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THE ROLE OF ICT

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ABSTRACT

A number of studies have examined the adoption of information and communication technology (ICT) and its impacts on personal travel, both at a general level and in the context of a particular kind of activity. While it is not surprising that initial attention has focused on the effects of ICT on travel for mandatory and maintenance activities, discretionary or leisure activities have received relatively little attention from this perspective. This report offers a conceptual exploration of the potential impacts of ICTs on leisure activities and the associated travel.

We start by discussing some ideas about what leisure is and is not. We point out that one reason for the nebulous nature of the concept of leisure is that the boundaries between leisure, mandatory, and maintenance activities are permeable, for three reasons: the multi-attribute nature of a single activity, the sequential interleaving of activity fragments, and the simultaneous conduct of multiple activities (multitasking).

With respect to the relationship of ICT to leisure activities, we discuss four kinds of ways by which ICT can affect leisure activities and travel: the replacement of a traditional activity with an ICT counterpart, the generation of new ICT activities (that displace other activities), the ICT-enabled reallocation of time to other activities, and ICT as a facilitator of leisure activities. We then present 13 dimensions of leisure activities that are especially relevant to the issue of ICT impacts: location (in)dependence, mobility-based v. stationary, time (in)dependence, planning horizon, temporal structure and fragmentation, possible multitasking, solitary v. social activity, active v. passive participation, physical v. mental, equipment/media (in)dependence, informal v. formal arrangements required, motivation, and cost.

The primary impact of ICT on leisure is to expand an individual's choice set; however whether or not the new options will be chosen depends on the attributes of the activity (such as the 13 identified dimensions), as well as those of the individual. The potential transportation impacts when the new options are chosen are ambiguous. A number of directions for further research are identified.

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OUTLINE

1. INTRODUCTION

There is widespread recognition that the growing use of information and communication technology (ICT)[1] can affect the demand for personal travel in a variety of ways. For one thing, because it offers alternative means of conducting various kinds of activities, ICT may substitute for going to a specific location to conduct the activity, and thus eliminate the travel to that location. In some cases, however, ICT-based activities may not directly and consciously replace location-based activities; they may simply be new activities that would not have occurred otherwise. In those cases, there may be no direct impact on travel (although there may often be indirect impacts). In yet other instances, ICT may in fact stimulate the demand for new location-based activities, which generate travel. The literature (e.g., Salomon, 1986; Mokhtarian, 1990) refers to these outcomes as substitution, neutrality, and complementarity, respectively. Another possibility is also identified: modification, in which travel is neither generated nor replaced, but altered in some way as a consequence of ICT. For a specific measure of travel, modifications can sometimes be reclassified as generation or substitution (e.g. a route change prompted by a mobile phone call may not change the number of trips, but may result in greater or lesser distance traveled, which could be viewed as generation or substitution, respectively)[2].

A number of studies have examined the adoption of ICT and its impacts on personal travel at a relatively general, overall level (e.g. Albertson, 1977; Day, 1973; Mokhtarian, 2002; Mokhtarian and Meenakshisundaram, 1999; Selvanathan and Selvanathan, 1994). It is more common, however, to consider the adoption and transportation impacts of ICT in the context of a particular kind of activity. For example, a great deal has been written about the adoption of telecommuting and its impacts on travel (see Mokhtarian, 1998 for one introduction to the empirical literature on this subject). Smaller bodies of work exist with respect to the demand for teleconferencing and its effects on business travel (see, e.g., Bennison, 1988), and the impacts of the burgeoning growth in teleshopping or e-commerce on shopping travel (see, e.g., Gould, 1998; Gould and Golob, 1997; Koppelman, *et al*., 1991; Marker and Goulias, 2000; Mokhtarian, 2004; Salomon and Koppelman, 1988; Tacken, 1990).

Travel behavior researchers (e.g. Reichman, 1976) have traditionally divided trip purposes (and hence activity types) into three categories: subsistence or mandatory (work and work-related), maintenance (shopping, medical, banking, other personal business), and discretionary or leisure (compare the parallel trichotomy of "compelled", "personal", and "free" activities described by Delespaul, *et al*., 2004). It is not surprising that initial attention has focused on the effects of ICT on travel for mandatory and maintenance activities, while discretionary or leisure activities have received relatively little attention from this perspective (Handy and Yantis, 1997 offer one exception). We speculate that there are several reasons for this (also see Meurs and Kalfs, 2000). For one thing, the other two trip purposes have been considered more important to addressing congestion problems (Anable, 2002), given the effect of commuting, for example, on peak-

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[1] In this report we take a broad view of what constitutes ICT, including "old" technologies such as radio, television, telephone, and fax as well as "new" technologies such as laptop computers, mobile phones, and the Internet. We do so not only because both types of technologies can affect activity and travel patterns, but also because the boundaries between old and new (e.g. radio and Internet) are often blurry.

[2] ICT can also affect the demand for travel by affecting the supply, as with various Intelligent Transportation System (ITS) applications. To the extent that ICT facilitates more efficient use of the transportation system, the cost of traveling is reduced and more or longer trips to activities may result. The primary focus of this report is the effects of ICT on the demand for activities and their associated travel, directly. However, indirect effects on demand through improvements in supply can fall under the third category of ICT impacts, discussed in Section 3.1.3.

period congestion and the desire to explore congestion-reducing alternatives. It is possible that in most places planners do not view leisure travel as economically productive (in contrast to work-related travel), and hence it is not factored into decisions about the cost-effectiveness of infrastructure improvements or other policies (even in areas of high tourism, tourism is viewed as part of the economy from a supply-side perspective – e.g. the employment it generates, and the infrastructure required to support visitors from outside the region – but the demand for leisure travel on the part of local residents may be neglected). It is also possible that planners (perhaps implicitly) view discretionary travel as less susceptible to policy intervention. Almost by definition, people tend to have and exercise more flexibility in their leisure activity choices, and since they are already (for the most part) conducting such activities because they want to, not because they have to, they may be less inclined to consider choices that will reduce those activities or the associated travel. The fact that some value-of-time studies show that people have lower monetary valuations of travel time for discretionary trips than for mandatory trips (e.g. Hensher, 1997) is one indication that people are less motivated to reduce their travel in these cases. Finally, the options for leisure activities and travel are simply far more numerous, diverse, and complex than those for the other two types of activities, and thus it is more difficult to measure, model, and predict peoples' behavior in this respect (Potier, 2000).

Yet leisure is by no means an insignificant segment of total activity. In many studies, discretionary purposes account for a third to a half of total personal travel (Anable, 2002; ECMT, 2000; Gˇtz, *et al.*, 2002). There seems to be growth not only in the importance that people place on leisure (e.g., Snir and Harpaz, 2002) and in the amount of time devoted to leisure related activities, but also in their diversity of type (Heinze, 2000) and spatial location (Schlich, *et al.*, 2004). The European Council of Ministers of Transport (ECMT, 2000, p. 182) notes that growth in leisure travel and activities can be attributed to three factors: "rising standards of living, earlier retirement and the trend towards shorter working hours." Thus, it can be expected that to the extent economic prosperity continues to rise worldwide, the demand for discretionary activities and their associated travel will increase.[3]

Given the current and future importance of leisure to humankind, therefore, it is relevant to examine the potential impacts of ICTs on this category of activities and hence on the associated travel. The purpose of this report is to offer a conceptual exploration of those impacts. By analyzing the possible types of impacts of ICT on leisure, and classifying leisure activities according to factors that are relevant to understanding those impacts, we hope to provide a conceptual framework from which future empirical studies can benefit.

The organization of this report is as follows. In the following section, we explore various issues related to the definition and classification of leisure activities. After discussing some ideas about what leisure is and is not, we briefly review several typologies of leisure activities that have previously appeared in the literature. Section 3 constitutes the heart of the report, exploring the relationship of ICT to leisure activities. First, we discuss four kinds of ways by which ICT can

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[3] However, the relationship may be more complex than these trends alone indicate. There is evidence suggesting that reduced work hours over the last few decades, especially in western European countries, have translated into more work on "second jobs" and increasing incomes. This growth in income may facilitate leisure activities of a different nature and on different time scales. For example, the reduction of daily leisure time availability due to second jobs may translate into more distant (and expensive) annual vacations. Thus, increasing incomes do not necessarily translate into more leisure activities. The income effect may be moderated in various ways, both in quantitative and qualitative dimensions.

affect leisure activities, and speculate on the general nature of the concomitant travel impacts of those effects. We then present 13 dimensions to leisure activities that are especially relevant to the issue of ICT impacts. Section 4 offers some concluding remarks, including suggested directions for further research.

2. WHAT IS LEISURE?

At first glance the concept of "leisure" – comprising social, recreational, and entertainment activities – is apparently well-understood. Numerous scholars have noted, however, that defining leisure is not at all as straightforward as might be initially assumed (see, e.g., Howe and Rancourt, 1990). This section first reviews and critiques several definitions of leisure. It then points to one key source of difficulty in defining it – the fact that the boundaries between leisure and other types of activities are not crisp – and discusses three ways in which this is true. One means of further defining an object is to classify the various forms in which it can be manifested, and also in this section we review several classification schemes for leisure activities that have been previously offered.

