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The Social Structure of Time: Emerging Trends and New Directions

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Abstract

Research on time use has seen several major developments in recent years. These include the adoption of exciting new technologies (e.g., smartphones, wearable Global Positioning System devices) that track behavior in real time, as well as a growing international database—the Multinational Time Use Study—that has surpassed one million days' worth of harmonized time-diary data. These developments are transforming our understanding of the social patterning of everyday behavior. This article provides updates about this area of work, including recent findings regarding foundational sociological issues such as trends in gendered divisions of household labor and over-time, cross-national aggregate estimates of time spent on paid work and leisure. We also highlight new approaches to the study of time use. This includes an overview of advances in the collection and analysis of time-stamped behavioral data, as well as a discussion of methodological advances in the analysis of the temporal sequential structure of everyday activities.

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INTRODUCTION

How do people spend and structure their time in everyday life? This question has been the subject of a vast and highly influential body of research in the social sciences for decades. It is an immensely important issue, as the patterning of everyday human behaviors—including work and consumption on the timescale of minutes and hours—reflects essential social structures, including divisions of labor at the household and societal levels. Despite the importance of time-use data in the study of core sociological topics such as the gender division of labor, a general overview of the methodological and substantive work on time use is long overdue. The last general review of time studies in this journal appeared more than three decades ago (Andorka 1987), with a recent review of research on work-specific schedules appearing last year (Gerstel & Clawson 2018).

Given the complex and dynamic nature of everyday life, understanding trends in time use and time structure requires mastering ever-more complex methods of data collection and analysis while simultaneously maintaining the link back to foundational studies. This article attempts to document key developments and trends that have emerged over the past several decades. Widespread scholarly interest in time use has led to the development of impressive data collection and dissemination projects. These have relied primarily on the collection of highly detailed, exhaustive time diaries. We address analyses that use data that are generally considered the gold standard for time-use estimates, but we also advance to innovative approaches to collecting sequential diary-type evidence on everyday activities via new technologies. This includes the adoption of exciting new technologies [e.g., smartphones and wearable Global Positioning System (GPS) devices] that track behavior in real time, as well as a growing international database—the Multinational Time Use Study (MTUS)—that recently surpassed one million days' worth of cross-national and cross-period harmonized time-diary data.

It is time to reassess the state of work on the time-related structure of everyday life. This work has always been central to sociologists' understanding of the real-time experience of social life, including the division of household labor and use of information and communication technology (ICT) devices, and how that relates to important social phenomena such as gender inequality and time pressure. This area of work has seen major advances in recent years, leading to new insights about the structure of work, leisure, family, social interaction, and health. However, some sociologists are unaware of the advances that have been made along these lines, how those advances tie into technological research advances, and how these are combining to shift sociology toward more micro-level time-centered issues. The sociology of time use and time structure needs an update and a new airing.

TIME-USE DATA: DEVELOPMENT AND DISSEMINATION

The vast majority of research on time use and structure depends on data from time diaries. We begin by providing a brief overview of this method, how it developed through time and across countries, and the main sources of time-use data that are currently available to researchers.

Historical Development

Time-diary research has a substantial historical hinterland, originating with Fabian social research in the United Kingdom (Pember-Reeves 1913), in Lenin's New Economic Policy in the 1920s Soviet Union, and in the US Department of Agriculture's interest in unpaid household and farm work in the mid-1920s (Kneeland 1929). It was later adopted by radio and subsequently television broadcasting authorities from the late 1930s to better understand their audience's behavior.

Time-use diaries first entered mainstream sociology with Lundberg et al.'s (1934) and Sorokin & Berger's (1939) studies of leisure.

Szalai (1972) produced the first purpose-designed cross-national comparative time-diary study, using samples from 12 countries, providing a model research protocol that is widely implemented today. It involved single-day paper-and-pencil diaries, randomly sampled across the year, which included information about specific diary episodes, simultaneous activities, location, travel mode, and copresence throughout a randomly chosen day. This multifield design was remarkably forward-looking, and it is widely imitated across the world. Key features such as the recording of multiple simultaneous activities, having remained largely unused for decades, are now proving crucially important.

