who have had no recent change in household size, marring the statistical significance.

Additionally, this part of the study reiterates that while shifts in telecommuting preference are caused by life events, they do not equally affect how much those preferences shift. When testing the proportional odds assumption, the transition between levels is inconsistent with some comparisons reporting large variations in the differences of Y values.

Towards the middle levels (i.e., from “slightly less preferred” to “no change” and to “slightly more preferred”), the variations in differences are smaller, leading to the belief that life events can be used to predict small changes in telecommuting preference. Yet, towards the extremes, the differences become larger, indicating that while life events might mediate the shifts, other underlying motivations to telecommute come into play to explain the stronger shifts. Therefore, the following chapters in this thesis attempt to put the pieces together by introducing individual-centric perspectives in predicting work location choice.

5.4. Practical implications

Drawing on the idea that life events do indeed affect employees’ preference to telecommute, more can be done to cater to match the telecommuting preferences to actual work arrangements. From a human resource perspective, it is valuable to gain insights into the segments of the working population that would be keener to telecommute as they experience different life events. Such flexibility can be offered to new parents, new hires and employees

who have recently relocated. Essentially, alternative working arrangements, both in terms of their work locations and work hours, might be well-received by these employees. Employees who are given such flexible arrangements are found to be more satisfied with their jobs. Unsurprisingly, job satisfaction is much higher among those given the flexibility to deal with family matters (Andrade et al., 2023). This might suggest that employers and managers should relook at the viability of providing more flexibility to improve employee well-being and job retention, a factor which employees who leave their jobs cite as one of the reasons for doing so (Mathews et al., 2022).

Another valuable takeaway is the evidence that car ownership continues to be a predictor of mobility patterns, in particular, commuting behaviours. This reinforces the findings of numerous studies (e.g., Ahmed and Moeckel (2023); Bell (1991); Lin et al. (2018); Sharmeen et al. (2013)) which show that employees who now own more cars tended to produce more significant vehicle-kilometres, either by choosing to commute or making more non-work trips. In congruence with those studies, an increase in the number of cars in a household made the odds of now preferring to telecommute especially low, eliminating potential reductions in vehicle-kilometres travelled.

This is both surprising yet expected, given the circumstances in Singapore. As a city-state that disincentivises car ownership by increasing related costs (Diao, 2019), the high cost might ironically promote their aggressive use within the 10-year Certificate of Entitlement (COE) period. For the COE, one pays upwards of S$100,000 (€67,372) (Motorist Pte Ltd, 2023) to be able to own a car. It can be argued that the car becomes a Veblen good that when owned, leads to conspicuous overconsumption to maximise the utility of the car (Eaton & Eswaran, 2009). Therefore, this raises questions on the topic of sustainable transport demand management as to whether classical economic theory of raising prices to quell demand is effective to deter car overuse, especially among high-income households.

6. Who is more likely to prefer working at each location?

6.1. Latent variable model analysis

The EFA revealed that a four-LV structure would be most appropriate for the indicators. Standardised factor loadings that were above 0.5 were retained as recommended by Hair (2006). Activities done outside work hours formed three LVs: the first was named *Prework* as they relate to before-work-hour activities, the second was named *Break* as they relate to work-break activities and the third was named *Postwork* as they relate to after-work-hour activities. Finally, the last LV was named *Productivity* as they relate to factors regarding work productivity relevant after experiencing life events. Only three indicators were found to be significant for *Productivity*: not sharing a workspace with other family members (ShareSpace), workspace comfort (Comfort) and communication with co-workers (WorkComm).

CFA then verified the measurement model and the results are shown in Table 11. Positive loadings on indicators are due to effect coding based on whether the occurrence (for activities) or value (for productivity) after their life events reduced, remained the same or increased. Model fit indices were generally satisfactory and were either very close to meeting or met the thresholds (see Hu and Bentler (1999) for CFI, TLI, SRMR; and Steiger (2007) for RMSEA).

Table 11. Standardised estimates and fit indices from the CFA.

LV	Item	Std. est.	SE	AVE	CR	CA
Prework	PreworkMeals	0.795***	-	0.38	0.63	0.82
	PreworkRec	0.900***	0.105			
	PreworkShop	0.650***	0.086			
Break	BreakMeals	0.761***	-	0.27	0.73	0.89
	BreakRec	0.940***	0.094			
	BreakShop	0.854***	0.085			
Postwork	PostworkMeals	0.826***	-	0.30	0.70	0.87
	PostworkRec	0.893***	0.075			
	PostworkShop	0.790***	0.070			
Productivity	ShareSpace	0.531***	-	0.50	0.47	0.71
	Comfort	0.939***	0.310			
	WorkComm	0.571***	0.156			

Note: SE = standard error, AVE = average variance extracted, CR = composite reliability, CA = Cronbach's alpha

Model fit statistics: χ^2 = 100.468, df = 48, χ^2/df = 2.09, CFI = 0.959, TLI = 0.944, SRMR = 0.044, RMSEA = 0.071, 0.051 < robust RMSEA < 0.090 at 90% confidence interval; *** p-value < 0.001

However, this measurement model fails on its convergent and discriminant validity. For the former, this latent structure falls short of meeting the AVE threshold which is recommended to be at least 0.5 (Diamantopoulos & Siguaw, 2000) for each construct to explain at least 50% of the variance of the measures. As seen in Table 12, the latter also fails as the squared correlation between *Prework* and *Postwork* is greater than the AVE of *Prework*, meaning that measures might be correlated with each other. In cognisance of this, a reduced model structure combining the two latent variables was subsequently examined but led to results that were far worse in terms of model fit. Thus, despite the shortcomings of this model, it is still acceptable across most of the other evaluation criteria.

Table 12. Construct squared correlations and their AVEs.

LV	Prework	Break	Postwork	Productivity
Prework	0.38			
Break	<0.01	0.27		
Postwork	0.51	0.01	0.70	
Productivity	<0.01	0.02	<0.01	0.50

Note: AVEs on the main diagonal and R^2 values on the lower triangular, AVE = average variance extracted

Subsequently, MIMIC model analysis included the explanatory variables regressed into the structural equations. The results of the estimation are shown in Table 13 on the next page. The structural components of the MIMIC model show that several socio-demographic factors can be used to predict the post-life-event attitudes towards the different aspects that NHBTC might stand to improve. For the goodness-of-fit indices, the MIMIC model showed satisfactory results across the different metrics.

The significance of job-related factors as predictors of the LVs in the model echoes the finding of Mokhtarian and Bagley (2000) who found that a number of such factors predicted the work location choices made by Californian employees. Trust by managers, job satisfaction and post-COVID workplace flexibility were found to be significant factors across LVs. Positive opinions towards one's job influenced post-life-event occurrences of non-work activities and values placed on work productivity.