2.1 Definitions of Leisure

The literature contains a number of definitions of leisure. For example, the 130 Australian adolescents studied by Passmore and French (2001) indicated that freedom of choice and enjoyability were crucial to an activity being considered leisure. Similarly, Tinsley, *et al*. (1993, p. 447) define four necessary characteristics for a leisure experience to occur: "The individual must perceive the activity as (a) freely chosen, (b) intrinsically satisfying, (c) optimally arousing, and (d) requiring a sense of commitment." But clearly at least the latter three characteristics can apply to subsistence and maintenance activities as well as leisure, and even the first character-istic, freedom of choice, can apply to numerous tasks within an individual's job or to certain aspects of maintenance activities. Conversely, it seems rather strict *not* to consider an activity such as accompanying a spouse to a ball game to be leisure if the individual does not entirely freely choose it, or is not fully "committed" to it or "aroused" by it (see, e.g., Kelly, 1978).

Meurs and Kalfs (2000, p. 128) define "leisure time" as "all the time a person does not devote to ensuring their *[sic]* future welfare in a broad sense." They indicate that this definition thus excludes activities associated with generating income, running a household, and maintaining physical well-being. They further define "leisure travel" as "all journeys not specifically made with the purpose of providing for the person's future welfare or even for sustaining a normal life." In other words, "there is no future penalty for not making these journeys." Yet these definitions also seem restrictive. Leisure activities should certainly be considered essential to one's psychological welfare, i.e. welfare "in a broad sense", with a corresponding psychological penalty for their complete neglect. And the exclusion of activities that support physical well-being would eliminate a large category of recreational activities, such as participatory sports or exercise, that would normally be classified as leisure.

Interestingly, although they can be more readily *de*ferred or "compressed" than can subsistence or maintenance activities, leisure activities are seemingly *less* readily *trans*ferred than the other

two types.[4] Work and maintenance activities are considered essential to the individual's physical well-being (although these activities can also make an important contribution to one's psychological well-being). As such, an individual can receive similar *physical* benefits from outsourcing many[5] of the latter two types of activities to other individuals (e.g. by marrying a person who supports the household financially, or by hiring domestic help). In contrast, since the main contribution of leisure activities is to psychological well-being (although recreational activities can also support the physical dimension, as mentioned above), the individual does not benefit by outsourcing leisure to others[6]. Thus, ironically, it is more essential to our well-being that we personally engage in leisure activities than that we personally engage in mandatory or maintenance activities.

One reason for the nebulous nature of the concept of leisure is that the boundaries between leisure, mandatory, and maintenance activities can be quite permeable. This permeability occurs in three different ways – the first conceptually intrinsic to how the individual perceives an activity, the second largely facilitated by ICT, and the third often but not exclusively associated with ICT.

2.1.1 Permeable Boundaries (1): One Activity, Multiple Aspects

The first basis for the permeable boundaries between activity types is that intrinsically, many activities possess characteristics of more than one of the conventional three categories (Gˈtz, *et al*., 2002; Meurs and Kalfs, 2000; Shaw, 1985; Tinsley, *et al*., 1993). This can be for a combination of three different reasons: (1) The same activity may be experienced differently by different people; (2) the same activity may be experienced differently by the same person at different times; and (3) an activity for a single person at a single time may mix aspects of multiple categories.

Examples of the general principle come readily to mind: eating out or even cooking could be considered maintenance activities, but are forms of recreation for many people. The same can be said of gardening and even housework or home repairs and improvements. Child care can be quite entertaining under the right circumstances (Shaw, 1984). Work-related travel and even commuting have some discretionary aspects for many (Mokhtarian *et al.*, 2001; Redmond and Mokhtarian, 2001; Ory, *et al*., 2004). Hochschild (1997) points out that for many people, in contrast to the stereotype of the dog-eat-dog work world from which home is a serene refuge, work (where we interact with mature professionals who value our contributions) is a welcome escape from home (where we interact with needy and demanding family members). Howe and Rancourt (1990, p. 398) note that "[a] generally accepted theme of the psychology of leisure literature is that some people do find personal meaning and do experience freedom and leisure in work."[7] And the recreational/ entertainment qualities of shopping (again, for some people) are

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[4] Anable (2002, p. 181) comments that leisure "represents one of the only journey purposes with essentially universal participation", and Gˈtz (2003) found that there was less variability across lifestyle clusters in the time devoted to leisure activities than in the time spent on non-leisure.

[5] The exceptions are those maintenance activities that must be performed directly on/by the individual herself, such as eating, personal grooming, and medical appointments.

[6] Again, there are exceptions: some leisure activities undertaken out of duty to other people (see discussion below) may occasionally be outsourced, as when we get someone to take our place at a social or entertainment event we really do not wish to attend.

[7] For similar views on the social-psychological fulfillment aspects of work, see Csikszentmihalyi and LeFevre (1989) and Tschan, *et al.* (2004); see Lewis (2003) for a thoughtful and balanced discussion of whether professional

well-recognized (Salomon and Koppelman, 1988; Tauber, 1972)[8]. Even within the leisure category itself, an activity may have multiple characteristics. When one goes to a ball game with friends, is the activity social, or entertainment? The answer probably affects the activity choice process, including the choice set of perceived alternatives: if the primary motivation is social, one may first decide to get together with friends, and then choose an activity around which to organize the gathering, whereas if the primary motivation is entertainment, one may first decide to attend the ball game and then see who else is able to join.

This discussion speaks to the types and degrees of various motivations for undertaking a given activity, which may differ from what the activity "label" itself would stereotypically imply (e.g. work is a necessary evil; leisure is an optional good). Understanding those motivations is important for analyzing the leisure activity engagement decision process, and the role of ICT in that process. For example, Handy and Yantis (1997) hypothesize that the more chore-like the activity (i.e. the less that a mandatory or maintenance activity is viewed as having leisure overtones), the greater the likelihood of in-home substitution for the out-of-home version of that activity.

On the other hand, we are wary of endowing a mandatory or maintenance activity with leisure qualities simply because it can be pleasant. Meurs and Kalfs (2000) consider enjoyment to be an important element of the definition of leisure time, and it is tempting to equate enjoyment with leisure, suggesting that to the extent that mandatory or maintenance activities are enjoyed, they contain elements of leisure. But that may confuse the concepts of "positive utility" and leisure: a job can be enjoyable, stimulating, or fulfilling without being "leisurely"[9]. Conversely, not all leisure activities may be enjoyable: one may visit relatives but be miserable the entire time, or one may go to a gym in order to stay physically fit but consider it "torture". We could say that a given activity constitutes leisure to people for whom it is enjoyable (see, e.g., the brief review of literature on "leisure as a state of mind" in Howe and Rancourt, 1990), whereas to those for whom it is not, it constitutes a form of maintenance – whether physical maintenance in the case of the gym, or social maintenance in the case of visiting family out of duty. But relying on subjective motivations as the basis for classifying the same activity differently for different people is not very practical for the large scale data collection and analysis needed for regional travel and activity modeling (although it may well be appropriate for more exploratory studies of activity and travel behavior, and as we discuss below, it is relevant for understanding activity choices in general and modeling ICT impacts on leisure travel in particular).

2.1.2 Permeable Boundaries (2): Multiple Types of Activities Fragmented and Sequentially Interleaved

Second, the boundaries between activity types are blurry due to what Couclelis (2000) refers to as the increasing fragmentation of activities, generally made possible by ICT. Whereas before, work, shopping, and leisure activities took place more or less in undivided blocks of time at

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knowledge work is "the new leisure". For a divergent perspective, in which "exciting and strenuous" leisure pursuits are chosen in deliberate contrast to "boring and sedentary" jobs, see Kernan and Domzal (2000, p. 97).

[8] It is perhaps not coincidental that all the examples just given involve a location-based version of the activity rather than an ICT-based version. It may well be that the leisure aspects of a mandatory or maintenance activity are stronger in its location-based form, although on-line shopping seems to have a strong leisure component.

[9] For example, a high-stress occupation such as stockbroker may be all of those things (much of the time) without being considered leisurely. On the other hand, the opposite condition, relaxation, cannot be used to define leisure, since many leisure activities such as those involving strenuous physical exercise would not be considered relaxing.

specialized locations, we now see such activities broken into smaller chunks, interspersed with fragments of other activities, and spread across a larger number of locations. For example, we shop from the Internet or play computer games during a break at the office, and work from home in the evenings (perhaps interwoven with family interaction activities). We send and answer e-mail while on vacation, and engage in sightseeing activities while on business trips (e.g., ECMT, 2000 points to the rise in "business tourism")[10]. This increasing fragmentability is also expected to have impacts on activity selection and scheduling, and the associated travel. For example, one may choose to watch a movie on DVD rather than in the theater precisely because the DVD can be stopped and started at will, and therefore woven into other activities at home rather than requiring the commitment of a larger block of time and a separate trip (although the travel involved in acquiring the DVD must still be taken into account, at least until downloading movies on demand becomes more widespread).