Szalai's (1972) design was further developed during the 1990s, partly on the initiative of Eurostat, as the Harmonised European Time Use Survey, or HETUS (Eurostat 2008). The American Time Use Study (ATUS), started in 2003, provides the largest volume of time-use data available anywhere, but departed from the Szalai-to-HETUS models by using a telephone interview with a single household member and by collecting only a single precoded activity for each episode. Otherwise, Szalai's survey provided a standard methodology and design that was adopted by virtually all subsequent studies.

This de facto standardization explains why time diaries now generally have a uniform structure that is conducive to harmonization across surveys in different countries. The diary shown in **Figure 1**, as an example, represents the latest design used in the HETUS (in this case, from the 2014–2015 United Kingdom Time Use Survey, or UKTUS). The diary includes rows representing successive 10-minute periods, with separate columns where respondents record their primary activity for that time period ("What were you doing?"), secondary activities ("What else did you do"), their location ("Where were you?"), and who else was present ("Were you alone or with somebody you know?"). Each of these 10-minute activity time slots, or episodes, describes part of a day. The two activity columns are each coded into more than 250 distinct activity categories.

Day 1 Time: 7am – 10am Morning		Day 1 Time: 7am – 10am			Were you alone or with somebody you know? Mark all relevant boxes							How much did you enjoy this time? 1 = not at all 7 = very much
Time: 7am–10am Morning (am)	What were you doing? Please write down one main activity.	If you did something else at the same time, what else did you do?	Did you use a smartphone tablet, or computer?	Where were you? Location, or mode of transport	Alone	Spouse/partner	Mother	Father	Child aged 0-7	Other person	Others you know	
7am-7.10	Woke up the children		<input type="checkbox"/>	At home	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	5
7.10-7.20	Had breakfast	checked emails	<input checked="" type="checkbox"/>	↓	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	6
7.20-7.30	" "	Talked with my family	<input type="checkbox"/>		<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	5
7.30-7.40	Cleared the table	Listened to the radio	<input checked="" type="checkbox"/>		<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4
7.40-7.50	↓	↓	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	↓
7.50-8am	Helped the children dressing	Talked with my children	<input type="checkbox"/>	↓	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	↓
8am-8.10	" "	↓	<input type="checkbox"/>	↓	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	↓
8.10-8.20	Went to the day care centre	↓	<input type="checkbox"/>	on foot	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	1

Use an arrow or quote marks to record that an activity lasted longer than 10 minutes.

Figure 1

Sample 80-minute section of a time diary from the 2014–2015 United Kingdom Time Use Survey.

Because respondents typically provide this information in their own words, they can be recoded into more detailed classifications if needed. The essence of time-use analysis is using one, some, or conceivably all of the diary columns to produce a classification of each of the episodes of the day, which together sum to the 24 hours (1,440 minutes) of the individual's day.

Advances in Data Dissemination

There are now well in excess of 100 nationally representative diary studies of developed and less-developed countries. Many of these were collected with the prior intention of facilitating cross-national comparative research. In addition, the detailed systems of classification of daily activities—often identifying 250 or more distinct daily activities, combined with the continuous recording of activities throughout the day—allow the harmonization of these studies retrospectively (ex post). This permits both cross-national comparative analysis of micro-level time-use data and, where suitable materials have been collected at different time points, comparative analysis of historical time-use trends.

Time-use researchers have now reached some major milestones in the harmonization and dissemination of time-diary data sets:

- More than 1.25 million harmonized diary days of the MTUS, including more than 85 surveys harmonized ex post for 25 countries across the period 1961–2015. The MTUS is developed by the Centre for Time Use Research (Fisher & Gershuny 2013). It focuses on Western Europe, North America, and Australia, but the archive is still expanding to cover the Pacific Rim (e.g., Korea), with new data from India, Pakistan, and Eastern Europe still in preparation. Researchers can access versions of the MTUS data at <https://www.timeuse.org/>.
- The completion of the second tranche of the HETUS, providing ex ante harmonized surveys from 20 European countries following the Eurostat guidelines (Eurostat 2008). The HETUS series of nationally representative time-diary surveys began at the turn of the twenty-first century and follow the general form of the diary shown in **Figure 1**. The design calls for continuous sequential recording of respondents' activities through two randomly selected days (weekday and weekend), together with simultaneous activities, location, and copresence. Diaries are collected from all members of the sampled household on the same days. This enables analyses of how the activities of different household members interact across the diary day and permits estimates of, for example, how much time different people in the same household spend doing the same activities or in each other's company.
- The fifteenth year of the ATUS, which started in 2003. This is the longest-running continuous time-use diary survey in the world. It collects single-day diaries from a randomly selected adult (age >15) member of 2,200 households randomly selected each month from the surviving Current Population Survey sample. The data cover one continuous sequence of primary activities for one 24-hour period, together with a separate indication of childcare responsibilities. Some years' data include additional modules of sequential information, covering, for example, eating and health (2006–2008, 2014–2016) and well-being (2010, 2012, and 2013).
- A new component of the Integrated Public Use Microdata Series consists of three integrated web sites: the ATUS-X, the American Heritage Time Use Study (AHTUS-X), and the MTUS-X. These data sets contain detailed episode-level files. Users can select subsets of cases, define activities as they choose, and aggregate them in a variety of ways, including by time of day, by location of activity, and with whom. Variables in each of these data sets are harmonized, and activity categories are comparable so that the user can access and merge comparable files with a simple point and click.

Advances in Data Collection

It is encouraging that many scholars are embracing developments in technology that extend the available options for time-use data collection beyond the time-diary method. The accumulation and analysis of real-time social behavioral data is now easier and more common, and it is inevitable that time-oriented scholars will draw more heavily on these methods in coming years. The final section of this article discusses new computational data collection and analytic social science methods that are reshaping the study of timed behavior. First, though, we review the body of work that has developed around how individuals use and structure their time, largely on the back of the conventional time-diary method just reviewed.

SUBSTANTIVE APPLICATIONS IN TIME USE

The area of time-use research is expansive and cuts across the fields of economics, sociology, and policy. We illustrate developments relevant to all of these areas, but with a heavy focus on sociological research and its unique contributions to the larger field of time-use analysis.

Since at least the 1960s, time-use diaries have been used to collect multiple fields of information about simultaneously occurring activities, as well as location, copresence, and other aspects of instantaneous experience. This complexity relates both to the multiplicity of social roles that may be reflected in each momentary activity and to the variety of social systems (economic and expressive) embodied within each segment of activity. Recent diary fields can now be used to construct improved accounts extending across a wide range of sociological purposes. For example, changes over the past two decades in the applications of mobile ICT devices may be investigated using data sets that combine diary fields registering electronic device use with simultaneous main and secondary activities (more on this below).

In this section, we address core sociological applications that have grown to become significant fields of inquiry since Andorka's (1987) review, in particular, cross-national, cross-time trends in aggregate time use and the gender division of domestic labor. We then provide brief illustrations of new diary fields, including ICT device use and instantaneous affect (enjoyment) fields. Finally, we present a new application of national-level time budgets in national accounting, extending this to the estimation of national well-being.

Cross-National Trends in Work and Leisure

One of the original motivations for the first cross-national comparative time-use survey (Szalai 1972) was to compare the details of "everyday life in twelve countries" (the title of a chapter by Robinson et al. 1972). The International Association for Time Use Research, originally a working group of the International Sociological Association (and cochaired by Andorka), brought Szalai's collaborators together with a widening group of sociologists, geographers, and economists during the 1980s (O'Conghaile & Köhler 1991) and provided the basis for the formulation of the HETUS guidelines. Developments in data harmonization enabled the continuing development of three strands of research activity: analysis of historical trends in single countries, cross-national comparisons, and comparative trend analysis.

A key substantive application of diary data has been the analysis of paid and unpaid work (see Gerstel & Clawson 2018). Young & Wilmott (1974) in the United Kingdom and Meissner et al. (1977) in Canada used early cross-sectional diary evidence to address the issue of women's dual burden of paid and unpaid work. Bittman & Wajcman (2000, p. 185) subsequently used diary evidence across 10 Organisation for Economic Co-operation and Development countries to replace the then-conventional "gender inequality resulting from extra work time" argument, with

the subtler position that gender specialization imposes a price in both earnings and “the quality of leisure.” We address the contributions of time-use diary data to research on the gender division of labor in greater detail below.