Markedly, job satisfaction was one explanatory factor that persisted across the three LVs describing non-work activity occurrence. It should be noted that employees who felt satisfied with their job continued to place value on engaging in non-work activities outside of work hours, indicating some continued desire for work-life balance. It might also signal that employees view these activities as breaks between their responsibilities at home and at the office.

Table 13. MIMIC component estimates.

Measurement equation	Estimate	SE
Measurement component: *Prework (PR)*		
PR1: PreworkMeals	1.000	-
PR2: PreworkRec	1.357***	0.102
PR3: PreworkShop	0.831***	0.086
Measurement component: *Break (BR)*		
BR1: BreakMeals	1.000	-
BR2: BreakRec	1.260***	0.091
BR3: BreakShop	1.141***	0.085
Measurement component: *Postwork (PS)*		
PS1: PostworkMeals	1.000	-
PS2: PostworkRec	1.112***	0.073
PS3: PostworkShop	0.908***	0.069
Measurement component: *Productivity (PD)*		
PD1: ShareSpace	1.000	-
PD2: Comfort	1.490***	0.238
PD3: WorkComm	1.002***	0.151
Structural component: *Prework (PR)* (R^2 value: 0.076)		
Has a child or children	-0.236***	0.081
Income: S$6,000 or less	-0.151**	0.073
Job satisfaction: agree or strongly agree	0.183**	0.085
Post-COVID workplace flexibility: agree or strongly agree	-0.107*	0.062
Structural component: *Break (BR)* (R^2 value: 0.203)		
Gender: Male	0.174***	0.066
Marital status: Married	0.144**	0.067
Place of residence: HDB flat	0.204**	0.104
Has a dedicated workspace at home	-0.380***	0.088
Job satisfaction: agree or strongly agree	0.152*	0.082
Structural component: *Postwork (PS)* (R^2 value: 0.160)		
Has a child or children	-0.499***	0.104
Income: S$6,000 or less	-0.189**	0.094
Has a car or cars in the household	-0.146**	0.074
Has a dedicated workspace at home	-0.196**	0.087
Job satisfaction: agree or strongly agree	0.280**	0.109

(Table continues on the next page)

Measurement equation	Estimate	SE
Structural component: *Productivity (PD)* (R^2 value: 0.075)		
Highest education level reached: Bachelor's or higher	0.107*	0.055
Number of children in household	-0.074**	0.033
Trust by managers: agree or strongly agree	0.107*	0.061
Post-COVID workplace flexibility: agree or strongly agree	0.099*	0.056

Note: * p-value < 0.1, ** p-value < 0.05, *** p-value < 0.01; SE = standard error

Model fit statistics: χ^2 = 270.968, df = 174, χ^2/df = 1.56, CFI = 0.931, TLI = 0.917, SRMR = 0.045, RMSEA = 0.050, 0.038 < robust RMSEA < 0.062 at 90% confidence interval

6.2. Discrete choice model analysis

Table 14 shows the results of the logit model estimations of the best-performing model selected for each structure. The reference alternative was set to the home (or HBTC).

Besides the AIC used to determine the best-performing model as done by Albaladejo and Díaz-Delfa (2020), the AIC with standard correction (AICc) was also reported since the ratio of observations to unique parameters, n/V, is less than 40 (Burnham & Anderson, 2002). While the simple ICLV model performed slightly better than the MNL model in terms of the log-likelihood and AIC, the difference is very minor. However, the performance of the ICLV model dropped slightly when interactions were introduced. This would suggest that the ICLV model without interactions was possibly the best-performing model, despite its higher AICc value due to it having more parameters. It reported a reasonable McFadden's R^2 value of 0.213. Herein, further discussions in this section will reference this ICLV model.

Work location choice was found to be predicted at the 10% significance level by two-way travel time, but not two-way travel cost. The relationship between travel time and utility was found to be positive, indicating that employees felt that travel time brought some benefits to them (Redmond & Mokhtarian, 2001). Similarly, Humagain and Singleton (2020) found that zero commute time was not the ideal commute time. By this line of reasoning, it can be inferred that employees place value on the act of spatially separating home from work, manifested by their commute.

Table 14. Logit model estimation results.

Attribute	MNL model		ICLV model		ICLV model with interactions	
	Estimate	SE	Estimate	SE	Estimate	SE
(Intercept): NHBTC	-1.1371***	0.3531	-1.7710*	1.0661	-3.0742**	1.2944
(Intercept): Office	-3.7380***	0.9840	-3.7585***	0.9845	-6.4788***	1.7898
Two-way travel time	0.0144**	0.0056	0.0146**	0.0057	0.0428**	0.0165
NHBTC-specific coefficients						
Has a child or children	-1.5117*	0.8375				
Number of children in household	0.7887**	0.3164				
Has a dedicated workspace at home	-1.2967**	0.5945				
Income: S$2,001-$4,000	-1.1208**	0.5347	-1.9363***	0.6193	-1.8514	0.6151
Marital status: Married	-1.0969*	0.6192	-1.9185***	0.5534	-1.9164	0.5557
Number of adults in household			0.3494*	0.1875	0.3506*	0.1879
Post-COVID workplace flexibility: disagree or strongly disagree			-1.5373	1.2107	-1.9285	1.3155
Trust by managers: agree or strongly agree			0.9896*	0.5912	0.9536	0.6115
Office-specific coefficients						
Age: 55 years or older	1.7739**	0.8777	1.7916**	0.8732	2.0498**	0.8636
Place of residence: HDB flat	1.2457*	0.6577	1.2600*	0.6551	1.2235*	0.6539
Has a car or cars	0.7323*	0.4029	0.7396*	0.4023	0.7153*	0.4054
Income: S$6,000-S$8,000	1.0295**	0.4157	0.9796**	0.4152	0.9798**	0.4238

(Table continues on the next page)

Attribute	MNL model		ICLV model		ICLV model with interactions	
	Estimate	**SE**	**Estimate**	**SE**	**Estimate**	**SE**
Post-life-event telecommuting preference: slightly less preferred or much less preferred	1.0797**	0.4875	1.0359**	0.4863	1.1960**	0.5021
Post-life-event telecommuting preference: slightly more preferred or much more preferred	-1.8099***	0.4766	-1.8090***	0.4778	-1.7961***	0.4825
Post-life-event telecommuting experience: slightly more pleasant or much more pleasant	0.7461*	0.4483	0.7662*	0.4466	0.8053*	0.4487
LVs						
Break: NHBTC			1.9458*	0.9989		
Productivity: NHBTC			-9.3405**	3.0256	-3.3407	4.6016
Productivity: Office					12.3670*	6.5822
Interactions with LVs						
Travel time × Productivity					-0.1289*	0.0702
Fit indices						
Log-likelihood (final)	-165.3138		-163.2240		-161.3357	
Pseudo-R^2 of McFadden	0.203		0.213		0.222	
AIC	360.6275		360.4480		360.6714	
AICc	362.9921		363.4928		364.4905	

Note: * p-value < 0.1, ** p-value < 0.05, *** p-value < 0.01; AIC(c) = Akaike information criteria (with standard correction); MNL = multinomial logit; SE = standard error

6.2.1. Significance of explanatory variables

While a range of explanatory variables were tested for their significance, only some of them showed statistical significance to be included in the choice model. To better understand why they might be relevant in the work location decision-making process, a summary of possible reasons for the relevance of those factors is provided in Table 15 for NHBTC and Table 16 for the office. While most explanatory variables can be attributed to some of the merits or drawbacks of the particular work location, post-life-event telecommuting experience was a surprise as it went against expectations. While it was expected to be negatively related to the utility of the office, two reasons were highlighted in Table 16 to potentially predict why the trend was the reverse. One revolved around the clear separation of work and home whereas the other was regarding the desire for a more productive environment. Since it is only possible to hypothesise reasons at this point, further studies are required to test the claims in understanding the contexts behind why they might be the case.