2.1.3 Permeable Boundaries (3): Multiple Types of Activities Simultaneously Overlapped (Multitasking)

The third way in which boundaries between activity types are porous is simply due to multitasking, a case in which fragments of multiple activities of different kinds actually overlap[11]. One may watch television (leisure) while doing a routine work task (mandatory) at home in the evening, or while cooking dinner (maintenance). One may phone a friend while traveling home from work, make work-related calls while watching one's child play soccer, or receive a call while eating with family or friends. Here again, the ability to multitask may affect one's choice of activity mode, location, and timing.

2.1.4 Implications

The blurry boundaries between various leisure activities and between leisure and non-leisure activities raise methodological complications. We have previously mentioned the impracticality of classifying the same activity as leisure or maintenance depending on one's motivation for undertaking it or enjoyment of it. Data collection and analysis are also inherently complicated by the presence of fragmentation and multitasking among multiple activity types and subtypes within a short time period.

In sum, we are left with the sense that the more closely the concept of leisure is examined, the more slippery it becomes. Although the considerations discussed above are important, as a pragmatic (if somewhat unsatisfying) solution to the general question of defining leisure we may simply conclude, as US Supreme Court Justice Potter Stewart said about pornography, that we may not know how to define it, but we recognize it when we see it. Of course, empirical studies of leisure will ordinarily need to be more specific than this, and that can be accomplished by

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[10] Whether constantly being "on call" is a *desirable* condition is of course debatable, and probably differently desirable for different people. Our point is simply that it is a *reality* for many people, with real implications for travel.

[11] The boundary between this category and the preceding one is also blurry, technically depending on whether the interspersed activity fragments occur one at a time, or overlap. In practice it can be difficult to make this distinction, depending in part on the time scale at which activities are distinguished. A 10-minute Internet shopping episode at work could be distinguished separately (constituting sequential interleaving) if the time scale were in minutes, but would be considered multitasking (a secondary activity overlapping the primary activity of work) if the time scale were in hours.

narrowing the definition for any particular investigation in ways that will best fit the objectives of that study (Samdahl, 1988).

2.2 Previous Classifications of Leisure Activities

Classification systems related to leisure activities and travel can be found in a number of different contexts, including the literatures related to travel, activity analysis, time use, and leisure. Although there are some interesting taxonomies based on the orientation of the individual toward leisure in general (Snir and Harpaz, 2002); personal values, personality, and lifestyle (Madrigal, 1995; Lanzendorf, 2002); or the purchase of leisure activities (Reid and Crompton, 1993), here we limit the discussion to studies that classify leisure activities themselves, according to various dimensions. At the simplest level, some typologies are based merely on the nature of the activity. For example, for the purposes of avocational counseling for the elderly, Overs, *et al.* (1977) classify activities under sports; nature; art and music; organizations; education, entertainment, and culture; volunteer; games; crafts; collecting. Passmore and French (2001) offer a simple tripartite classification: achievement leisure (playing sports, hobbies, creative and performance arts); social leisure (activities for the purpose of being in the company of others); and time-out leisure (listening to music, watching TV, contemplation).

Another relatively simple classification is based solely on purpose. For example, the 2001 National Household Transportation Survey uses two categories of trip purposes that could be considered "leisure": "social recreation" and "eat meal." The *social recreation* category comprises five subcategories:
- go to gym/exercise/play sports,
- rest or relaxation/vacation,
- visit friends/relatives,
- go out/hang out (entertainment/theater/ sports event/go to bar),
- visit public place (historical site/museum/park/library).

The *eat meal* category comprises two subcategories:
- get/eat meal and
- coffee/ice cream/snacks.

Other typologies involve objective characteristics of the activity itself. For example, in addition to distinguishing social from recreational *purposes*, Meurs and Kalfs (2000) consider the dimensions of :
- *number of overnight stays* (day trips, short stays of 1-3 nights, short holidays of 3-5 nights away, and long holidays of more than 5 nights away);
- *trip length* (short trips of up to two hours, and day journeys of more than two hours);
- *destination location type* (local, regional, national, international); and
- *role of journey* (purely to reach a destination, versus having an intrinsic recreational value);
where the latter dimension of role is subjective rather than objective. Bhat and Lockwood (2003) classify weekend out-of-home social/recreational activities according to whether they are physically active or passive, and whether they constitute travel itself (e.g. jogging, cycling) or take place at a specific out-of-home location.

Several classifications of leisure activities are based primarily or in part on individual values or psychological needs. For example, Holmberg, *et al.* (1990) list 760 leisure activities classified

by combinations of two of the following six interest dimensions: realistic, investigative, artistic, social, enterprising, conventional. Tinsley and Eldredge (1995) developed a taxonomy of leisure activities based on their psychological benefits. Starting with a list of 82 leisure activities and an empirical rating of each leisure activity for eleven different psychological benefits, they used cluster analysis to define 12 classes of leisure activities (Table 1). The psychological basis of these classes is appealing in that it might provide a convenient way of hypothesizing which kinds of leisure activities are more likely to be impacted by ICT and in what ways. For example, agency activities involve physical exertion that is not required for ICT-based activities. Activities fulfilling the "novelty," "belongingness," and "sensual enjoyment" needs also seem unlikely candidates for substitution (the category 1 effect of ICT discussed in Section 3.1 below). For all of these activity classes, however, ICT may play an important role in managing travel and may even generate travel (the category 4 effect). Activities fulfilling other needs, such as cognitive simulation, self-expression, and creativity, do not so clearly necessitate travel to begin with, in which case ICT may provide a new dimension to the participation in these activities (the category 2 effect).

[Table 1 goes about here]

3. RELATIONSHIPS OF ICT TO LEISURE

In this section, we explore the relationships of ICT to leisure activities in depth. First, we discuss four kinds of ways by which ICT can affect leisure activities and travel, followed by 13 dimensions to leisure activities that are especially relevant to the issue of ICT impacts. Although the four types of impacts and the 13 dimensions are presented in separate subsections (3.1 and 3.2, respectively), there is inevitably some forward and backward referencing between the two parts. Table 3 will integrate them by presenting a 13x4 matrix summarizing the role of each dimension with respect to each type of impact.

3.1 Four Types of Impacts of ICT on Leisure

It is possible to identify four types of effects that ICT may have on leisure activities and travel; these are shown in Table 2.[12] All four types have the result of increasing the individual's choice set, which can then be acted upon in several different ways. We discuss each of these types of impacts in turn.

[Table 2 goes about here]

3.1.1 Replacement of Traditional Leisure Activity with ICT-based Counterpart

Most directly, ICT may present an alternative way of conducting a leisure activity, which will be chosen if the net utility of the ICT-based form of the activity exceeds that of the other forms. Clearly, to the extent that ICT-based forms are chosen over location-based forms of an activity, travel is likely to be reduced.

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[12] It is worth noting that this classification can apply to the effects of ICT on all activities, not just leisure, and to any number of technological improvements, not just ICT. For some technologies (e.g., microwave ovens), the time savings-effect (category 3) may dominate the time-stealing effect (category 2), and in some cases the facilitation effect (category 4) may be inconsequential. But for a technology such as the automobile, all four effects are quite relevant.

Mature ICT technologies, like radio and television broadcasts, have been used for leisure purposes for decades, sometimes serving as substitutes for physical attendance at a stadium, theatre, or concert hall. In the 1960s, for example, it was suggested that television would replace theatre movies as people would prefer the home-based alternative. Television watching has significantly increased during the second half of the 20th century, and yet movie theatres have maintained or increased their patronage. This situation provided an early warning that ICTs' impacts on engagement in activities and travel may not be simply that of substitution, and clearly, there are many indications that complementarity is a viable option. This is all the more true as ongoing cost reductions and miniaturization increase the number and portability of leisure-related technologies (consider the progression from the Sony Walkman, to portable CD players, to multifunctional mobile phones).

As has been suggested elsewhere with respect to ICT-based alternatives to work (Salomon and Salomon, 1983) and shopping (Salomon and Koppelman, 1988), an important reason why substitution does not always occur to the extent expected is that the ICT-based alternatives are often not desirable substitutes to the individual decision-maker at all. To illustrate this point in the context of leisure activities, let us further consider the example of watching a movie. Going to a movie theatre constitutes a totally distinct experience from that of watching the same movie at home, on one of various technologies that enable home viewing. If watching a particular movie were the single attribute of this leisure activity, then the concept of substitution could properly apply. However, screen size, popcorn, chained activities en-route to or from a theatre, seeing people and being seen, sharing an experience with a crowd, and devotion of uninterrupted time (provided cellular telephone calls or other simultaneous demands are eliminated), all make the cinema a different activity than the home-based movie (Handy and Yantis, 1997).