US trends in work and leisure have been a particular focus of study. Robinson & Godbey (1999), Sayer (2005), Bianchi et al. (2006), and Aguiar & Hurst (2007) published comprehensive studies of the evolution of work and leisure in the United States, while Sevilla et al. (2012) added an affective dimension to the analysis of US leisure. Gershuny & Harms (2016) traced an 85-year trend in US women’s work time (paid and unpaid, adjusting results for demographic changes). Beyond this, there were many other early single-country trend studies—for example, Bittman et al. (1999) in Australia and Knulst & Kraaykamp (1997) in the Netherlands.

Gershuny & Robinson (1988) identified the conceptual opportunity offered by the comparison of cross-national trends. Gershuny (2000) deployed an earlier incarnation of the MTUS to produce a trend analysis for eight countries (alongside cross-sectional evidence for a further twelve). Gauthier et al. (2004) showed gender-differentiated trends, particularly reductions in women’s unpaid work across Europe and North America, while Hook (2006, 2010) used multilevel modeling to analyze the contributions of country and individual effects to differentials in housework. Subsequently, Kan et al. (2011) produced welfare regime-structure models of change in unpaid work times. Altintas & Sullivan (2016) updated this to provide a modeled view of changes in relative women’s and men’s housework time from the 1960s to the second decade of the twenty-first century across more than 20 countries.

Now surfacing are applications of diary materials from outside the social sciences. In the field of public health, for example, Zick & Stephens (2010) use diary evidence to examine 30 years of change in US food-related time, while Chau et al. (2012) use standard time-diary data to examine the evolution of sedentary behaviors in Australia between 1992 and 2006.

These developments, and many other findings emerging from recent work, are genuinely new. Examples include: (a) the slight historical increase in sleep time, despite a supposed 24/7 society (Robinson & Michelson 2010, Lamote de Grignon Pérez et al. 2018); (b) the majority of a population’s physical exercise comes not from sports and gym participation but from paid and, particularly, unpaid work (Gershuny & Harms 2019); (c) more than 40% of the economic output of modern societies comes from private household production excluded from conventional GNP calculations (Suh & Folbre 2016); and (d) despite popular claims that life gets busier and more stressful, time-diary evidence shows a contrary trend of diminishing multitasking and time pressure (Sullivan & Gershuny 2018). These findings can only be obtained from time-diary-based materials.

The Gender Division of Domestic Labor

Research on the gender division of domestic labor was dominated from the start by the study of the unequal gender division of time (e.g., Hochschild & Machung 1989). Nationally representative time-diary data, recognized as the gold standard in terms of the reliability of the estimation of time, have provided an invaluable quantitative complement to early qualitative studies demonstrating gender inequality in household labor and care time (see Bianchi & Milkie 2010, Coltrane 2000, Lachance-Grzela & Bouchard 2010 for decade reviews). Early cross-sectional results using US time-use data demonstrated the persistence of a large gender gap in housework and childcare time, even though women’s housework time was shown to be declining (Coverman & Sheley 1986, Shelton 1992). Subsequent analyses began to show some signs of gender convergence, with a widespread decrease in women’s housework and some corresponding, although much smaller, increases in men’s housework, and a larger increase in men’s childcare time (Bianchi et al. 2000, 2006; Gershuny 2000; Sandberg & Hofferth 2005; Sayer 2005).

Various theoretical perspectives relating to couples' marital bargaining power (reflecting their relative resources) received support as possible explanations for the continuing gender gap in housework time (Davis & Greenstein 2013). The best known of these is economic dependency theory, while the idea of gender deviance neutralization, based on gender display, provided a gender-based alternative (e.g., Bittman et al. 2003, Brines 1994, Greenstein 2000, Gupta 2007, Killewald 2011). However, no consensus has yet emerged as to the relative importance of these explanations (Bianchi & Milkie 2010, Killewald & Gough 2010, Sullivan 2011).