Table 15. Relevance of explanatory variables for NHBTC.

Variable	Relationship	Possible reasons for relevance
Income: S$2,001-$4,000	-	Lower-income employees would be reluctant to spend a part of their income to pay for a place to work.
Marital status: Married	-	Working at home provides the couple with opportunities to spend their breaks together to do activities.
Number of adults in household	+	Having more working adults at home requires more sharing of limited workspaces in the house.
Post-COVID workplace flexibility: disagree or strongly disagree	-	Employees are less keen to explore alternative locations if their employers do not give them the freedom of choice.
Trust by managers: agree or strongly agree	+	Employees are keener to explore alternative locations if their supervisors believe they will still be productive, regardless of where they work at.

Table 16. Relevance of explanatory variables for the office.

Variable	Relationship	Possible reasons for relevance
Age: 55 years or older	+	Older employees tend to feel more attached to the office, preferring to work there (Rothe et al., 2012).
Place of residence: HDB flat	+	Working at the office avoids the disturbances (e.g., noise) from other households living in the same block.
Has a car or cars	+	Car ownership encourages more regular commuting to maximise the utility of the car (Bell, 1991).
Income: S$6,000-S$8,000	+	This income group earns slightly above the median income (Dayani, 2023) and is likely to be in middle management who attends in-person meetings.
Post-life-event telecommuting preference: slightly less preferred or much less preferred	+	Employees that now show a lower preference to telecommute would prefer to work at the office more.
Post-life-event telecommuting preference: slightly more preferred or much more preferred	-	Employees that now show a higher preference to telecommute would prefer to work at the office less.
Post-life-event telecommuting experience: slightly more pleasant or much more pleasant	+	Employees who can now be managing matters at home but get distracted might feel that the office offers better work-life separation (Nakayama et al., 2022). Employees that are now comfortable working at home might be sluggishly unproductive and choose to be at the office to be more productive (Russo et al., 2021).

6.2.2. Inclusion of only some of the latent variables

Notably, in the ICLV model without interactions, only the *Break* and *Productivity* LVs were included. Even then, it was only for the NHBTC alternative. Other LVs, however, did not show statistical significance to the utility functions.

The *Break* LV was positively related to the utility function of NHBTC. It suggests that post-life-event occurrence of activities during the work breaks seems to increase the utility of NHBTC, reiterating its merit in terms of bringing non-work activities closer to employees. The convenience of being within a bustling activity centre (where CWSs are located) seems to attract people who are keen to engage in those activities.

Yet, the *Productivity* LV showed a negative relationship to the utility function of NHBTC. This counters the hypothesis put forth in Table 2 which posited that NHBTC and working at the office leads to higher productivity as compared to working at home. After narrowing down the indicators during the EFA, three indicators were retained to measure that LV (i.e., having one's workspace that is not shared with other family members, comfort of one's workspace and communication with other co-workers). Based on these indicators and the resultant coefficient to NHBTC utility, it can be deduced that employees that valued these aspects deem NHBTC to be inadequate as compared to working from home.

It is also worth mentioning that the *Productivity* LV for the ICLV model with interactions yielded a positive coefficient in the utility function of the office. This meant that employees who felt greater value towards their work productivity after their life events tend to prefer the office over their home. Given the same set of indicators that were used to measure that LV for both alternatives, the positive coefficient points toward the belief that these are better catered for in the office setting as compared to at home.

6.3. Sensitivity analysis of travel time for NHBTC

Using the ICLV model without the interactions, sensitivity analyses were used to determine if the choice of mean and SD of the one-way travel time to the CWS affected the coefficient of travel time during DCM. Sensitivity analyses were done for means of 15, 20 and 25 and SDs of 5, 7.40 and 10. Twenty runs of each pair of means and SDs were conducted. In the analysis in Chapter 6.2, the mean was 20 and the SD was 7.40, producing the coefficient labelled with the blue dot in Figure 13. To prevent unreasonably low or negative values, the minimum of the randomised times was set to 2.5. While larger SDs result in a wider spread of coefficients, the mean values remained at around 0.01. This demonstrates that the noise introduced into the CWS travel time does not make the model estimations unstable.