From a transportation perspective, the cardinal question is, to what extent will or can the use of ICT change the behavior of individuals in time and space? To explore this issue, we have mapped the range of several leisure activities on a two dimensional diagram, with time and space ranging from dependence to independence, respectively. Thus, in Figure 1, the lower left quadrant represents "old" activities, both time- and location-dependent, whereas the upper right quadrant represents the activities that are independent of time and location (positions of activities are only approximate).

[Figure 1 goes about here]

Some leisure activities are fixed in space or time, and hence cannot readily be altered by ICT. For example, a Christmas-based family visit is fixed in time, although there may be spatial flexibility. Location-specific outdoor activities, such as hiking in a particular area, are fixed in space[13], although there may be some temporal flexibility. Other leisure activities may not be tied to the intrinsic geography of a place, but to equipment or supplies that are stored there (a hobby like woodworking, falling in the bottom half of the figure, is a case in mind) – these also are less amenable to ICT alteration. Other activities (such as reading a book), falling in the upper right quadrant, are already both location and time independent, which also renders them less likely to be affected by ICT.

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[13] Although this is true in a narrow sense, the ability of ICT to facilitate information-seeking and transactions (discussed further in Section 3.1.4) can broaden the choice set to include a larger class of "similar" locations. For example, instead of limiting one's choice set of "great mountain climbing locations" to the Alps and the Rockies, browsing the Internet may expand it to include the Himalayas, the Andes, the Pamirs, the Karakoram, the Kunlun, and so on. The result is, in a broad sense, greater location independence.

An arrow connects each of the activities in the lower left quadrant to its ICT-based counterpart. Generally, these arrows point in a diagonal direction, right and up, implying greater flexibility in time and space. The arrowhead designates the frontier of the expanded choice set, with possible intermediate combinations in between. Some activities in Figure 1 are shown to have two arrows, indicating different impacts of ICT. Consider the case of attending a baseball or other spectator sports event. One possible ICT application allows one to hear on the radio, or see on TV, the action in real time, while not being there. Another possibility is to see the action in a time-independent mode via a recorded form. The three types of leisure activity, that of "being there", "being there temporally but not physically" and "sharing the activity at a different time and place" constitute very different experiences, as noted by Katz and Dayan (1985).

For substitution to take place, the availability of an ICT-based alternative is a necessary, but not a sufficient condition. We believe that such availability is often not nearly as extensive as some would expect. For example, in a study of one week of activities conducted by each of 398 residents of Toronto, Canada in 2002-03 (comprising about 7,000 activities altogether), Doherty (2003) found that fully 80% of them were reported to have only one location at which they could occur.[14] Temporal flexibility was higher: only about a quarter of the activities fell into the lowest range of a temporal flexibility indicator, while more than half fell into the highest range. Conversely, as noted in the Introduction, many ICT-based activities do not have a location-based counterpart as a practical alternative, but simply would not have occurred otherwise (e.g., listening to a recorded performance on the radio). These types of activities fall into Category 2.

The degree of time- and location-independence of an activity may influence the *choice set*, but does not determine *choice*. A number of studies have investigated factors influencing the adoption of ICT activities such as telecommuting (Mokhtarian and Salomon, 1996), teleconferencing (Button and Maggi, 1994), and teleshopping (Salomon and Koppelman, 1988). In general, adoption is a function of the relative advantages and disadvantages of the ICT-based versus location-based alternatives, taking into account (as mentioned earlier) that the individual may value a number of factors beyond the surface ones. Mokhtarian and Salomon (2002) suggest a generic utility function for evaluating such alternatives, including variables such as the quality of the information obtained and the social/psychological content of the alternative. These variables often favor the location-based form of an activity over its ICT counterpart. Several dimensions relevant to the choice context and the characteristics of the alternatives are presented in Section 3.2 below.

3.1.2 Generation of New ICT Activities

ICTs offer opportunities for many new activities, such as playing games on a mobile phone. If individuals spend more time on ICT-based activities, it stands to reason that they are spending less time on non-ICT-based activities (with the exception noted below).[15] To the extent that the foregone activities involved travel, this effect, like the preceding one, may also reduce travel. Although the displacement may be immediate, as when an individual decides at a particular moment to spend time on an ICT-based activity rather than some other activity, it can also occur over longer periods of time and more subconsciously than consciously. For example, when an

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[14] Perhaps this figure was 95% a few years ago, and will be 70% in a few years. ICTs clearly are releasing some spatio-temporal constraints. Thus, we should not underplay this effect, but we should keep it in proper perspective.

[15] Both the new ICT-based activities and the ones they displace could be non-leisure as well as leisure; for example, the ability to conduct business anytime, anyplace may crowd out leisure time.

individual experiences increased use of the Internet over time, each use specifically replaces another activity: either the non-ICT version of that activity (the kind of substitution described in the previous section), or some other activity altogether (a form of cross-substitution). But most likely that individual finds it more and more difficult to pinpoint exactly what activity has been "crowded out" by Internet use. As a result, the time displacement of other activities by ICT may be better captured by measuring longer-term trends in time use than by analyzing individual choices on particular occasions.

Available data indicate that Internet use and cell phone use have grown rapidly in recent years. Given these increases, two questions arise: to what degree have ICT-based activities crowded out other activities (and to what degree will they do so in the future), and which activities get crowded out (and will in the future)?

The degree to which ICT-based activities crowd out other activities depends on the characteristics of ICT-based activities and the utility they provide relative to other activities. Characteristics that may tend to increase the utility of ICT-based activities include location independence, time independence, and fragmentability (see the dimensions discussed in Section 3.2 and summarized in Table 3). Utility will, of course, also depend on the technology. In general, as the technology improves, the utility of the activity will increase, and the potential for the ICT-based activity to crowd out other activities will increase.

However, the multitasking ability that comes with many ICT-based activities means that increased time devoted to these activities does not necessarily crowd out other activities. For example, when students talk to friends on their cell phones while walking across campus, they do not reduce time devoted to other activities,[16] rather they do more with the time they have. The characteristics of location independence, time independence, and fragmentability also mean that ICT-based activities may get squeezed into the little blocks of time during the day that are too short or too inconvenient for other significant activities. In this case, ICT-based activities displace otherwise wasted time and also enable individuals to do more with the time they have.

Which activities will get displaced by increasing ICT use may vary considerably from individual to individual and from activity to activity. One might expect the activities most likely to be displaced over time to be those that offer rewards and satisfactions similar to those of the ICT-based activities that replace them. One might also hypothesize that the same kinds of activities that are more likely to be *replaced* by ICT versions of those activities, as described in the previous section, are also more likely to be *displaced* by increases in ICT-based activities more generally. But the characteristics of the displaced activity may not play as important a role in this case, given the unconscious nature of the displacement over time. Increased Internet use, for example, could be crowding out all kinds of activities, from doing jigsaw puzzles to attending concerts. Also, as the range of ICT-based activities increases over time, one type of ICT-based activity may crowd out another, as, for example, when Internet use leads to a reduction in TV watching.

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[16] Although it can be argued that they do, in fact, reduce time devoted to previously overlaid activities such as interaction with one's surroundings and undirected contemplation. Different people will value this "lost" time differently.

3.1.3 ICT-enabled Reallocation of Time to Other Activities

The use of ICT may reduce the time and/or cost required to conduct activity X (or the travel associated with X), with the saved time or money used (at least in part) to engage in activity Y. For example, the travel time saved by telecommuting, or by videoconferencing instead of traveling to a meeting, may be spent in part on leisure activities. The money saved by finding a low-cost last-minute airfare on the Internet may be spent on other leisure trips and/or activities. With respect to this category of impacts, relevant questions include: To what extent will time-saving ICT applications be adopted? How much savings will this mean? And how will the savings then be used?

As with the previous two categories, the extent to which time-saving ICT applications will be adopted depends on the characteristics of the ICT-based activities and the utility they provide relative to other activities. To the extent that the use of ICT in this context is a choice between two forms of the same activity (e.g. commuting versus telecommuting to work), considerations similar to those mentioned in Section 3.1.1 specifically for leisure activities apply. As usual, whether or not the ICT-based alternative is chosen depends on the characteristics of each alternative, the decision-maker, and the choice context.

The amount of time or money that is saved by a given ICT activity can depend on individual-specific characteristics (e.g. one's commute time, in the case of telecommuting) as well as on technology (e.g. how effective an online "shopbot" is at identifying cost savings for a desired item). Savings may not always be realized at all (or may be negligible), even in situations where they might be expected. For example, some studies show little or no cost savings achieved by Internet shopping (Brynjolfsson and Smith, 2000; Lal and Sarvary, 1999).