The development of harmonized cross-national and over-time series of time-use data facilitated the analysis of international trends in these areas. These data showed that similar trends were also evident across Europe, Canada, and Australia (Altintas & Sullivan 2016; Gauthier et al. 2004; Gershuny 2000; Hook 2006, 2010; Kan et al. 2011; Treas & Lui 2013). It became clear that a widespread process of stuttering progress toward gender convergence was occurring across many countries. Men's contributions to housework were slowly increasing, while women's were dramatically decreasing—and both mothers and fathers were increasing their childcare time. According to Gershuny et al. (1994), Gershuny (2005), and Sullivan et al. (2018), these slow and halting convergences derive from combinations of the processes of wider gender ideologies, gender socialization, and employment experience playing out across generations.

New analyses using country-level variables and multilevel methodologies emerged as an attempt to understand the contribution and articulation of macro-level (i.e., policy and ideology) and micro-level (i.e., individual education and employment status) explanations for the gender gap in housework and care (e.g., Cooke & Baxter 2010; Craig & Mullan 2010; Davis & Greenstein 2004; Fuwa & Cohen 2007; Hook 2006, 2010; Knudsen & Waerness 2007; Neilson & Stanfors 2014; Voicu et al. 2008). These analyses revealed that women do less housework and men do more housework in countries that have: (a) higher levels of full-time employment among women, (b) a greater provision of publicly funded childcare, and (c) more egalitarian gender attitudes. There are indications that more traditional countries may now be moving faster in the direction of egalitarianism over time than countries where the gender equality revolution has progressed further, indicating a catch-up effect (Altintas & Sullivan 2017, Geist & Cohen 2011, Sullivan et al. 2014).

The phenomenon of gender symmetry in paid plus unpaid work time (with similar totals, but with women currently doing more than 60% of the unpaid and less than 40% of the paid) was first identified by Young & Wilmott (1974). This has been generalized recently using time-diary data to a cross-national iso-work proposition (Burda et al. 2013). Women and men do similar totals of work (adopting the broadest possible conceptualization of work to include paid and unpaid work), though men do more paid and women more unpaid, with attendant consequences for the accumulation of economic capital—hence, the gender wage gap. MTUS data on trends in 15 countries demonstrate this same proposition historically (Gershuny & Fisher 2017). Also remarkable is an apparent historical consistency in total work-time, clustered around 480 minutes, or 8 hours, per day across countries and time periods (for similar trends in the United States, see Jacobs & Gerson 2005).

A major focus of recent attention has been the widespread increase in fathers' childcare time. Time-use data show that in the United States, parents (both men and women) have substantially increased their time investment in childcare of all kinds over the past few decades (Bianchi et al. 2006, Sandberg & Hofferth 2005, Sayer et al. 2004a). These increases are also present cross-nationally across a range of developed countries (Altintas & Sullivan 2017, Kan et al. 2011). Increases have been most notable among more highly educated mothers and fathers, and in childcare activities that promote children's opportunities for learning (Altintas & Sullivan 2016, Craig et al. 2014, Dotti Sani & Treas 2016, Sayer et al. 2004b, Sullivan 2010, Sullivan et al. 2014). Although Raley et al. (2012) argue that US fathers do more routine care tasks when mothers are

employed, these increases in mother and father childcare time in routine and developmental activities suggest that an explanation based on a ceiling effect in men's engagement in a traditionally feminine-defined task (like childcare) is difficult to support.

Despite these general trends in the direction of greater equality in the division of household labor and care, much attention recently in the United States has focused on whether the gender transformation of paid and unpaid labor in society has hit a wall, or at least stalled (see Cotter et al. 2011, England 2010). The slowing in convergence is particularly clear in the case of the United States, where the trend toward gender convergence reached its most equal point in the late 1990s before increasing again in the direction of greater inequality (although see Allard et al. 2007, Bianchi et al. 2012). The wider cross-national picture also shows some indications of a slowing in the trend toward gender convergence among certain countries. Altintas & Sullivan (2016, 2017) distinguish groups of country trends where the gender division of unpaid work was more unequal in the 1970s and 1980s but showed steep declines in that inequality in later years (including evidence for the catch-up effect among fathers from Mediterranean countries) from those where the gender division of housework was more equal at the start of the period but the trend toward convergence flattened off gradually.

