ASSESSING THE IMPACTS OF OFFICE RELOCATION ON TRAVEL BEHAVIOR AND THE ORGANIZATION OF ACTIVITIES WITHIN HOUSEHOLDS

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ABSTRACT

The aim of this paper is to study the effects of office relocation on travel behavior and household organization of employees and their household members. In general, office relocation can have various short and long term impacts and may influence decisions relating to mode choice and task sharing within the household. Most of these impacts usually happen over time during an adaptation process. Against this background a new methodological approach was designed to capture these impacts of the relocation. This approach proposes two survey waves to analyze the entire adaptation process, whereby the first wave also contains a retrospective section to capture travel behavior and household organization before the relocation. Thus altogether three successive time periods can be recorded by means of only two survey waves.

A case study from Karlsruhe, Germany using this approach shows a significant change in travel behavior when an institution is relocated from a suburban site to the inner city. The relocation results in a modal shift in travel behavior from the car to bicycle and public transportation caused by poor parking facilities and shorter commuting trips in average. The findings illustrate significant adaptations within two years after the move. Employees change their mode of choice on the commuting trips and are able to further support the household members, e.g. by making smaller purchases during their commuting trips. Based on the results it is recommendable to analyze relocations not only in terms of employees' behavior but considering impacts on household organization and household member during the entire adaptation process as well.

INTRODUCTION

Office relocation in Germany is a common instrument used to optimize processes and reduce costs. Companies of various sizes are affected by office relocations and their reasons for relocating workplaces vary. In Germany, relocations to countries abroad are less common than relocations within the country – nearly 72% of all office relocations take place on the national territory (*1*). In case the new location is close to the old company site, most of the employees remain with the company. As a consequence, an important destination in the employees' daily life changes. This affects different areas of life – such as travel behavior on commuting trips, as well as leisure and shopping activities. It is likely that changing the workplace location affects the employees' mode choice for the commuting trips. Beyond this, the office relocation may have impacts on the household organization and may influence the travel behavior of the other members of a multi-person household. Household members have to make arrangements, e.g. who can use the car and when shared activities take place.

Office relocations also affect employees' travel routines. Especially for commuting to work, employees develop routines (*2*) in order to simplify the complexity of daily life. They refer to well-known decisions and habits in the event of daily trips such as commuting. Verplanken and Wood (*3*) show that when it comes to their routines, people have a biased perception of information on alternative means of transportation. This means that they do search and process new information and options, but to a lesser extent. This results in unreflected decisions and a stable behavior which lacks an assessment of alternatives (e.g. using the car on the commuting trip, even if an ecologically and economically sensible alternative exists). Workplace relocations can be a chance to break those routines as they make it necessary to consider alternatives. Indeed Verplanken and Wood (*3*) report an adaptation in modal choice in the case of a discontinuity in daily life. As individuals have to adapt to a new situation and choose an alternative, the chance to make a reflected and conscious decision emerges, also with regards to their travel behavior.

In consequence, office relocations start a process of adaptations which include many different processes nearly at the same time. In order to analyze these adaption processes we analyzed an office relocation in Karlsruhe, Germany. This paper is focused on the methodology as well as on the findings of this office relocation in Karlsruhe and is organized as follows.

In the following section, we conduct a literature overview and analyze existing research about office relocation. Subsequently, we show the methodology and introduce the case study, of which we then present the results. Finally, we evaluate our methodology and point out recommendations for future research in regards to office relocations.

LITERATURE REVIEW

This section gives a short overview of research on office relocation, showing some significant findings and summarizing the survey methods of these studies. Only a few publications are

available dealing with office relocation and their impacts on travel behavior. The existing literature mainly describes impacts on travel behavior of employees (*1; 4–6; 8; 7; 12; 9–11*). The majority of studies deal with workplace relocations from the inner city to suburban areas. These studies report an increase in car usage – also benefiting from a good parking situation and poor access to public transportation at the suburban site (*4–6; 10*). Consequently, travel time of employees increases. Bell (*4*) observes a lower increase in car use for commuting if the new site has sufficient access to public transport or when a considerable part of employees already lives closer to the new location. Only two studies from Singapore state that office relocation to suburban areas did not cause any significant increase in car usage (*8; 7*); these outcomes should however be considered in the light of the restrictive policies against privately owned cars in Singapore. Overall, office relocations from inner city to suburbs, with the exception of Singapore, induced an increase in the share of car use of the modal split. An opposite effect is caused by relocation within the suburban area from a location with poor access to public transportation to a location with a good supply of public transportation. In this case a substantial decrease in car usage is observed (*11*). Office relocation from the suburbs to the inner city has not yet been studied to a large extent. In the context of a study in Trondheim, Norway Meland (*12*) describes a shift from car use to public transportation. The changes were mainly due to poor parking facilities at the new location.