The time or money saved by ICT applications can be applied either to more ICT-based activities, or to non-ICT based activities, and to activities in any of the three basic categories. Thus, time saved by telecommuting might be used to work longer (mandatory), to cook more elaborate meals (maintenance), or to throw a Frisbee with the kids (leisure). The new mix of activities will again depend on individual-, activity- and alternative-specific variables. The effect on travel is ambiguous, depending on whether the new activities involve new travel or not. The evidence for telecommuting in particular is that the net impact is substitution, i.e. that the non-commute travel generation effect appears to be negligible and in any case far outweighed by the commute travel substitution effect (e.g., Mokhtarian, 1998).

3.1.4 ICT as Enabler/Facilitator/Modifier of Leisure Activities

Finally, the availability of ICT can facilitate activity generation and scheduling. For example, mobile phones permit an impulsivity of activity engagement (spontaneous arrangement of meetings; last-minute reservations) that was not previously possible (or at least not easy). By providing readily-available information about an enormous variety of activity and travel opportunities, the Internet facilitates making the arrangements for holiday and business trips, and may offer price bargains that allow more travel[17] to be consumed within a given budget. The result is at least a more flexible activity engagement, and potentially engagement in more out-of-

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[17] Technically, to fall into this category the cost savings should result in choosing a more distant destination for a trip that was planned in any case. If the cost savings for one trip (or other purchase) is applied toward purchasing other trips or goods, it is an example of the third type of impact of ICT, discussed in the immediately preceding subsection.

home activities and/or a greater variety of activities, than before. The impact on travel is likely to be modification in some cases (e.g. en-route diversions in response to a mobile phone call), outright generation in others (organizing a social activity on the fly that would not have occurred without the mobile phone), and (less often, we believe) reduction in others (as when a phone call en route prevents one from driving around lost).

As discussed further in Section 3.2 below, ICTs have a number of characteristics that support their increasing popularity as facilitators: location independence, time independence, fragment-ability, and multitasking ability. Currently, technological factors and cost are still barriers in many circumstances, but these barriers are rapidly being eroded with further technological progress.

3.1.5 Similarities and Differences among the Four Types of Impacts

Figure 2 groups the four types of impacts in such a way as to illustrate similarities and differences among them. We see, for example, that categories 1 and 2 have in common that ICT is in some sense the "end" – the basis of conducting the new activity itself. In category 1 the ICT leisure activity directly *replaces* its traditional counterpart, whereas in category 2 the ICT activity more indirectly *displaces* other activities through a reordering of one's time allocation priorities. In categories 3 and 4, ICT is the "means" – the instrument by which other activities of interest are affected, rather than the affected activity itself. Categories 2 and 3 both involve a reallocation of one's time budget, with cross-activity effects (something about activity(ies) X affect(s) activity(ies) Y). In the case of category 2, ICT (activity X) *takes* time from other activities (Y), whereas in category 3, ICT (X) *gives* time (or money) that can be spent on other activities (Y), whether non-ICT or ICT, leisure or other. Category 4 is a case of activity generation or modification: activity X either would not have occurred at all without ICT (which is viewed in this context as being mainly the ancillary instrument rather than a separate activity[18]), or is materially changed by it[19]. Category 1 is a case of direct or own-activity substitution, in contrast to the cross-activity substitution effects of Categories 2 and 3.

[Figure 2 goes about here]

To fully understand the leisure-related impacts of ICT, it is important to consider all of these types of effects. While it may be tempting to focus on modeling the choice between ICT- and location-based forms of an activity (category 1) because it is relatively straightforward to do so, for example, that may not constitute the largest impact of ICT on leisure travel. In truth, we do not know at this point the magnitudes or even the rank-ordering of the travel impacts of these four types of effects. There is fertile ground for further research.

3.2 ICT and Relevant Dimensions of Leisure

The complexity of leisure activities is reflected in the diversity of dimensions under which leisure, including its ICT-based versions, can be classified and affect choice. A comprehensive classification extends beyond the scope of the current report, but the list of factors having ICT

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[18] Although at the extreme, use of ICT to facilitate other activities may involve so much time that it becomes a case of category 2 as well.

[19] To the extent that this effect results in new activities or in time savings for existing activities, then naturally a cross-activity time reallocation effect results from this category as well. However, such effects are not inevitable for this type of impact (the modification may leave time allocation relatively unchanged).

relevance and those of interest from a spatial behavior perspective is described below. Perhaps the most important dimensions are time and space, but many others warrant the attention of researchers as well. For convenience, in discussing the various interactions between ICT and activities, we refer to changes within the leisure activities category (substitution or complementarity) as *intra-category* interactions while changes between leisure and other categories (work and maintenance) are called *inter-category* interactions.

From the diverse list of dimensions available to classify leisure activities, the following discussion focuses on 13 that seem to us to be the most ICT "sensitive" (Doherty, 2003 uses some of these same dimensions to characterize any type of activity). As a way of organizing the discussion, these dimensions are grouped into five types: location, time, social context, traits intrinsic to the activity, and the benefit/cost tradeoff. Accompanying the description of the 13 dimensions, Table 3 summarizes the relationships between the four types of ICT interactions introduced in Section 3.1, and each of the dimensions. Although some blank cells of Table 3 could be filled in, those relationships seem less likely and/or less important than the ones that are included.

[Table 3 goes about here]

Location: An activity is inseparable from its time and space dimensions. Location and time have long been recognized as the basic attributes of each activity. The introduction of ICT has changed the meaning or the costs of traversing space in time, but has not nullified them! Thus, our first group of dimensions of leisure activities refers to the impacts of ICT on the location of activities.

1. **Location (in)dependence:** A location, in the present context, is not just the geographical coordinates at which the activity takes place. An additional location-relevant attribute includes the type of setting, such as outdoor-indoor or home-other (Lawson, 2001). As discussed earlier in connection with Figure 1, ICT facilitates the engagement in some leisure activities at any location. Listening to a radio program can be done almost anywhere, subject to some coverage limitations. Enjoying the sunny beach while still "communicateable" with a cellular telephone is another example. But there are still a number of constraints acting to limit spatial independence. Many leisure activities require particular types of facilities (an auditorium, a ball field, a beach), and others are focused on a specific geographic location of interest (one's backyard garden, the Alps, the Taj Mahal). Thus, the expansion of the spatial dimension of the choice set is not universally continuous.

2. **Mobility-based vs. stationary:** Leisure activities, as noted above, may be location-specific or independent of place. But a separate dimension refers to the question of whether the activity itself involves movement or is performed at a given location (see, e.g., Mokhtarian and Salomon, 2001 for a conceptual analysis, and Bhat and Lockwood, 2003 for a recent empirical study, that make this distinction). Driving, biking, and hiking as well as flying and boating are all examples of movement that can be leisure-related, at least in part. To the extent that movement is an essential component of the activity, clearly the ability to replace it with an ICT alternative is quite limited. At the margin there may be opportunities, however, such as using virtual reality technology for pilot training or sports training courses (see, e.g., Kernan and Domzal, 2000).

Time, the second fundamental attribute of activities, has two aspects. The first is the timing of activities on the calendar (relating to dimensions 3 and 4), and the second is the duration of the activity (dimensions 5 and 6). ICT may affect both.

3. **Time (in)dependence:** Similar to the case of spatial independence, ICTs relieve a number of temporal constraints, thus allowing much flexibility in the timing of activities. The primary effect of ICT is that it facilitates the disengagement of activities (e.g., theatre, sports events, etc.) from a fixed time constraint. Asynchronous leisure-related communications with others (e.g., e-mailing friends) is another example of the relaxation of coordination constraints. With regard to the temporal dimension, this expansion is, where applicable, generally continuous (from a technological standpoint, although still limited by individuals' other constraints), thus increasing the flexibility of timing activities. However, the qualifier "where applicable" is important: many more sports, cultural, and entertainment events are *not* televised (or otherwise digitally captured for anytime playback) than are. And as noted earlier, even when an ICT alternative *is* available, it may not be a satisfactory substitute.

4. **Planning horizon:** For most people, activities are planned ahead of time and only a few activities result from impulsive behavior.   The planning of activities can be short, medium or long term, where we use "medium" to refer to activities that are planned for some days or months (e.g., going to Antarctica next year), and "long" to mean over a number of years, e.g., a long-term commitment to work. At the other end, the short-term activity planning horizon refers to hours (e.g., going to eat out tonight). ICT is likely to affect leisure activities having each of the various planning horizons. With respect to the short term, ICT facilitates greater time-space flexibility, so planning and engagement in activities can be on impulse, with almost zero planning horizon. At the other extreme, ICT may make it easier for even the most committed workaholic to plan more and/or longer holidays, with the assurance that she can still make the necessary business contacts while away from the office. This may result in an increase in the demand for vacation travel.