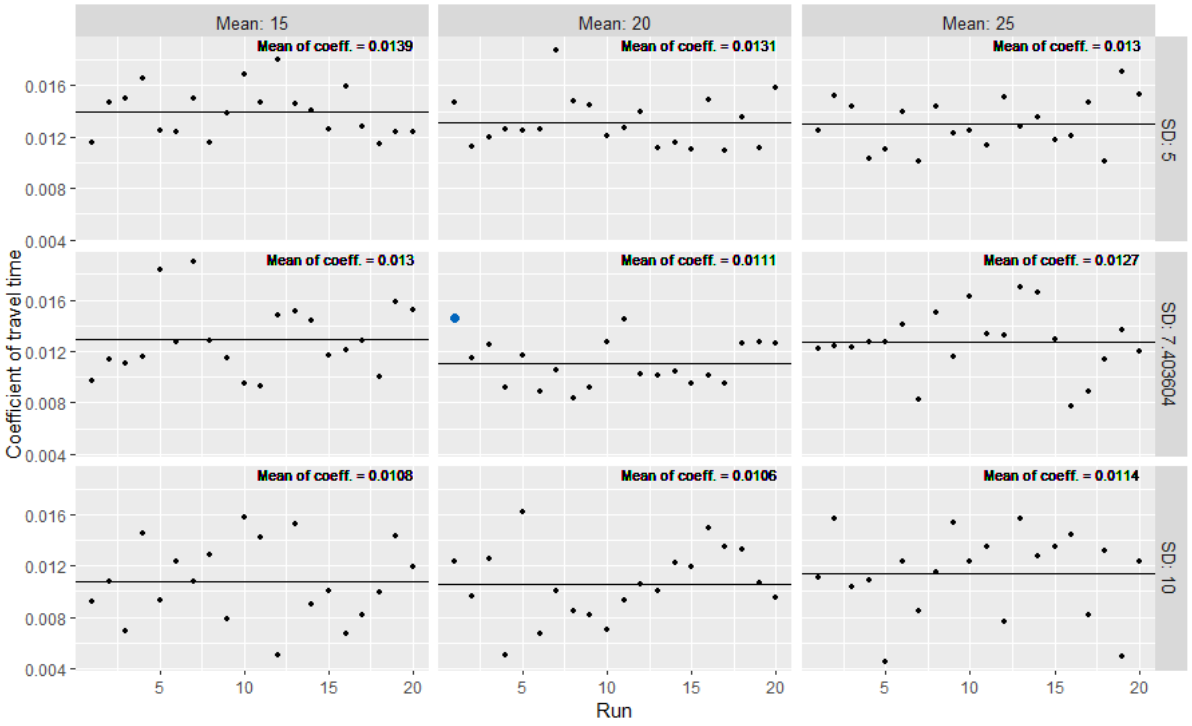

Figure 13. Sensitivity analysis of the two-way travel time coefficient.

6.4. Theoretical contributions

Firstly, this study contributes to the existing literature by reiterating the value of personal attitudes on choice models. The inclusion of LVs as continuous explanatory variables in the utility equations for NHBTC resulted in a slight improvement in model performance as compared to the classical reduced form multinomial logit model. They provided some understanding of how attitudes towards work productivity affected the choice of NHBTC and shed some light on a relatively less explored area of work location choice modelling.

Moreover, as seen in the SEM and DCM results, several socio-demographic variables show both direct and indirect effects in predicting work location choice. For instance, living in a HDB flat predicts the *Break* LV in SEM and is one of the office-specific explanatory variables in DCM. This serves as a precursor for future studies to evaluate alternative model structures (e.g., nested logit models, more complex structural models) to improve the predictive power of the model and develop a deeper understanding of this field. However, as seen in the ICLV model with interactions, more complex models may not perform much better than simpler ones, similar to the findings of Vana et al. (2008) whose MNL model performed better than their mixed MNL and nested logit models.

6.5. Practical implications

6.5.1. How does shortening travel times for NHBTC affect its choice?

To translate the findings of the ICLV model to practical takeaways, the incremental choice model (Koppelman, 1983) gauges how changing travel times to CWSs might affect resultant utilities and thus their probabilities of different work locations being chosen.

Using the ICLV model without interactions, the new probability of NHBTC (i.e., $P_{NHBTC,t+1}$) being chosen is shown in Equation (7) and the new probability of the home or the office (i.e., $P_{Other\ work\ location,t+1}$) being chosen is shown in Equation (8), given the new and existing utilities of the NHBTC being $u_{NHBTC,t+1}$ and $u_{NHBTC,t}$, respectively.

$$P_{NHBTC,t+1} = \frac{P_{NHBTC,t} \cdot exp(u_{NHBTC,t+1} - u_{NHBTC,t})}{P_{NHBTC,t} \cdot exp(u_{NHBTC,t+1} - u_{NHBTC,t}) + (1 - P_{NHBTC,t})} \quad (7)$$

$$P_{Other\ work\ location,t+1} = P_{Other\ work\ location,t}\left(\frac{1 - P_{NHBTC,t+1}}{1 - P_{NHBTC,t}}\right) \quad (8)$$

The change in work location choices for a one- and five-minute change in one-way travel time to the CWS (i.e., two- and ten-minute two-way travel time) are shown in Table 17 below.

Table 17. Change in work location choices from travel time changes.

Change to one-way travel time (min)	$P_{Home,t+1}$	$P_{NHBTC,t+1}$	$P_{Office,t+1}$
Decrease by 5	61.22% (+1.40%)	14.94% (-1.95%)	23.83% (+0.55%)
Decrease by 1	60.11% (+0.29%)	16.49% (-0.41%)	23.40% (+0.11%)
No change	59.81%	16.90%	23.29%
Increase by 1	59.52% (-0.30%)	17.31% (+0.41%)	23.17% (-0.12%)
Increase by 5	58.27% (-1.55%)	19.04% (+2.15%)	22.69% (-0.60%)

Again, the results in Table 17 revisit the argument made earlier that shifting CWSs closer to the home might blur the separation between the workplace and home or might reduce the accessibility to non-work activities. Furthermore, it could be assumed that the "better accessibility to home" in Chapter 4.2 that employees desire could be achieved by improving the convenience of travelling home via a more direct public transport service or reducing the walk times or transfer times.

6.5.2. Implications for stakeholders

The findings from the DCM also reiterate the importance of job contexts. The flexibility to be able to choose where to work as well as the trust given by managers are both influential factors that promote NHBTC. The ICLV model results concur with that of Lee and De Vos (2023) who also found that employees' choice of work locations depended strongly on how their employers' perceptions about those work locations.

If companies wish to move towards reducing their ecological footprint from employee commuting, more should be done to cater to the desires of where employees want to work, rather than instating a blanket company-wide policy. In this vein, Table 18 captures several improvements that can be considered regarding the current situation of work location choice. A number of the proposed improvements stem from the need for greater employee-employer synergy in this aspect.

Table 18. Potential improvements across stakeholders regarding work location choice.

Stakeholders	Potential improvements to the current situation
Employees	• Seek understanding from supervisors and managers if life events now require more flexibility in terms of work arrangements • Explore alternative work locations if the office or home makes one less productive or focused
Employers	• Diversify work locations beyond a single centralised office by collaborating with CWSs located in regional centres • Provide managers with flexibility to determine their team's work arrangement policy based on their operational needs
CWS operators	• Improve the collaborative environment by offering work-together packages for colleagues who are in the same company • Provide more private workrooms that allow for deep-focus work
Urban planners	• Enhance the allure of regional centres as an attractive one-stop work, leisure and shopping destination for employees (Mohamed Tahir & Wong, 2022) • Provide better intra-town transport such as high-frequency short-turn services to improve connectivity to activity centres

7. Further discussion

7.1. Key lessons learnt

Drawing from both parts of the study, two major takeaways should be reiterated. The first takeaway is that life events do indeed provide the impetus that shifts work arrangement preferences. As hypothesised earlier, life events disrupt existing household arrangements by requiring family members to adjust to new routines. With the exception of having a new child, life events that were found to be significant in predicting a higher telecommuting preference were events that affected commute travel decisions. An event that made commuting more convenient tended to decrease an employee's preference for telecommuting and vice versa. The choice analysis then demonstrated that changes to telecommuting preference and experience which were induced by life events influenced the preferred work location. In essence, this means that employees experiencing life events that upset household routines reassess the viability of telecommuting in the adjustment period. This, consequently, affects their choice of work location based on the priorities that have shifted since their life events.