The methods of the above mentioned studies differ. Most of the studies analyze only the travel behavior of employees concerning mode choice, travel time and travel distance by using a self-completion questionnaire (*13; 9; 10*). Other surveys also observe activities (e.g. shopping or sports) using a travel diary for one day (*4; 6*). Overall, surveys usually only investigate effects on employees. Effects on travel behavior of other household members or on the household organization in multi-person households were not considered.

We also analyzed the studies as to the timing of the surveys and if they capture the adaptation processes caused by the workplace relocation. Only few studies investigate the relocation ‘before’ and ‘after’ (*4; 6; 11*). Walker (*11*) has conducted two waves after the relocation. One wave has been carried out after the move and another one four weeks later. This allows for an observation of short term processes of adaptation. Vale (*10*) has chosen an efficient survey method after the move. The ‘after’ survey included a retrospective section, in which employees report their travel behavior on the old location. As the former routinized behavior is mostly well remembered, such a retrospective approach can be regarded as appropriate.

However, there are no research studies which investigate the process of adaptation as a whole, because the last survey wave was generally conducted four weeks after the relocation at the latest. Lally et al. (*14*) mentions that adaptation of behavior takes between 18 and 254 days – depending on the individual. This emphasizes the need for another survey wave after a longer time period at the new location in order to capture the adaptations. In conclusion, two survey waves are required to observe the entire process: one survey wave immediately after the relocation and a second survey approximately two years later.

METHODOLOGICAL APPROACH

The aim of this paper is to study the process of adaptation of employees and their partners in multi-person households in the case of an office relocation from the suburban site to 'downtown'. In order to analyze those processes, we designed a new survey approach, which embraces a total period of three years including the behavior 'before' and 'after' the relocation within the adaptation process. The approach consists of two survey waves with a self-completion questionnaire and a personal interview. The self-completion questionnaire contains information about basic socio-demographic criteria (age, gender, household size, approximate location of home and mobility tools). The personal interview records the travel behavior of employees as well as the travel behavior of partners in multi-person households since a dependency between the household members has to be presumed. We designed the interview to investigate the 'typical' travel behavior of employees and their partners (i.e. most frequently used modes for commuting trips) to reduce overall variance of the findings. This leads to only the interpersonal variance being in the focus. Furthermore, the interview consists of questions about the level of satisfaction concerning travel behavior, especially commuting behavior.

Both waves are carried out 'after' the relocation to the new site took place, whereby the first wave takes place immediately after the relocation. Within the first survey the personal interview is split into two survey parts examining two different time periods. One part is a retrospective query of travel behavior and household organization regarding the situation before the relocation. The other part of the interview is about their current situation. This approach enables a direct comparison of the travel behavior 'before' and 'after' relocation within the first interview. With this approach, short term changes in the travel behavior can be discussed with the interviewees.

The second survey wave is conducted approximately two years after the relocation (i.e. the process of adaptation is almost completed) and has a similar structure as the first survey. However, findings of the first survey and interview experiences were used to optimize the second wave's contents. The second survey focuses on the analysis of adaptation to the new location. With this approach we are able to analyze both short term adaptation and long term effects. The approach also ensures efficiency, because the test persons have to participate only twice to cover three different periods of time.

CASE STUDY

In order to test our new methodology, we analyzed the effects of a workplace relocation of a research institute based in Karlsruhe, Germany. In March 2012, the Institute for Technology Assessment and Systems Analysis (ITAS) of the Karlsruhe Institute of Technology (KIT) moved from a peripheral location in the north of Karlsruhe to the inner city (FIGURE 1). The old location had 'unlimited' and free of costs parking facilities as well as fair bus services (service approximately every twenty minutes) connecting with the rail services of surrounding railway stations. At the new location (approximately 10 kilometers away) there is an easy access to the

entire public transport system (mainly by rail), with radial routes serving the city and the surrounding suburban areas of Karlsruhe. On the other hand neither sufficient nor free of charge parking space exists. The relocation has thus resulted in significant differences in travel options and parking possibilities.