5. **Temporal structure and fragmentation:** As discussed in Section 2.1.2, ICT changes not only the timing constraints but also the structure of the blocks of time required for performing certain activities. For example, some home-based alternatives to a movie (VCR and DVD, but not television) allow the fragmentation of the time block devoted to that activity, in contrast to the case of a movie theatre where an uninterrupted block of time must be allocated. (In fact, the last sentence should be qualified, as increasingly interruptions do occur at the theatre, a facility that is presently being invaded by cellular phones. In this case, ICT can be seen as a potentially undesired intrusion on, as well as a facilitator of, leisure).

6. **Possible multitasking:** As mentioned in Section 2.1.3, some leisure activities are amenable to multitasking, both in the intra- and inter-category dimensions. Reading a book or jogging while listening to music are simple examples of intra-leisure multitasking, while watching television and watching the kids simultaneously falls into the inter-category case. In the case of multitasking it is important to note the nature of the relationship between the two or more activities simultaneously undertaken by the individual. In some cases the tasks may be conflicting in the sense that the gratification from one activity is reduced due to the attention consumed by the other. This relationship

seems likely to occur more often in the inter-category interactions. In other cases, the activities may complement each other in gratification. Again, ICT can enable multitasking, but not all multitasking may require ICT. Among the new ICTs, the cellular telephone is especially susceptible to multitasking (both incoming and outgoing calls are frequently placed while doing something else, often traveling), but old ICTs such as TV and radio have also been associated with considerable multitasking.

The Social Context of leisure activities is yet another major attribute that calls for attention. The implications of the dimensions related to the social context may include issues like the need for coordination, the positive or negative utility of spending time with particular individuals, and the extent to which an individual wants to be "on display" in conducting an activity. Again, it is worth emphasizing that the attributes of the activity as defined by the researcher may not necessarily be the same as perceived by the individual.

7. **Solitary vs. social activity:** While some leisure pursuits may be enjoyable only in solitude (e.g., reading a book, contemplating) and others can only be gratifying in a group (e.g., playing soccer), there are a variety of activities in which engagement can be either solitary or social. The category of "other people" can be completely redefined by ICT; i.e. ICTs enable the relaxation of the boundary between the two types of activities. Stand-alone computer-based games, such as chess and many other games, involve a virtual partner or group that is personified by the computer. Alternatively, networked computers facilitate the formation of a group consisting of real people who may be scattered around the globe. But these may differ between a group of people who "meet" repetitively and thus share some level of belongingness, or a random group, typified by a single event interaction. One potential impact of ICT is that some individuals with solitary leanings may now opt for an ICT-based activity that is locally solitary but virtually networked.

8. **Active vs. passive participation:** If "active" and "passive" are opposites as they are commonly taken to be, then a "passive activity" is something of an oxymoron. Taken to an extreme, of course, the only time we are fully passive is when we are dead. We believe it is useful to distinguish, however, the degree of agency or instrumentality of the individual in an activity. Here, therefore, we do not use "active" to refer purely to physical involvement or to movement, but rather to "engagement in an activity (whether physical or mental) in a way that affects the outcome". Thus, playing in a baseball game is clearly active participation, watching it on TV is clearly passive, and watching it a stadium is somewhat less passive, given that the collective reaction of the spectators can encourage or discourage the athletes on the field[20] (with the same distinctions applying to mental activities such as a bridge tournament). There is an interaction between this dimension and the following one: for *physical* activities (consider performance in musical, theatrical, or athletic events), if the individual wishes to be an active participant, ICT is not likely to offer an attractive substitute (although ICT can disseminate the resulting physical activity more broadly), whereas *mental* activities offer more opportunities in this regard (as discussed under dimension 7 above).

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[20] Not to mention the occasions on which a fan has actually directly changed the outcome of a game, e.g. by interfering with a ball that a player could have caught.

Traits Intrinsic to the Activity: Several characteristics of the activity itself are relevant to the potential impacts of ICT, including whether it is predominantly physical or mental (or both, or neither), the technology or equipment required to conduct the activity, and the degree of formality of arrangements required.

9. **Physical vs. predominantly mental:** Leisure activities vary widely with respect to the nature of the activity performed, from strenuous physical activity to predominantly mental activity, or even the lack of either, as in the case of getting tanned on the beach[21]. Mental activities are presumably the most amenable to the ICT substitution effects of category 1 (e.g. playing chess or backgammon either with the computer, or with a remote human opponent over the Internet), and may constitute the bulk of the displacing ICT activities of category 2. However, even physical activities can be (a) crowded out by new ICT-based interests (category 2); (b) newly inserted into one's schedule because of time made available by ICT (e.g., going to the health club during the saved commute time due to telecommuting; category 3), or (c) facilitated by ICT (e.g. using the mobile phone to organize an impromptu tennis game; category 4).

10. **Equipment/media (in)dependence:** Many leisure activities involve the deployment of physical objects of some kind, whether equipment (such as a basketball and hoop, tennis racket and net, camping gear, camera), a vehicle (boat, horse, bicycle, surfboard, recreational vehicle), or other physical media (e.g. cooking ingredients, craft materials, collectibles such as stamps or coins). In some cases, of course, the equipment in question is an ICT. To the extent that physical objects (other than ICT) are required, it is unlikely that a suitable ICT-based substitute (category 1) can be found (although there are limited exceptions relating to physical objects that primarily convey information that can be digitized, as in the potential replacement of physical books with electronic ones, or in the replacement of film and developing equipment with digital photography storage and display media. Even in these cases, however, physical equipment is required, albeit ICT equipment). However (category 4), ICT can certainly facilitate planning such activities (possibly leading to greater participation than would have been the case otherwise, as when one joins a special interest group, finds people of similar interests, and then joins them for an activity), and may augment participation in them with additional information not readily available otherwise (e.g. finding recipes and cooking instructions on the Internet).

    In other cases (e.g. watching a ball game), the activity itself does not necessarily require any special equipment, and it is generally a subset of this set of cases that can be considered potentially substitutable by ICT. In these cases of potential substitutability, the utility of the ICT alternative, and hence the choice between the traditional and ICT-based forms of the activity, will very much depend on the technological characteristics of the ICT alternative (assuming its availability): Does it transmit audio, still pictures, full-motion video? Is it one-to-one, one-to-many, or many-to-many? Is it synchronous or asynchronous? Can access be mobile, or only fixed? Is the desired/needed amount of transmission bandwidth available? What is the comparative cost of the ICT alternative (discussed under dimension 13 below), and is it shared or transferred (e.g. by using the

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[21] Of course, even mental activities require at least a modicum of physical movement, and most physical activities require strategic and tactical mental engagement. Thus, "physical" does not preclude mental activity, but we use the label "predominantly mental" to distinguish those activities which involve mental engagement without much physical movement.

employer's high-speed network to browse the Internet)? Beyond these technical characteristics lie the more intangible factors that we have mentioned earlier as being relevant to choice: the degree to which the ICT alternative replicates the experience of "being there" to the desired extent.

11. **Informal vs. formal arrangements required:** Some leisure activities require formal arrangements prior to engagement, such as purchasing tickets, owning a subscription, or simply coordinating for a particular service, such as in a spa. ICT will generally ease the process of making the necessary arrangements. In particular, it is the telephone (fixed as well as mobile) and the computer that enable these arrangement. It is worth noting that for ICT to be an efficient enabler of formal arrangements, there need to be payment mechanisms, namely credit options, so that the benefits of ICT can be realized.

Benefits and Costs: Whether consciously or unconsciously, human decisions other than the most primally instinctive ones tend to involve some kind of mental tradeoff between costs and benefits. The perceived benefits constitute the motivation or drive to take part in leisure and other activities. This motivation serves as a mechanism that encourages engagement in activities as long as the gratification is greater than the costs involved. The remaining two leisure activity classification dimensions explore these two aspects.

12. **Motivation:** It is useful to determine the motivations for engaging in a given leisure activity, because these motivations are likely to affect the gratification one gains from the ICT-based, as opposed to the traditional, form of an activity. It is plausible to assume, for example, that playing a game on a stand-alone computer provides at least different, if not less, gratification than that experienced in playing the same or similar game with other real people through a network (and for that matter, also from playing with others on a non-networked computer). As distinguished from the empirically-driven classification of Tinsley and Eldredge (1995) shown in Table 1 (which has some unexpected groupings, such as placing chess in the Creativity group with baking, and separate from other games in the [mental] Competition group), we suggest that the motivations for conducting a given leisure activity can include one or more of the following six conceptual types:
    - physical exercise (as active participant or passive spectator, where the latter refers, e.g., to the motivation of enjoying watching the skilled execution of physical activities by others);
    - mental exercise, learning (as participant or spectator);
    - aesthetic or creative production (participant, spectator);
    - socializing;
    - status or self-identity enhancement (e.g., Kernan and Domzal, 2000);
    - relaxation, escape.