Similarly, the study has demonstrated that CWSs have yet to be perceived as attractive alternative work locations, as compared to one's home or the office. Slightly above half of employees do not intend to choose to work at a CWS during any part of their work week. A combination of factors contribute to this phenomenon: monetary costs are incurred to work there, perceived accessibility is not attractive enough and productivity gains by working there are not significantly better than conventional work locations. The choice analysis has also pointed out that the attitude towards work productivity is negatively related to the utility of CWSs, again reiterating that employees do not feel that CWSs fulfil their needs for a more productive environment over their current options. Overall, at this point in time, it can be argued that CWSs fall short of meeting the needs of employees in Singapore and have to reposition and rebrand themselves to attract users.

7.2. Limitations

Notwithstanding the valuable takeaways from this study, several limitations should be addressed. Firstly, one shortcoming is the limited responses gathered. Given the constraints of the thesis duration as well as the limitations of being in Munich, the statistical significance of several variables might have been undermined due to the small sample size. Furthermore, model calibration and testing could not be conducted.

It should additionally be noted that several factors that could have influenced work location choice were unintentionally left out. Through the free response question in the survey (Q34), some respondents deemed that, for instance, concerns regarding personal health in the post-pandemic world were pertinent in their decision-making process. As an example, one study showed that COVID-19 has altered employees' opinions about telecommuting (Asgari et al., 2022). Other factors that were initially thought to be irrelevant also surfaced as answers to that question. In essence, should this work be furthered, a more complete picture needs to include personal concerns as well as other influences of the employee's job context.

Lastly, LVs as predictors of work choice location have been merely constructed as a group of predictive socio-demographics. Given that each individual was only involved in a single choice experiment of the three alternatives, it raises doubts as to whether the attitudes do explain the occurrence or whether the socio-demographics on their own were sufficient. As it would be meaningless to create other attributes to the "Office" alternative (where the respondent would still likely draw on their own experiences to their own office), multiple choice experiments were not conducted. Hence, while the experimental design has been constructed to the best of the author's ability, the effect of this single-choice experiment on the validity of overall findings is still unknown.

7.3. Future research directions

One finding drawn from DCM was that there was a positive linear relationship between travel time and utility. However, while studies have shown that the positive relationship might be the case, it remains to be investigated whether this linearity holds for all values. Should this not be the case, careful consideration of other possible relationships should be studied. It is then important to understand how other socio-demographic factors might interact with this optimum travel time. Similarly, travel cost was found to not significantly predict work location choice but there seems to be a relationship between those earning lower than S$4,000 and a dislike for NHBTC. Again, this could be due to missing mediating variables or a non-linear trend that would be a better input for DCM. Future studies are recommended to delve deeper into these aspects to strengthen the model.

Furthering on the prediction of the single-day work location choice, count regression models would be able to predict the number of workdays for each work location. This would be similar to the approach taken by Moreno et al. (2023) in predicting the number of mobile days for home-based work trips. This would integrate concepts from ICLV modelling and zero-inflated modelling, especially for NHBTC which sees a large percentage of zero points. While ICLV modelling packages are available in R (e.g., *apollo* and *mixl*) and Python (e.g., *Biogeme*) to run all steps simultaneously (which were not used due to time constraints in this thesis), these new steps would require separate analyses for the complete modelling process.

8. Conclusion

This study has sought to understand the influences of life events on telecommuting preferences as well as work location choices. In the first half of this thesis, the OLR models showed the significance of several life events in shifting short-term telecommuting preferences, midterm telecommuting preferences or both. Subsequently, attitudinal factors specific to NHBTC were integrated when modelling work location choice, manifested through an ICLV model. The findings of the former models showed that shifts in telecommuting preferences due to three life events continue to persist and that life events do not shift between levels of telecommuting preferences equally, especially to stronger preferences or dispreferences. Findings in the latter half demonstrated that post-life-event telecommuting preferences did affect work location choice and that attitudes towards work productivity and non-work activities during breaks could be related to the choice of working from the office. Lastly, several theoretical contributions were highlighted with regard to the current state of literature, alongside practical implications for consideration across the stakeholders involved in work location choice.

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Declaration of independent work

I hereby confirm that this thesis was written independently by myself without the use of any sources beyond those cited, and all passages and ideas taken from other sources are cited accordingly.

Munich, 2023-08-21

Muhammad Sofian Bin Mohamed Tahir

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Appendices

Appendix A: Survey questionnaire

Opening page

Modelling How Life Events Change Your Views on Your Work Location?
How do your views of different work locations change when you experience a life event?

Dear participants,

Thank you for your interest in this research and welcome to this survey.

My name is Sofian Tahir and I am conducting this survey as part of my master thesis supervised by the Associate Professorship of Travel Behavior at the Technical University of Munich (TUM). This study aims to explore how different life events might change your perceptions of various work locations, including novel workspaces. Your participation in this survey will help shape how future work locations in Singapore might be designed!

You are kindly invited to complete this short 10-minute survey if you:

1. are **currently employed** in **Singapore** and
2. are working in a **job that is possible to be done remotely**,

Your participation is voluntary. All of the information that you provide will be treated as confidential and will only be used for research purposes. If you understand the above information and agree to participate, please click "*Next*" to continue.

Thank you very much for your support!

Student: Sofian Tahir; Supervisor: Dr Ana Moreno

(Filtering questions)

1. What is your employment status? [*Full-time, Part-time, Self-employed, Unemployed*]
2. Would you describe your job as one where remote working is **possible**, even if your company does not practise this? [*Yes, No*]

[*If Q1 == Unemployed AND/OR Q2 == No, then screen out*.]

General characteristics

3. Do you possess a driving licence valid in Singapore? [*Yes, No*]
4. Does your household own any cars? [*Yes, No*]
5. What is your marital status? [*Never married, Married, Widowed/Divorced/Separated, Prefer not to say*]
6. [*Show if Q5 == Married or Q5 == Prefer not to say*] Are you currently living with your partner? [*Yes, No*]
7. [*Show if Q5 == Married, Q5 == Widowed/Divorced/Separated or Q5 == Prefer not to say*] Do you have children aged 17 years or younger? [*Yes, No*]

Occurrence of life events

8. Over the past **two years**, which of the following major events have occurred in your life?
    a. You changed jobs.
    b. You started a new job from having no job.
    c. You gave birth to or parented a child.
    d. You changed residence to one that is closer to your employer's office.
    e. You changed residence to one that is further from your employer's office.
    f. You received your driving licence.
    g. You began living in the same house as your partner.
    h. You stopped living in the same house as your partner.
    i. Your child(ren) started a new stage of their education.

9. Over the past **two years**, have any of the following characteristics changed in your life? *[Decreased, Remained the same, Increased]*
    a. Number of cars owned by your household
    b. Number of adults (18 years or older) in your household
    c. Number of mandatory work hours

Scenario of life events [*Show if Q8 == no answers and all of Q9 == Remained the same*]

Since you have not experienced any life events over the past two years, please imagine that in the past two years:

- *Event 1* and;
- *Event 2*

Answer the rest of the survey based on how you would behave if you have experienced both of those events recently.