In the first survey wave n=53 employees participated, representing about 48% of the institute's staff. The first survey wave was completed between July and November 2012. Between January and March 2015 the survey was repeated at the new location. In the repeated survey n=39 employees participated. For those persons who participated in both survey waves – conducted in the form of a panel approach – it is possible to observe short and long term adaptation processes. Participants of only the first survey can be monitored regarding short term changes in the travel behavior directly after the relocation.

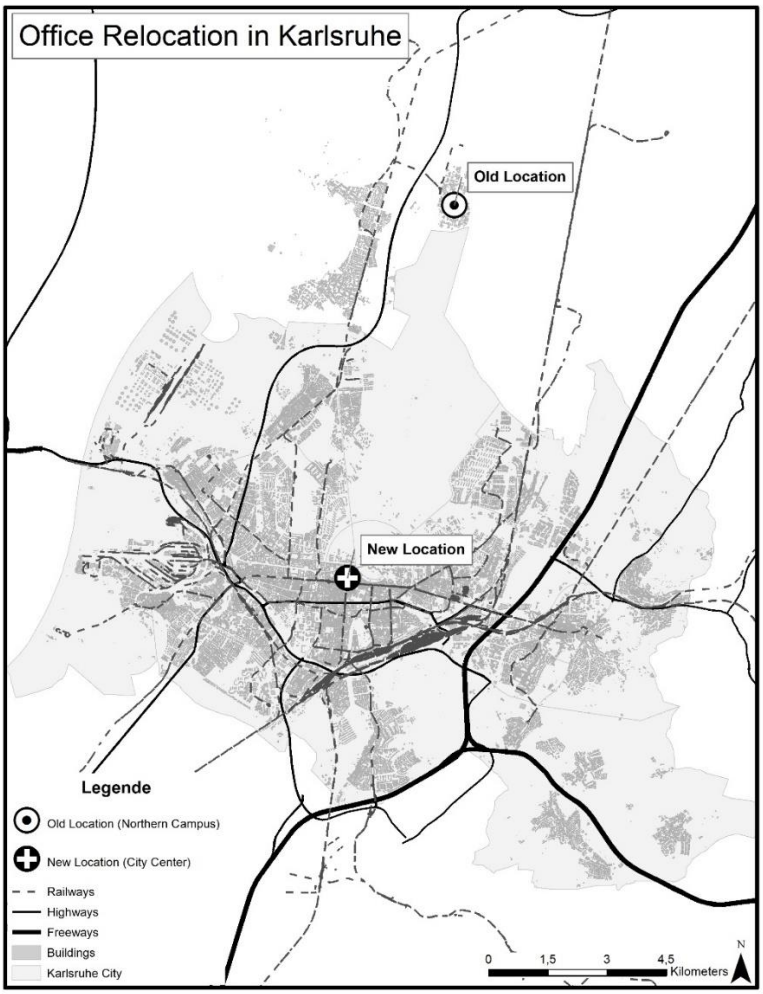


FIGURE 1 Office Relocation from the suburb to the inner city in Karlsruhe.

RESULTS

We split our analyses into two parts according to the two waves. First, we show results of short term adaptions derived from the first survey. This is followed by results of people who participated in both surveys.

Short term adaptations as a result of a workplace relocation

In the first wave of the survey, 22 female and 31 male employees participated. The first sample consists of 9 one-person households, 21 two-person households and 23 households with more than two household members. The geographical dispersion of the employees' home locations is also an important aspect: before the relocation more than 50% of the participants lived in the inner city of Karlsruhe. Another approximately 25% of the participants had their residential location in the north of Karlsruhe i.e. nearby the former location.

Average travel time before the relocation was 39 minutes, dropping to 36 minutes after the relocation. Average distance decreased from 29.82 kilometers to 26.93 kilometers. TABLE 2 shows the short term changes in travel time and distance after the office relocation.

TABLE 1 shows that the majority of the employees have a shorter travel time after the institute moved to the inner city. About half (47.2%) of the participants are positively affected concerning their commuting time whereas 37.7% of the employees had to accept an increased commuting time. Of these, only four persons have an increase of their travel time of more than 30 minutes.