Information Technology and the Speeding Up of Everyday Life

Theoretical analyses of social acceleration in late modernity (Rosa 2013) and popularizations of the idea of an increasingly time-pressured lifestyle—including the increasing use of ICT (e.g., Schor 1992)—take the increasing tempo of daily life as a central theme in their analysis of social change. Rapid technological developments—including the rise of the Internet and microelectronic communication devices such as smartphones—are increasingly implicated in debates about the pressure of time. Analyses of actual time-use data, however, have provided a challenge to the idea of an inexorable increase in time pressure.

While time spent using a computer has been included in time-use diary surveys since the late 1990s, and has even prompted their collection (Anderson et al. 2007), the inclusion of a “device use” field in some time-use surveys is providing new insight. Analysis of this field is emerging, as it has only been included in relatively recent surveys (e.g., see the middle column of the diary shown in **Figure 1**: “Did you use a smartphone, tablet or computer?”). Analysis of the recent UKTUS shows that a substantial amount of time using devices occurs during paid work, especially among those workers who use devices for a large part of the day (Mullan 2019). Men used devices more than women, although among 8–19-year-olds there was no gender difference in device use. The substantial age differences in time spent using digital devices are concentrated outside rather than in paid work, primarily in media activities. However, in keeping with other research analyzing mobile phone use (Bittman et al. 2009), no direct link is found between overall time using digital devices, time pressure, and subjective well-being.

Concepts relating to time pressure, or hurriedness in daily life, can be measured and tested using time-use diary surveys in a number of different ways. The multitasking literature based on time-use data has focused particularly on the way in which women's greater levels of multitasking mean that their time is more pressured than that of men (Offer & Schneider 2011, Sullivan 1997, Sullivan & Gershuny 2013). A measure of the fragmentation of time—or Taylorization, as Hochschild (1997) puts it—has been used in previous research to identify inequalities in leisure and other activities (e.g., Cornwell 2013, Jarosz 2015, Mattingly & Bianchi 2003, Sevilla et al. 2012, Sullivan & Katz-Gerro 2007). In particular, it has been found that women's leisure and other activities are more fragmented—that is, more likely to be interrupted by other activities—and shorter in duration than men's leisure time.

However, Sullivan & Gershuny (2018) show from UKTUS data that from 2000 to 2014–15 there were declines over time in the percentage of people reporting feeling “always rushed.” Simple measures of time spent in constrained activities (employment and family care) are more strongly associated with reported feelings of rushedness than anything else, including ICT use. Neither the frequency of events per day nor the percentage of time spent multitasking increased. More striking are the higher levels of time fragmentation/multitasking and reporting of feeling “always rushed,” among women as compared with men.

One of the keys to this disjunction between the popular and empirically informed academic findings on speed-up appears to lie in distinguishing the experiences of different socio-demographic groups in a more finely tuned way (Jacobs & Gerson 2005). Gershuny’s (2005) “busyness as the badge of honor” hypothesis holds that busyness may have more to do with the superordinate class’s self-representation as busy, rather than objective reality. The data show that those who are employed in professional/managerial occupations indeed report feeling more rushed than those employed in other occupations.

With current research technologies, it is possible to collect time spent using ICT devices directly from the devices themselves (see the section titled New Data Collection Methods). But this method provides little information about the contexts and purposes of the activity. In recognition of the increasing importance of this area, some diary studies are already including more detailed descriptions of the types of ICT devices associated with every diary episode, and the inclusion of this field as standard in future time-use diary studies will enable a better appreciation of how new ICT technologies are impacting our daily lives.