Choose 2 from list:

- you changed jobs
- you started a new job from having no job
- you changed residence to one that is closer to your company's office
- you changed residence to one that is further from your company's office
- the number of adults (18 years or older) in your household increased
- the number of adults (18 years or older) in your household decreased
- your mandatory work hours increased
- your mandatory work hours decreased
- you received your driving licence
    - Only if Q3 == No
- the number of cars owned by your household increased
- the number of cars owned by your household decreased
    - Only if Q4 == Yes
- you gave birth to or parented a child
    - Only if Q5 == 2 or Q5 == 4
- you began living in the same house as your partner
    - Only if Q6 == No
- you stopped living in the same house as your partner
    - Only if Q6 == Yes
- your child(ren) started a new stage of their education
    - Only if Q7 == Yes

Changes to your travel patterns

10. How often do you **now** go out for these activities **before work hours** as compared to before your life event(s)? *[less often than before, just as often, more often than before]*
    a. meals with other people
    b. recreation and entertainment
    c. shopping
11. How often do you **now** go out for these activities **during your break** as compared to before your life event(s)? *[less often than before, just as often, more often than before]*
    a. meals with other people
    b. recreation and entertainment
    c. shopping
12. How often do you **now** go out for these activities **after work hours** as compared to before your life event(s)? *[less often than before, just as often, more often than before]*
    a. meals with other people
    b. recreation and entertainment
    c. shopping

Opinions about your work productivity

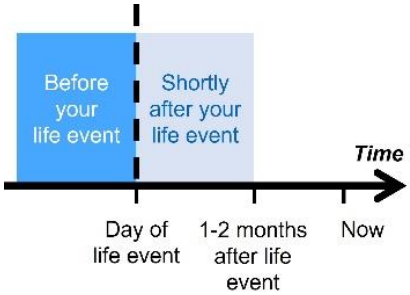
13. Does your job require you to use a computer? [*Always, Often, Sometimes, Rarely, Not at all*]
14. How much do you **now** value these aspects during work hours as compared to before your life event(s)? *[less valued than before, just as valued, more valued than before]*
    a. having the technology or equipment for work
    b. fewer distractions
    c. not having to attend to other family members
    d. having your own workspace that is not shared with other family members
    e. comfort of your workspace
    f. communication with other co-workers

Your work patterns (Part 1/2)

15. How long is your one-way commute to your company's office? _____ minutes
16. Which mode(s) do you usually use when travelling to work? [*Private modes (e.g., car, motorcycle), Public transport, Active mobility (e.g., walking, cycling), Company-chartered vehicles (e.g., van, bus)*]
17. For both before your life event(s) and now, how many workdays do you usually have in a week and how many of those days do you usually work from home/remotely??
    a. Number of workdays (Before life event(s)): _____
    b. Number of workdays (Now): _____
    c. Number of workdays that you work from home/remotely (Before life event(s)): _____
    d. Number of workdays that you work from home/remotely (Now): _____

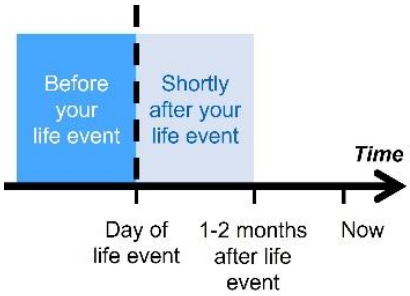
Your work patterns (Part 2/2)

18. Rate the **change** in your **experience** of working from home/remotely [*Much less pleasant, Slightly less pleasant, No change, Slightly more pleasant, Much more pleasant*]



    a. shortly after your life event(s) as compared to before your life event(s)
    b. now as compared before your life event(s)

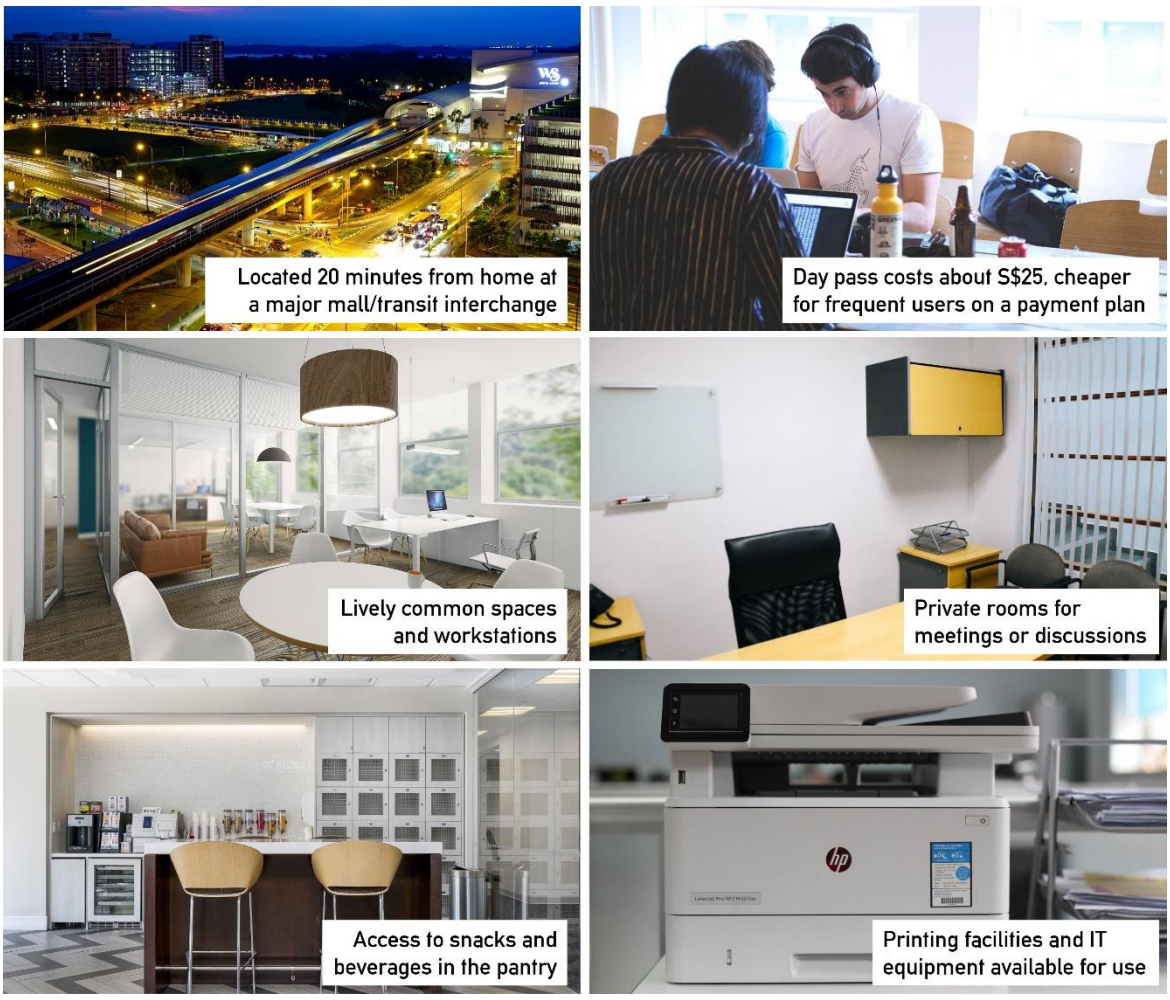
19. Rate the **change** in your **preference** of working from home/remotely [*Much less preferred, Slightly less preferred, No change, Slightly more preferred, Much more preferred*]



a. shortly after your life event(s) as compared to before your life event(s)
b. now as compared before your life event(s)