TABLE 1 Short term shifts in the commuting time of employees

		Travel time after the relocation					
		0 - 10 min	11 - 20 min	21 - 30 min	31 - 40 min	> 40 min	**Total**
Travel time before the relocation	0 -10 min	1	0	1	0	1	3
	11 - 20 min	0	1	4	1	3	9
	21 - 30 min	3	4	2	3	2	14
	31 - 40 min	6	3	2	0	5	16
	> 40 min	2	2	1	2	4	11
	Total	12	10	10	6	15	**53**

*Numbers given in the table are the quantity of employees

For this methodological approach we asked only the 'typical' travel behavior of employees and partners (i.e. most frequently used modes on commuting trips or shopping trips in 'typical' weeks) to reduce overall variance of the results.

TABLE 2 Statistical analysis of the changes of travel time, travel distance and modal split

	before relocation	after relocation	after two years
travel time in minutes			
n=53			
Average	39	36	-
Median	32	30	-
Standard deviation	35	33	-
n=39			
Average	41	37	41
Median	33	30	33
Standard deviation	38	33	33
travel distance in kilometers			
n=53			
Average	29.82	26.93	-
Median	14.80	8.80	-
Standard deviation	53.28	57.09	-
n=39			
Average	28.46	24.90	27.29
Median	14.80	8.30	12.20
Standard deviation	45.10	49.05	48.92
modal split - most frequently used mode (in %)			
n=53			
Car	39.62	9.43	-
Bicycle	39.62	50.94	-
Public Transportation	33.96	35.85	-
Walk	1.89	3.77	-
n=39			
Car	48.72	7.69	7.69
Bicycle	28.21	51.28	41.03
Public Transportation	20.51	35.90	46.15
Walk	2.56	5.13	5.13
weighted modal split (in %)			
n=53			
Car	48.23	5.16	-
Bicycle	46.61	84.11	-
Public Transportation	5.02	10.16	-
Walk	0.13	0.58	-
n=39			
Car	71.81	3.47	4.63
Bicycle	22.90	85.34	73.52
Public Transportation	5.07	10.24	20.36
Walk	0.23	0.95	1.49

The relocation led to considerable changes in mode choice. TABLE 2 shows the commuting travel mode choice of the participants before and after the relocation as well as for the situation after the long term adaptation period. With a focus on the weighted mode choice car usage dropped from 48% to 5% at the new location. In this case 'weighted' means that the employees were asked which modes are used for their commuting trips. The participants also reported on alternative modes and how frequently they use them (intrapersonal variation). This results in a 'weighted' modal split which includes the variation. The use of bicycle was already high at the old location considering that the location was outside of Karlsruhe. However, bicycle use increased further from 47% to 84% in the short term adaptation period.

An adaptation of behavior in multi-person households can also be noted. In seven households the partners of the employees started using a different mode for their commuting trips after the relocation. In two cases participants reported a direct dependency regarding their commuting trips and the use of cars, because these households possess only one car which the household members alternately used 'before' and which becomes available for the partner more frequently 'after' the relocation.

Changes in mode choice on the individual level are shown in TABLE 3. Since the institute moved to the inner city only a few employees continue to use the car for commuting. Overall, 17% of the participants switched from car to bicycle and 13.2% from car to public transportation as most frequently used mode. 28.3% of the participants have not changed their bicycle usage after the relocation. The reasons for the shift in mode choice are the poorer parking conditions and the better accessibility with other means (i.e. bicycle and public transportation).

At the same time, the employees' contentedness concerning their travel behavior improved after the relocation. The proportion of the participants claiming to be generally satisfied with the travel behavior increased from 60.4% to 84.9%. More than 75% of the participants who changed from car to bicycle evaluate the change positively.

TABLE 3 Short term shift in mode choice on the commuting trips

		Main transport mean after the relocation				
		Car	Bicycle	Public Transport	By foot	**Total**
Main transport mean before the relocation	Car	5	9	7	0	21
	Bicycle	2	15	4	0	21
	Public Transportation	0	1	7	2	10
	Walk	0	1	0	0	1
	Total	7	26	18	2	**53**

*Numbers given in the table are the quantity of employees

Long term adaptations of the workplace relocation

A further aspect of our analyses focuses on the second survey and the investigation of long term adaptations due to the relocation. This survey was carried out two years after relocation with n=39 participants who also participated in the first survey.