    For each of these types (with the possible exception of the last one), the motivation can further be one of *enjoyment*, or of *necessity/expectation* (the last category seems to require an enjoyment motive – almost by definition, if one relaxes because of an activity, one is enjoying it). In the former case (enjoyment motive), the leisure activity is valued as an end in itself; in the latter case (necessity motive) as a means to the end of fulfilling a duty or satisfying an expectation. For example, one may visit the in-laws because the spouse demands it, or one may engage in "recreational" jogging because one is determined to stay in shape rather than out of an intrinsic enjoyment of the activity.

There are, as usual, hybrid cases, relating to the reason for the blurry boundary between activity classes discussed in Section 2.1.1. Consider for example the case in which an individual is expected to play golf with a business client. This is purely a work-related activity if the individual does not enjoy the game. But if the person actively likes golf and plays it "on her own time" as well as in the work context, this requirement of the job may actually make work more like leisure (unless playing a client involves sufficient stress so as to rob an otherwise desired activity of its pleasure).

13. **Costs** of various types are yet another dimension along which the engagement in leisure activities may vary. Generalized costs, including monetary, time, physical energy and others affect the level of engagement in activities. Costs are a disutility and are compared against other dimensions, most prominent of which are the motivations. Costs act as constraints on particular leisure activities; expensive activities cannot be included in one's choice set if the individual's budget does not allow for it. But, there may be a trade-off not only between different activities, but also between participation levels in a particular activity. One may go to a concert less frequently than desired but still budget for concerts rather than other activities. As frequently mentioned earlier, one important effect of ICT on this dimension is that of reducing costs, as better coordination and scheduling are facilitated. But the costs of acquiring and using the ICTs themselves must not be neglected. In particular, computer-based leisure activities can be quite costly in terms of maintaining state-of-the-art hardware and software, along with communications costs – especially if users become "addicted".

In summary, most dimensions identified above can be categorized as being ICT-sensitive, meaning that the introduction of ICTs may have significant impacts on the way people perceive leisure activity options and use. The two most directly relevant attributes from a travel behavior perspective are the impacts on time and space, but all are relevant to travel to the extent that they influence the adoption of ICT activities, which in turn have travel implications.

4. CONCLUSIONS

In this conceptual discussion of the potential impacts of ICT on leisure activities and travel, several recurring themes emerge. One theme is that a key role of ICT is to expand the individual's choice set, both of activities and of ways to conduct a given activity. Among new ICTs, clearly the mobile phone and the Internet are having the largest impact on activity patterns. At present, the Internet is perhaps more important in the United States and the mobile phone more important elsewhere in the world, but both technologies are still spreading, as well as merging in forms such as the Web-enabled mobile phone and laptops or personal digital assistants (PDAs) with wireless Internet connections.

Another recurring theme, however, is that just because new choices are available, there is no guarantee that people will choose them. The appeal of ICT-based activities will depend on characteristics of the choice context, the alternatives, and the individual. We are reminded that in many cases, ICT does not offer a satisfactory alternative to traditional ways of conducting activities. And in fact, although we have generally assumed the availability of ICTs in the foregoing discussion, that assumption is not universally true. In some cases a desired ICT is not available to *anyone* – being technologically or economically out of reach at this point – and in other cases it is available to some people but not to *everyone*. Obviously availability is a necessary, though not sufficient, condition for an ICT alternative to be chosen. Following the

interesting results of Doherty (2003) with respect to the spatial and temporal flexibility of activities (discussed in Section 3.1.1), it would be valuable to monitor the extent to which that perceived flexibility is changing over time, as well as simply the extent to which ICT alternatives are perceived to be available. Further, the differential availability of ICTs to different geographical locations and socio-economic segments of society is a matter of policy concern as well as research interest.

A further overarching observation is that the potential leisure-related impacts of ICT on travel are mixed. For some types of effects (categories 1 and 2 of Table 2 and Figure 2) the adoption of ICT is likely to reduce travel; for others (categories 3 and 4) the primary effect is likely to be generation of new travel, although secondary modification and substitution effects are also likely. We do not know the net outcome of these complex and counteracting relationships, nor even a rank ordering among the various types of ICT impacts with respect to their implications for travel.

In addition to those already expressed or implied, a number of directions for further research have been suggested by this discussion. One fundamental question worth exploring is, how do people perceive leisure? That is, what qualifies an activity as leisure or not-leisure to a given individual, and with what factors does that classification vary across people? Besides being of theoretical interest in their own right, from a practical standpoint the answers are important to our ability to craft empirical studies in a way that will be meaningful to the participants, even – or perhaps especially – if our desired definition differs from theirs (see Passmore and French, 2001 for one example of such a study).

With respect to each of the four types of ICT impacts identified in this report, two generic questions can be raised: (1) What is the extent of the adoption of the relevant ICTs (whether they are the ends of interest as in categories 1 and 2, or the means to another end as in categories 3 and 4); and (2) for a given level of adoption of ICTs, what is the nature and extent of their impacts on the targets of study? For a study of category 1 adoption (the choice of an ICT-based versus traditional way of conducting a given activity), discrete choice models probably constitute the logical analysis methodology. For adoption within the other three categories, the natural paradigm is not so much that of an either-or choice among discrete alternatives, but rather a shift in the way one's time is allocated. Accordingly, appropriate analysis methodologies could include utility maximization based models of time allocation (see, e.g., Kraan, 1997), structural equations models (e.g. Lu and Pas, 1999), and/or duration models (Bhat, 1996).

In sum, the study of the impacts of ICTs on leisure activities and travel presents a number of interesting and important challenges to the profession. We look forward to the further development of this rich and rewarding topic.

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Table 1. Taxonomy of Leisure Activities Based on Psychological Need

Activity Cluster	Examples
Agency	Bicycling, jogging, swimming, tennis, weight lifting
Novelty	Backpacking, camping, gardening, hiking, nature walks
Belongingness	Acting/stage, baseball, dancing, Frisbee, soccer, volleyball
Service	Attending church, visiting friends and relatives, volunteer
Sensual enjoyment	Attending plays, dining out, drinking and socializing
Cognitive stimulation	Art shows and galleries, reading fiction, working puzzles
Self-expression	Ceramics, collecting stamps, fishing, quilting, woodworking
Creativity	Baking and cooking, chess, collecting books, painting
Competition	Arcade games, cards, checkers, computer games, poker
Vicarious competition	Watching basketball, watching football
Relaxation	Bingo, radio listening, watching television
Residual	Bowling, bridge, collecting bottles, golf, sailing

Source: Tinsley and Eldredge (1995)

Table 2: Types of Impacts of ICT on Leisure Activities

	1. Choice between ICT-based v. traditional activity (replacement)	2. Generation of new ICT-based activities (displacement)	3. ICT-enabled reallocation of time to other activities	4. ICT as enabler/ facilitator/modifier of activities

Mechanism(s) through which effect occurs	• ICT-based activity offers higher net utility than the alternatives	• new ICT-based activities are adopted
		  − new activities overlay others (multitasking); no change in other time allocation; or
		  − new activities crowd out others, reducing time spent on other activities
			• time saved through using ICT for another activity is applied to new activity(ies)
			• money saved through using ICT for another activity is applied to new activity(ies)
			• ICT increases effective supply of travel, reducing travel times
				• more flexible time management in the face of relaxation of spatial &/or temporal constraints (internal or external)
				• more information about availability of options
				• ability to save money (directly)

Typical media	• TV • audio (radio, CD, etc.) • DVD • computer, stand-alone • computer, networked • mobile phone/PDA, stand-alone • mobile phone/PDA, networked	• TV • audio (radio, CD, etc.) • DVD • computer, stand-alone • computer, networked • mobile phone/PDA, stand-alone • mobile phone/PDA, networked	• TV • audio (radio, CD, etc.) • DVD • computer, stand-alone • computer, networked • mobile phone, stand-alone • mobile phone, networked • audio- or videoconferencing	• computer, networked • mobile phone/PDA/ pager, networked
Time scale	short-term	medium-term	short-term	short-term medium-term
Likely effect(s) on travel	substitution	substitution	substitution generation	modification generation substitution