The Enjoyment of Time

The instantaneously measured enjoyment of activities collected through time-use diaries is becoming a major method in studies of well-being and happiness. Rather than relying on stylized questions about domain satisfaction (Van Praag & Ferrer-i-Carbonell 2004, Rojas & Veenhoven 2013), asking respondents to report their enjoyment of each 10-minute interval of time via diaries provides an alternative, complementary measure based on everyday lived experience (Kahneman et al. 2004). These measurements of the instantaneous enjoyment can be accumulated, for individuals or for whole populations, into an overall measure of happiness or well-being.

The conceptual origin may be traced to the US national time-diary survey collected by the Institute for Social Research at the University of Michigan in 1975 (Juster & Stafford 1985). The method of collecting enjoyment concurrently with information on activities was first used in the mid-1980s by both a small-scale UK study and a US national sample (Erllich 1987, Robinson 1988, Robinson & Godbey 1999). Subsequently, diary fields on enjoyment (or pleasantness) of activities have been introduced into national-level HETUS surveys in France (2010), Italy (2008–2009), and the United Kingdom (2014–2015). (See the far right of the diary in **Figure 1** for an example.) A somewhat truncated version of a retrospective time-use diary (e.g., Kahneman et al. 2004) is used for the ATUS Subjective Well-Being module from 2010. Respondents are asked how happy, tired, sad, stressed, and in pain they felt while engaged in three specific activities on the day prior to the interview.

There are interesting and easily interpretable differences in the levels of enjoyment of time spent in different activities measured from time-use diaries. The ranking of activities is entirely clear and plausible, and appear also to be historically and cross-nationally quite stable. Gershuny compared both the US and UK 1980s samples, and the UK 1980s and 2015 samples, finding considerable consistency (Gershuny 2011, 2019). Activities receiving the lowest ratings involved school homework, various housework activities, job searches, and paid work. The most enjoyed activities involved outdoor leisure activities such as eating out, going to sports events or cultural

performances, and playing with children. The most recent UK results also show that standard socioeconomic and demographic differences have hardly any systematic effect on the ranking of the preferences for activities, although throughout, women generally claim higher mean enjoyment levels than do men. The exceptions to this involve the educationally least-well qualified. This may reflect aspects such as the tedious and precarious nature of women's unskilled paid work, and on the stress of shopping with very little income to spend (Gershuny 2019).

National Accounts from Aggregated Time Budgets

Modern national accounts of economic activity are a surprisingly recent innovation. Unpaid work within the household was, conventionally, considered unproductive. This position was first rigorously challenged in social science literature by a US pioneer of national accounts, Kneeland, whose 1929 *Annals of the American Academy of Political and Social Science* article was the first to discuss the annual value of household work.

Kneeland was also the originator of the time-diary instrument used in the 1920s by the US Department of Agriculture, and by US sociologists in the 1930s (Lundberg et al. 1934, Sorokin & Berger 1939). Unpaid activities are considered to be work if the final use derived from them would remain if the activity were undertaken for pay by another agent without affecting the result for the final consumer, or the third party criterion (Reid 1934). National accounts can be extended to include unpaid household work by placing a monetary value (such as a shadow wage) on all time input to private household production (Walker 1969, Walker & Woods 1976). Subsequently, an alternative output approach for using time-diary data to the same end was invented by Goldschmidt-Clermont (1993). The total extended value of the household's production of goods and services is the value added by all of its members' paid and unpaid work.

All activities, from the third party criterion perspective, involve either consumption or production. The value of production is identical to that of consumption. So, time-diary samples provide the basis for exhaustive, double entry-type national accounts. Holloway et al. (2002) produced the first experimental account of this sort, an approach now becoming routine within the UK Office of National Statistics (Webber & Payne 2016).

A full time-budget account is constructed by combining time-use data with household expenditure, input/output, and occupation/industry survey data. Columns represent different sorts of daily activities; rows represent different sorts of purposes or wants. The rows show how paid and unpaid work and consumption time contribute to each category of want. Over historical time there has been substantial change in distributions of modes of provision for wants due to technological innovation (Gershuny 2011).