It is necessary to mention that two employees from the first survey changed their job since they could not handle the change in their commute. The workplace relocation had a strong negative effect on their household organization. Already in the first interview both employees had indicated that they were likely to change their jobs due to negative impacts in their commute. Both employees belonged to the group who lived near the old location and had arranged their whole life (house, friends, kind and places of leisure activities) around the location of their workplace.

In the following, only the sample of those persons participating in both surveys is considered, in order to observe the process of adaptation. The time period between the first and the second survey wave is long enough to give a robust assessment of the process of adaptation. Lally et al. (*14*) found that individuals need a duration of no longer than 254 days to strengthen their behavior. The duration of this process depends on the individual. Using both surveys long term adaptations can be investigated such as car ownership, travel behavior or household organization. In his study – a relocation from the inner city to the suburb – Bell (*4*) reported an increase in the car ownership of employees. In our study an opposite development would seem an obvious assumption. Nevertheless, the findings also show an increase in car ownership, even though car usage dropped after the relocation.

As we examined only the sample of persons who participated in both survey waves, it is also possible to identify shifts in the modal use after long term adaptation processes. After two years the bicycle usage drops from 51% to 41% (TABLE 2). Altogether this means that the employees have gone through a kind of learning process e.g. in terms of mode choice, various routes and different weather conditions and seasons and successively adapted their travel behavior. This results in a well-tested, successively adjusted and optimized modal behavior.

Furthermore, travel distance changes between the three periods. Within the sample of 39 participants, travel distance increased from 24.9 to 27.29 kilometers within the two years after relocation to the inner city. Adaptations in travel distance are shown in FIGURE 2. Before the relocation none of the employees lived within a five kilometer radius from the old site. The main part lived within a range of 10 – 20 kilometers from the old location (i.e. they lived in the city of Karlsruhe). At the new location the number of employees living within a radius of less than 5 kilometers increased to over ten persons (i.e. approximately 25 %). After two years the number of employees living in this radius decreased slightly. The employees were asked whether or not the change of their residential location was linked to the workplace relocation, which all employees denied. However, the geographical dispersion shows an indirect relation between workplace and home location. Before the relocation most of the employees lived in the inner city or in the north of Karlsruhe. The number of employees with residencies in the south of Karlsruhe was low. Due to the workplace relocation to the inner city residential locations in the south became more

interesting for employees than in the past. An advantage of city center locations of a workplace is that more urban (or even suburban) districts are suitable for the employees due to reasonable travel distances and options to their workplace: Considerably more radial routes and options with nearly the same travel distance exist at a location in the center of a city. In addition, the more centrally located workplace also offered a considerable increase of available housing options. These factors, in the case of our study, led to an increased propensity to live in the south.