Table 3: Relationships of Leisure Activity Classification Dimensions to Types of ICT Impact
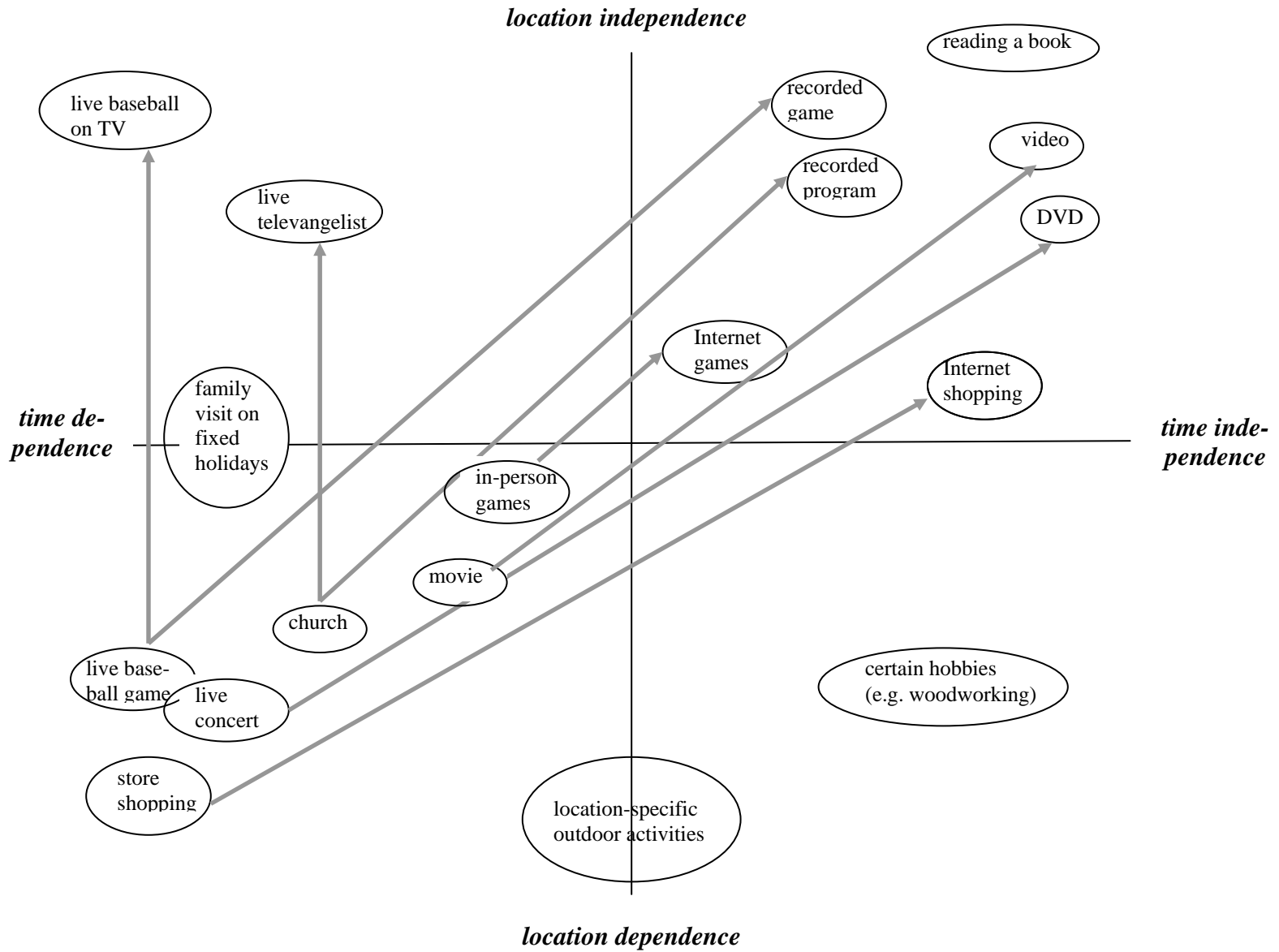
Types of ICT Impact → Dimensions ↓	1. Replacement of Traditional Activity with ICT Counterpart	2. Time Displacement of Other Activities by ICT	3. ICT-enabled Reallocation of Time to Other Activities	4. ICT Facilitation of Other Activities
1. Location (in)dependence	ICT partly relaxes location dependence; location-dependent activities less likely to be substituted by ICT.	Location independence of ICT increases its utility and may contribute to its crowding out more constrained activities.	To the extent the location independence of certain ICT applications increases their adoption, resulting time or money savings can lead to engagement in leisure and other activities.	Location independence of ICT may increase its use as a facilitator.
2. Mobile or stationary	Mobile activities less likely to be substituted by ICT (except e.g. in virtual reality training programs).			
3. Time (in)dependence	ICT partly relaxes time dependence; time-dependent activities less likely to be substituted by ICT.	Time independence of ICT increases its utility and may contribute to its crowding out more constrained activities.	To the extent the time independence of certain ICT applications increases their adoption, resulting time or money savings can lead to engagement in leisure and other activities.	Time independence of ICT may increase its use as a facilitator.
4. Planning horizon			ICT effects may be either medium-term (one plans to telecommute, in part to save time for other activities) or short-term (the time savings and/or the decision to reallocate it may arise spontaneously).	ICT facilitates the generation or modification of activities in both the short term (spontaneous meeting with friends organized by mobile phone) and the medium term (using the Internet to find holiday travel bargains).
5. Temporal structure and fragmentation	ICT-based forms of activities are often more easily fragmentable, which may increase the utility of these alternatives.	Fragmentability of ICT activities may increase their utility and contribute to their crowding out more constrained activities.		Fragmentability of ICT activities may increase their utility as facilitators (making a mobile phone call "on the fly"; browsing the Net on a short break at work).
6. Ease of multitasking	ICT-based forms of activities often lend themselves	Ability to multitask sometimes means that ICT activi-		

Types of ICT Impact → Dimensions ↓	1. Replacement of Traditional Activity with ICT Counterpart	2. Time Displacement of Other Activities by ICT	3. ICT-enabled Reallocation of Time to Other Activities	4. ICT Facilitation of Other Activities
	more readily to multitasking, which may increase the utility of these alternatives against their traditional counterparts.	ties can be added without "sacrificing" others.		
7. Solitary vs. social	ICT relaxes boundary between solitary and social activities, and may increase the utility of "virtually social" activities for otherwise solitary individuals.	ICT-based leisure activities can be solitary or social. Because the solitary ones are easier to conduct, those may be more likely to displace time from other activities.		Ability of ICT to facilitate spontaneous or short-notice meetings may increase time spent in social rather than solitary activities.
8. Active vs. passive participation	Active participation in physical activities less likely to be substitutable by ICT.	ICT may promote more active participation in mental activities (e.g. computer games).		
9. Physical vs. predominantly mental	Mental activities more likely to be substitutable by ICT than physical ones.	Physical (or mental) activities can be crowded out by ICT.	The time freed up by ICT may be devoted (partly) to physical (or mental) activities.	ICT can facilitate the organization of physical (as well as mental) activities.
10. Equipment/media (in)dependence	Among others, technological characteristics of the ICT alternative will influence its utility relative to traditional counterpart. Activities requiring non-ICT equipment or media may be less substitutable.	Among others, technological characteristics of ICT-based activities will influence their utility and hence the extent to which they are adopted and crowd out others.	Technological characteristics of ICT-based activities will influence their utility, hence the extent to which they are adopted, hence the extent to which they free resources for other activities.	Technological characteristics of ICTs will influence the extent to which they are useful as facilitators (e.g. coverage of mobile phone service; availability of wireless Internet).
11. Informal vs. formal arrangements				ICT can facilitate making the necessary arrangements, perhaps even last-minute, and hence may increase the engagement in activities requiring such arrangements.
12. Motivation	Quality of experience via the ICT alternative may be inferior on an important dimension (e.g. enjoyment of			

Types of ICT Impact → Dimensions ↓	1. Replacement of Traditional Activity with ICT Counterpart	2. Time Displacement of Other Activities by ICT	3. ICT-enabled Reallocation of Time to Other Activities	4. ICT Facilitation of Other Activities
	aesthetic production), and hence reduce its utility compared to traditional counterpart. Status motivation may involve conspicuous consumption, which may be perceived as higher with the traditional form (box seats at stadium v. watching on TV). But consumption of ICTs can also involve status.			
13. Cost	Relative costs of alternatives (balanced against relative benefits) will determine choice between ICT and traditional form.	Among others, cost of ICT-based activities will influence their utility and hence the extent to which they are adopted and crowd out others.	Cost of ICT-based activities will influence their utility, hence the extent to which they are adopted, hence the extent to which they free resources for other activities.	Cost of ICTs will influence the extent to which they are adopted as facilitators.

Figure 1: Spatial and Temporal Impacts of ICT on Selected Activities

location independence

reading a book

recorded game

live baseball on TV

video

recorded program

live televangelist

DVD

time de-pendence

family visit on fixed holidays

Internet games

Internet shopping

time inde-pendence

in-person games

church

movie

live base-ball game

live concert

certain hobbies (e.g. woodworking)

store shopping

location-specific outdoor activities

location dependence

Figure 2: Relationships among Types of ICT Impacts

	direct (own-activity) substitution: activity X is now done by ICT instead of the traditional way	*activity generation or modification:* activity X either would not have occurred without ICT, or is materially changed by it	
ICT is the end – the new activity itself	**1. Choice between ICT-based v. traditional activity (replacement)**	**4. ICT as enabler/ facilitator/modifier of leisure activities**	*ICT is the means* (of saving time, money); can affect non-ICT as well as ICT activities
	2. Generation of new ICT activities (time displacement – ICT *takes* time from other activities)	**3. ICT-enabled reallocation of time to other activities (ICT *gives* time or money that permits other activities to occur)**	
	cross-activity substitution: activity(ies) X affect(s) activity(ies) Y		