Your perceptions of novel work locations

Shared offices and **coworking spaces** are alternative work locations besides working at home or at the company's office for employees that can work remotely. Some features are shown here:



20. Have you ever worked at a coworking space or a shared office? [*Yes, No*]
21. How would you expect this coworking space or a shared office to affect your: [*Higher, Remains the same, Lower*]
    a. ease of doing other activities outside work hours as compared to at home
    b. ease of doing other activities outside work hours as compared to at your company's office
    c. work productivity as compared to at home
    d. work productivity as compared to at your company's office
22. What would make such coworking spaces or shared offices more attractive to you? [*Better accessibility from my home, Better accessibility from my company's office, Better accessibility from other activities that I can do outside work hours, Changes to the type of payment plan (e.g., from monthly payment to weekly payment), Partial payment by my company, Improved atmosphere and interior aesthetics, Improved layout of the space, Improved reception and hospitality, Improved diversity of workstations, Others*]

Your preferences of work locations

For this section, assume that your employer gives you free choice of where you can work at and that you do not have any in-person matters to attend to at your company's office.

23. On a particular workday, I would choose to work at… [*home; a coworking space, a shared office or an informal workplace (e.g., library or café); my employer's office*]
24. For the [Use answer from Q17.b] workdays in the week, I would choose to work at…
    a. home for _____ days
    b. a coworking space, a shared office or an informal workplace (e.g., library or café) for _____ days
    c. my employer's office for _____ days

Opinions about your job

25. Rate the following statements about your current job. [*Strongly disagree, Disagree, Neither agree nor disagree, Agree, Strongly agree*]
    a. My supervisors trust me to do my work.
    b. I am satisfied with my job.
    c. Since COVID-19, my employer has become more flexible about where I work.

Your household characteristics

26. Do you have a dedicated room for yourself to work from home? [*Yes, No*]
27. What is your dwelling type? [*HDB 1- and 2-room flats, HDB 3-room flats, HDB 4-room flats, HDB 5-room flats/executive flats, Condominiums and other apartments, Landed properties, Others*]
28. Including yourself, how many adults (18 years or older) and children (17 years or younger) live in your household?
    a. Adults: ____
    b. Children: ____

Socio-demographics

29. What is your gender? [*Male, Female, Others, Prefer not to say*]
30. How old are you? [*17 years or younger, 18-24 years, 25-34 years, 35-44 years, 45-54 years, 55-64 years, 65 years or older, Prefer not to say*]
31. What is the highest level of education you have completed? [*Below secondary, Secondary, Post-secondary (non-tertiary), Diploma or other professional qualifications, Bachelor's degree or equivalent, Master's degree or equivalent, Doctorate, Others*]
32. [*Show if Q1 != Self-employed*] How would you describe your position in your company or organisation? [*Regular employee, Manager, Board/owner, Others*]
33. What is your monthly income before any CPF deductions? [*S$2,000 or below, S$2,001-4,000, S$4,001-6,000, S$6,001-8,000, S$8,001-10,000, S$10,001 and above, Prefer not to say*]

Closing out

34. Feel free to share with us your opinions or feedback (if any) regarding this survey, your experiences towards telecommuting, your own workplaces, about coworking spaces or about how COVID-19 has affected your work arrangements. _____
35. If you would like to be informed about the findings from this study, feel free to leave your email address here. A short summary of the results will be sent to you after the study has concluded. Otherwise, you can leave this question blank. _____
36. If you received a partner code with the invitation to take part in the survey, please enter it now. *[The code is _____, I do not have a code]*

Closing page

Thank you for your support! I am very grateful for your help in filling out this survey!

If you have found this survey interesting, I would greatly appreciate if you could forward the link to your family, friends and colleagues.

https://tum-travelbehavior.limesurvey.net/755615?lang=en

You can now safely close the survey as your responses have been successfully captured. Have a nice day!

Sofian Tahir (sofian.tahir@tum.de)

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Appendix B: Determination of travel times and costs

For the home, no travel time *tt* or cost *tc* are incurred hence *tt* = 0 and *tc* = 0.

No travel costs were collected in the survey hence they are approximated based on commute times for public transport (PT) and car users. In the event that both modes are used for the current commute, the PT fare will be used as it is assumed that the car was used as an access mode to the PT stop or station.

For the *tt* and *tc* of the other two alternatives (NHBTC and office),

	NHBTC	Office
tt	*Mean of 20 minutes with SD proportional to SD of commute time in sample*	*Commute time* (min)
tc *(PT users)*	*For tt = 20, S$1.56* Distance-based fare[1] based on: • Proportion of in-vehicle time (%)[2] • Average PT travel speed (km/h)[3]	*fare(Commute time × 0.48)* Distance-based fare[1] based on: • Commute time (min) • Proportion of in-vehicle time (%)[2] • Average PT travel speed (km/h)[3]
tc *(Car users)*	*For tt = 20, S$7.37* Total cost based on: • In-vehicle time (min)[4] • Average car travel speed (km/h)[5] • Incurred cost of commute (S$/km)[5] • Daily parking cost (S$)[6]	*In-vehicle time × 0.05148 + 9.76* Total cost based on: • In-vehicle time (min)[4] • Average car travel speed (km/h)[5] • Incurred cost of driving (S$/km)[5] • Daily road pricing (ERP) cost (S$)[6] • Daily parking cost (S$)[6]

[1] Distance-based PT fares are retrieved from SBS Transit (2023).

[2] The proportion of in-vehicle time for PT was estimated using data from Moovit (2023).

Average commute time	= 47 minutes
Average wait time	= 9 minutes
Average walk time	= 4 minutes
Average in-vehicle time	= 47 – 9 – 4 = 34 minutes = **72%** of commute time

[3] For the average PT speed, a speed of **40 km/h** was taken to account for the variation of speeds between the MRT (80 km/h) and bus (17 km/h).

[4] For the in-vehicle time for cars, it is assumed that access and egress time was also 4 minutes (i.e., same as walk time for PT) each way and this time (8 minutes) was removed from the commute time.