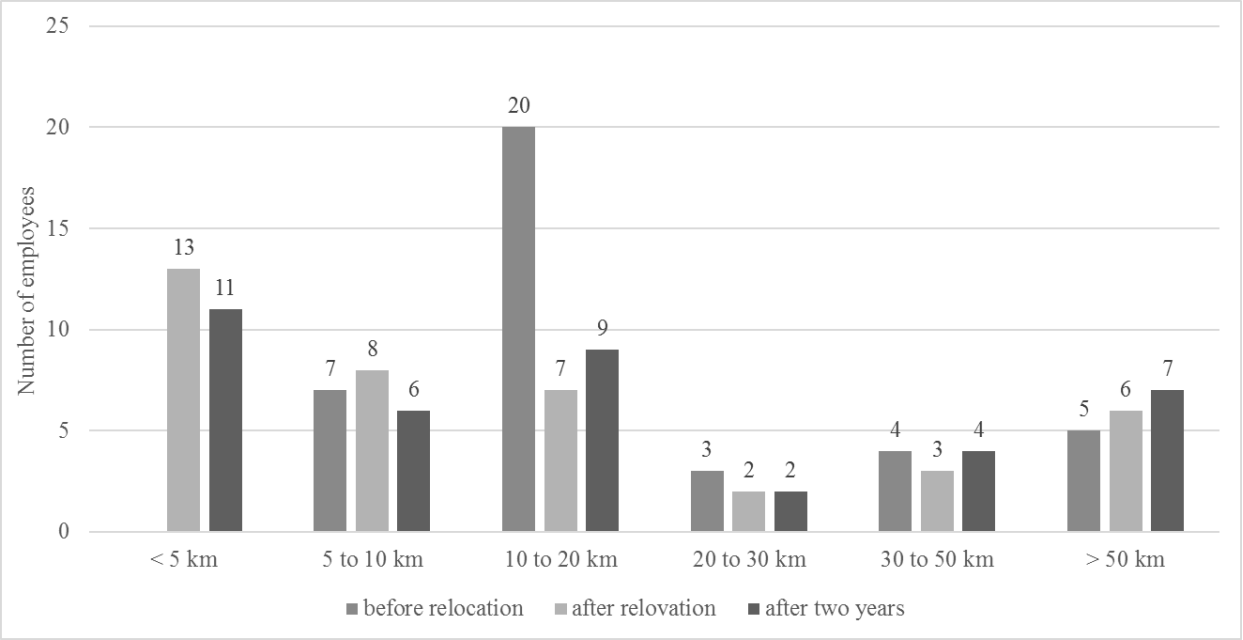
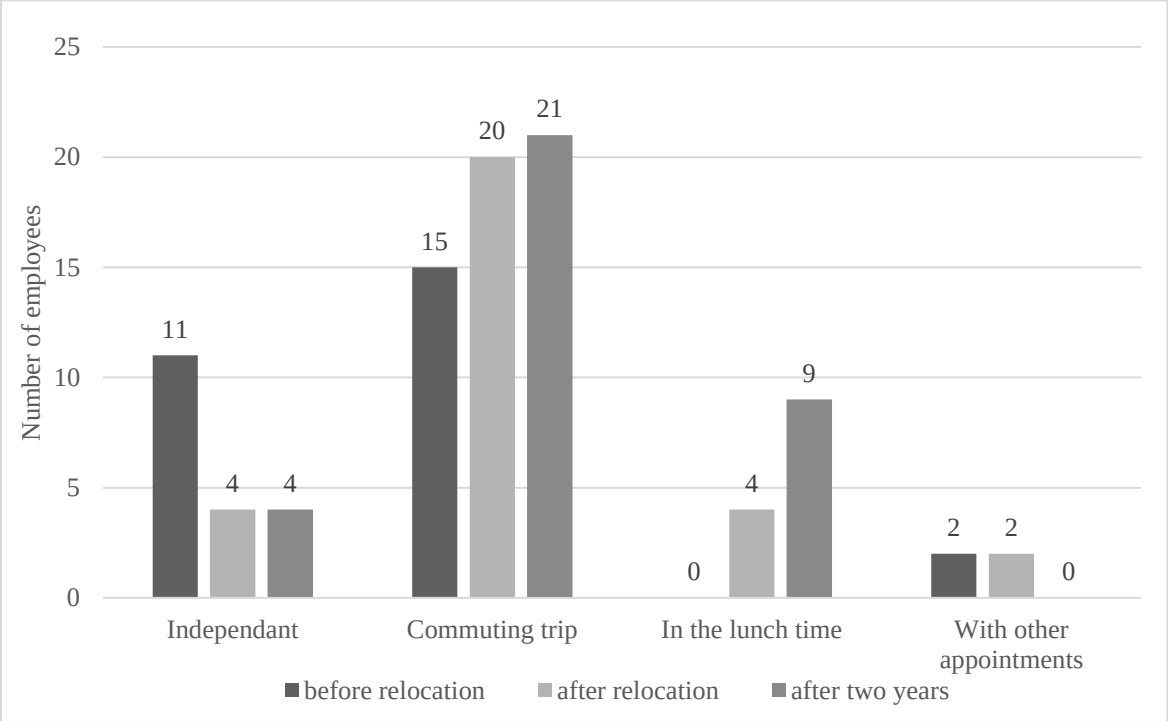
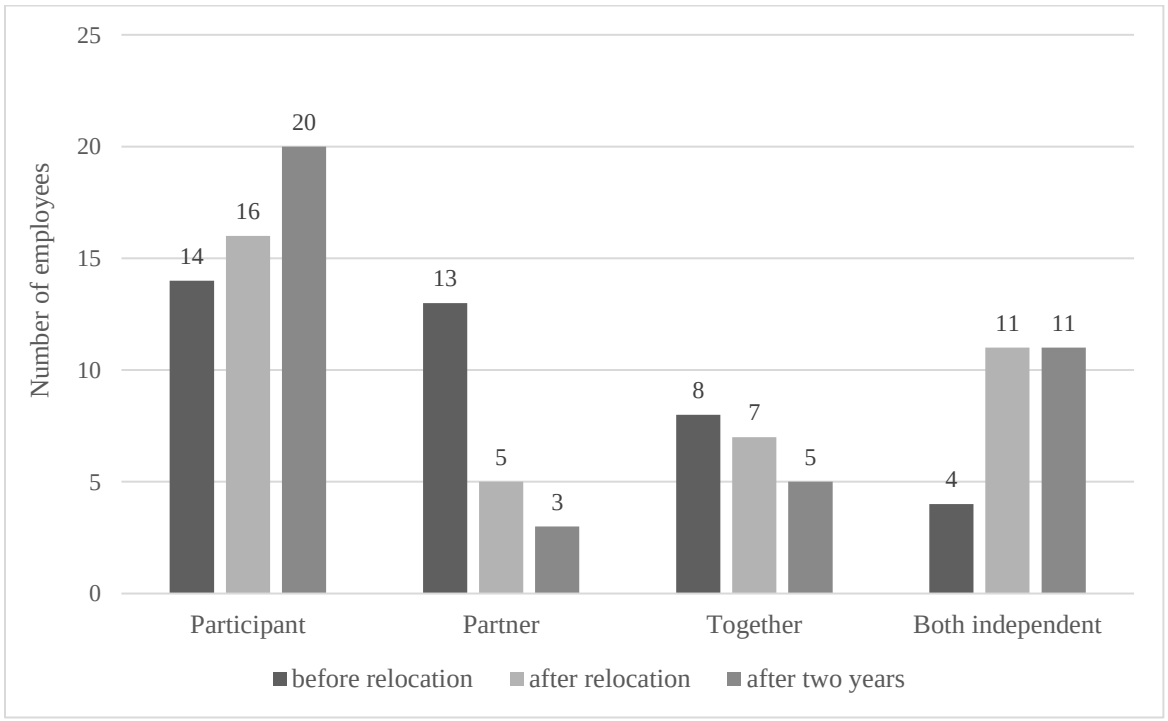


FIGURE 2 Distribution of travel distances.

We also analyzed the adaptations in multi-person households, an aspect which was neglected in previous studies. An important issue with regards to a households' task sharing are shopping activities. We distinguished between small and bulk purchases. For bulk purchases – which are however comparably rare – people usually use their car. In contrast, smaller shopping activities (e.g. bakery, newspaper kiosk, drugstore) happen more frequently, but need to be coordinated within the household as well. Before relocation, more employees organized these 'small' purchase activities with an extra trip from home, as such kind of shops were not available neither around the old location, nor on the commute route back home. Moreover, it was also impossible to make such smaller purchases during the lunch break. After the relocation more employees do their shopping on commuting trips or during lunch time (FIGURE 3a). Altogether this means a relief of other household members in terms of the need to carry out trips for smaller purchases. FIGURE 3a also shows an adaptation process since the number of employees, who do their shopping on commuting trips or during lunch time, increased within the period between both surveys. This means employees have learned to make use of the amenities and characteristics of the new location with its many options in terms of shopping or even leisure activities.



a) Combination of shopping trips with other trips.



b) Responsibility for smaller purchases in multi-person households.

FIGURE 3 Changes in the behavior for shopping activities (smaller purchases) after the relocation.

The possibility of increased shopping opportunities at the new location goes hand in hand with a shift in the responsibility for smaller purchases from the partners to the employees. Before the relocation, only 14 employees were responsible for smaller purchases in the households. After the relocation the number increases from 16 to 20 persons over the period of the adaptation process. At the same time the number of responsible partners dropped from 13 to 3. FIGURE 3b illustrates this adaptation. Another effect is that less couples do their smaller purchases together. In the case of bulk purchases an opposite effect is visible. Since more people use alternative modes than cars for commuting, a connection of these trips with bulk purchases is no longer possible due to limited transport capacities. This results in a growing number of independent trips for shopping.

An adaptation in the mode choice for purchases can also be observed within the survey. Especially for smaller purchases the share of the mode 'walk' increased during the process of adaptation. Before the relocation only 16 participants made their small purchases by foot (TABLE 4). At the new location the number increased to 28 people. The usage of car dropped to 3 persons. The share of bicycle usage regarding smaller purchases aligned to its previous level before the relocation. A reason might be that the use of a bicycle already allowed for flexibility to integrate small shopping activities in the 'before' situation.