[5] According to TomTom (2023), the average car travel speed during the morning peak hour is **36 km/h**. The incurred variable cost of commuting by car is S$22.30/km/year or **S$0.0429/km per one-way commute**.

[6] According to Sun and Wong (2023), the mean daily road pricing (ERP) cost is **S$2.80** and the mean daily parking cost is **S$6.96** for their sample of 700 motorists in Singapore. No ERP costs expected for driving within the town to the NHBTC location as ERP charges are usually for inter-town expressway use.

Appendix C: Explanatory variables in the model

Attributes	Types
Age_18_24	1 if employee is between 18-24 years old
Age_25_34	1 if employee is between 25-34 years old
Age_35_44	1 if employee is between 35-44 years old
Age_45_54	1 if employee is between 45-54 years old
Age_55_more	1 if employee is 55 years or older
Degree	1 if employee has a degree (i.e., bachelor's or higher)
DrivLic	1 if employee has a driving licence
Flat	1 if employee lives in a HDB flat
HasCar	1 if employee's household has a car
HasChild	1 if employee has children 17 years or younger
HomeOffice	1 if employee has a private workspace at home
Income_2000_4000	1 if employee earns between S$2,001 and S$4,000 monthly
Income_4000_6000	1 if employee earns between S$4,001 and S$6,000 monthly
Income_6000_less	1 if employee earns S$6,000 or less monthly
Income_6000_8000	1 if employee earns between S$6,001 and S$8,000 monthly
Income_8000_10000	1 if employee earns between S$8,001 and S$10,000 monthly
Income_10000_more	1 if employee earns S$10,001 or more monthly
Male	1 if employee is male
Manager	1 if employee is in a managerial role at work
Married	1 if employee is married
nAdults	Number of household members aged 18 or older ($\mu = 3.39$, SD = 1.23)
nChild	Number of household members aged 17 or younger ($\mu = 0.50$, SD = 0.77)
Changes to telecommuting preference after life events	
RWPref_D	1 if employee now prefers to telecommute less
RWPref_A	1 if employee now prefers to telecommute more
Changes to telecommuting experience after life events	
RWExp_D	1 if employee now has worse telecommuting experience
RWExp_A	1 if employee now has better telecommuting experience
Trust by work supervisors: 'My supervisors trust me to do my work.'	
Trust_D	1 if employee strongly disagrees or disagrees to statement
Trust_A	1 if employee strongly agrees or agrees to statement

(Table continues on the next page)

Attributes	Types
Job satisfaction: 'I am satisfied with my job.'	
Satis_D	1 if employee strongly disagrees or disagrees to statement
Satis_A	1 if employee strongly agrees or agrees to statement
Post-COVID 19 work location choice flexibility: 'Since COVID-19, my employer has become more flexible about where I work.'	
COVID_D	1 if employee strongly disagrees or disagrees to statement
COVID_A	1 if employee strongly agrees or agrees to statement

Appendix D: Initial OLR model results

		Model 1: **Short-term**		*Model 2:* **Midterm**	
Life event		**η**	**SE**	**η**	**SE**
Began living in the same house as your partner	*StartCohabit*	-0.545	0.435	-0.474	0.458
Stopped living in the same house as your partner	*StopCohabit*	1.068	0.690	0.746	0.648
Decreased number of adults (18 years or older) in your household	*DecrAdults*	-0.520	0.536	-0.874	0.540
Increased number of adults (18 years or older) in your household	*IncrAdults*	-0.192	0.386	-0.428	0.399
Children started a new stage of their education	*NewChildEdu*	0.088	0.452	-0.577	0.462
Changed jobs	*ChangeJob*	0.454	0.305	0.072	0.310
Started a job from having no job	*NewJob*	**0.710****	0.345	0.499	0.341
Decreased number of mandatory work hours	*DecrWorkHours*	0.298	0.48	0.152	0.476
Increased number of mandatory work hours	*IncrWorkHours*	**1.598*****	0.455	**1.004*****	0.429
Changed residence to one that is closer to your company's office	*MoveNearer*	-0.474	0.418	**-0.999****	0.415
Changed residence to one that is further from your company's office	*MoveFurther*	**1.555*****	0.411	**1.029****	0.409
Received your driving licence	*NewDrivLic*	0.174	0.495	-0.198	0.503
Decreased number of cars owned by your household	*DecrOwnCar*	0.278	0.561	0.211	0.595
Increased number of cars owned by your household	*IncrOwnCar*	**-1.528*****	0.501	**-1.821*****	0.507
Gave birth to or parented a child	*NewChild*	**1.598*****	0.408	**0.722***	0.387

(Table continues on the next page)

	Model 1: **Short-term**		*Model 2:* **Midterm**	
Intercepts	**β**	**SE**	**β**	**SE**
much less preferred | slightly less preferred	-2.299	0.465	-3.416	0.523
slightly less preferred | no change	-0.920	0.406	-1.809	0.431
no change | slightly more preferred	0.203	0.396	-0.063	0.412
slightly more preferred | much more preferred	2.243	0.428	2.030	0.441
Model performance				
Log-likelihood (zero coefficients)	-320.87		-310.78	
Log-likelihood (final)	-286.59		-282.08	
Residual deviance	573.17		564.16	
Akaike Information Criteria (AIC)	611.17		602.16	
Pseudo-R^2 of Nagelkerke	0.284		0.245	

Note: * p-value < 0.1, ** p-value < 0.05, *** p-value < 0.01; SE = standard error

		Model 1: **Short-term**	*Model 2:* **Midterm**
Life event		**Odds ratio (OR)**	**Odds ratio (OR)**
Began living in the same house as your partner	*StartCohabit*	0.580	0.623
Stopped living in the same house as your partner	*StopCohabit*	2.909	2.108
Decreased number of adults (18 years or older) in your household	*DecrAdults*	0.595	0.417
Increased number of adults (18 years or older) in your household	*IncrAdults*	0.825	0.652
Children started a new stage of their education	*NewChildEdu*	1.092	0.561
Changed jobs	*ChangeJob*	1.574	1.074
Started a job from having no job	*NewJob*	**2.035**	1.648
Decreased number of mandatory work hours	*DecrWorkHours*	1.348	1.164
Increased number of mandatory work hours	*IncrWorkHours*	**4.945**	**2.729**
Changed residence to one that is closer to your company's office	*MoveNearer*	0.623	**0.368**
Changed residence to one that is further from your company's office	*MoveFurther*	**4.736**	**2.797**
Received your driving licence	*NewDrivLic*	1.190	0.820
Decreased number of cars owned by your household	*DecrOwnCar*	1.320	1.235
Increased number of cars owned by your household	*IncrOwnCar*	**0.217**	**0.162**
Gave birth to or parented a child	*NewChild*	**4.943**	**2.058**

Note: Events with significant coefficients at 90% confidence level or higher in the OLR have their OR values in bold.