TABLE 4 Changes in the mode choice for the shopping activities

	before relocation	**after relocation**	**after two years**
Means of transport (in number of employees)			
smaller purchases			
Car	9	3	3
Bicycle	26	29	26
Public Transportation	3	4	2
Walk	16	23	28
bulk purchases			
Car	26	24	23
Bicycle	8	7	7
Public Transportation	0	0	0
Walk	5	6	7

To evaluate the success of a workplace relocation regarding travel behavior it is important to ask participants about their level of contentedness. The first survey also included a retrospective question about participants' contentedness concerning travel behavior to the old location. Directly after the move 22 participants claimed to be more satisfied than before while 8 were less satisfied. After the process of adaptation there was a little shift. 7 participants were less satisfied than immediately after the relocation. This decline may be caused by the shift in the residential relocation of some of the employees between both survey waves. Last but not least, for two employees the changes in daily life caused by the relocation were too difficult to handle. Their dissatisfaction with the new commute caused them to change their workplace. Overall, most of the participants were rather satisfied with their commuting situation after the relocation. This leads to

the conclusion that the new location offers employees more options to organize their commuting trips and make them more independent from the car.

CONCLUSION

We have shown that office relocations affect travel behavior and household organization of employees and their household members as well. The methodological approach with two survey waves within a time period of two years after relocation illustrates changes not only immediately after the relocation but also the adaptations in behavior and the learning process. The instrument records short term and long term changes caused by relocations. In contrast to existing studies on office relocations we ask employees a second time two years after the move in order to capture the entire adaptation process. Furthermore, the approach uses only two survey waves which cover three time periods, by introducing retrospective elements into the survey. We survey only the 'typical' behavior in order to reduce the intrapersonal variance of travel behavior and to omit randomness. Most existing studies use trip diaries to report the travel of one day, which however results in large intrapersonal variance. Our approach results in a reduced overall variance, which is more suitable for the analysis of smaller samples.

Our methodological approach was tested in a case study monitoring the relocation of ITAS. Firstly, the study shows significant changes in mode choice, travel time and travel distance for employees. The relocation from a suburban location to the inner city results in a shift from car to bicycle and public transportation. These changes are caused by the central position of the new location with good accessibility to different modes but poor parking facilities. In addition, a significant number of employees already lived in Karlsruhe before the relocation. The relocation thus gives them an advantage for their travel distance. The study also shows adaptations of the travel behavior of employees' partners. The relocation led to a decrease in average travel time and distance for employees. The study also shows a subsequent adaptation within two years after relocation. For example, bicycle usage declined by approximately 10% after two years. Moreover, average travel time and distance increased slightly. Secondly, the relocation resulted in changes in the contentedness of employees with their commuting trips. After the relocation participants were more satisfied with their commuting situation than before. The findings suggest a positive impact on the subjective perceptions regarding travel behavior. Nevertheless, this does not apply for each single person. Due to changes in their daily life caused by the relocation, two employees decided to change their jobs. Finally, we demonstrate impacts on the household organization of the employees. Adaptations in the organization of smaller purchases relieves partners in multi-person households since employees have good access to different shopping facilities in the inner city and can combine the smaller purchases with commuting. After relocation we also observed a process of adaptation with regards to the responsibility for purchases. The number of employees who are responsible for that kind of purchases increased over time. This caused a shift in the modal split from car to bicycle or walking on the shopping trips for smaller purchases.

In general, the study illustrates the importance of a survey with three survey and analysis periods for the case of relocations. This approach enables the observation of the whole process of adaptation as well as impacts on employees and their households caused by a relocation. Based on the findings of our study it is also recommendable to observe effects on households in future studies. Our study shows that impacts of relocations affect not only employees, but also household members. A further adjustment of the method is pursued. The questionnaire needs to be adapted and sharpened. Furthermore, it is advisable to include questions about attitudes to different modes or to environmental issues. If major reorganizations take place in the event of the relocation, we recommend employers to assist employees in the process by providing information and other amenities. Options may be the use of an in-house mobility management or making refrigerators available for the staff so that employees may benefit from the amenities of the central location with its different shopping opportunities.

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