The time-budget account also serves as a basis for integrating extended national accounts with enjoyment accounts. The output = consumption identity means that time is double-counted here—a result ultimately deriving from the third person assumption that work is entirely instrumental (as opposed to expressive or affective). An alternative, suggested by Krueger (2009), following Dow & Juster (1985), is to calculate process benefits, or national utility accounts, by multiplying each minute in the time-budget accounts by instantaneous pleasure or other affect rates associated with it in the diary (enjoyment or other measures of affect discussed above). The disaggregated time-budget accounts, showing contrasting trends in the sizes and distributions of national product, extended national product, and national utility, are examples of the previously mentioned multidimensional metrics proposed by Stiglitz et al. (2009).

THE SEQUENTIAL-STRUCTURALIST PERSPECTIVE OF TIME

A growing body of research moves beyond the analysis of aggregate time-use statistics to examine the sequential nature of activity. This work includes recent studies that employ analytic approaches

to study not just what people spend their time on, but also the order and timing of behavior—that is, when and in what order individuals engage in certain activities during the course of the day. We refer to this as the sequential-structuralist perspective of time. We include here several sections that describe this work, the new analytic approaches that are employed in it, and findings.

Substantive Analyses

The sequential-structuralist perspective of time has been influential mainly in the sociology of work and family, where there is evidence of an increasing prevalence in shift work and other forms of nonstandard work that does not occur during the stereotypical 9-to-5 shift (see, e.g., Gerstel & Clawson 2018, Kalleberg 2009, Su & Dunifon 2017). The interest in this issue is justified in part by evidence that when and/or in what sequence people engage in certain activities has consequences for individuals' well-being, family life, community involvement, and other outcomes (e.g., Bianchi & Milkie 2010, Cornwell & Warburton 2014, Gracia & Kalmijn 2016, Lesnard 2008).

This perspective has been used in the past primarily to identify typical patterns of longer-term social processes, such as career and work histories, marital and partnering histories, and other life-course processes (e.g., Pavalko 2015, Sugie 2018). More pertinent to this review are structural accounts of how individuals temporally order a variety of everyday social activities. Some of this work addresses the question of when certain activities will occur, or with what probability they will occur at a given time, during the course of a given day. Recent statistically oriented relational approaches (e.g., Butts 2008) view activities as unfolding in a stochastic framework, in that when a given activity occurs depends on the events of earlier time points and the activities of individuals' social connections.

This literature documents considerable variation in the ordering and timing of individuals' involvement in several key aspects of everyday life, especially paid work, unpaid work, social/cultural activity, leisure activity, and personal care. Heterogeneity with respect to when and in what order people engage in certain events is explained in particular by factors such as gender and socioeconomic status, as well as larger social institutions such as the family, work organizations, and national context (e.g., Flood et al. 2018, Lesnard 2008). For example, sequence research of time-diary data shows that people of higher socioeconomic status, and those in dual-earner arrangements, are more likely to experience leisure in a harried state—that is, their leisure sequences occur in more fragmented spells (Glorieux et al. 2010, Sullivan & Katz-Gerro 2007).

At the same time, this work has uncovered evidence that there are several common patterns of everyday activity sequencing that reappear across different historical and geopolitical contexts. Vagni & Cornwell (2018) analyzed a combination of work, leisure, and other activities and uncovered similar activity sequence patterns, finding that similar patterns reappear across 23 countries and over half a century of time diaries dating back to 1961. People across these varying contexts tend to fall into one of five common paid work patterns (including two shift-work patterns), two unpaid work patterns, and a predominately leisure-based pattern.

Recent Methodological Developments

Treating time use in sequential terms has led to new developments in the measurement and modeling of structure in time use. A key methodological innovation in this respect came with Abbott's optimal matching approach, which sees sequences of action as strings of events that can be compared much in the same way that DNA or protein sequences are compared with each other (see Abbott & Tsay 2000). This has led to a number of substantive and methodological discoveries that have changed the way sociologists study time-diary and related microtime data. Social scientists

have since devoted considerable effort to developing sequence analysis methods for use in social research (see also Aisenbrey & Fasang 2010). Approaches such as optimal matching and related sequence techniques are used along with classification methods such as cluster analysis to compare and classify individuals with respect to the order and timing of their everyday activities (Cornwell 2015). Recently, methodologists have focused on developing social sequence analysis methods to do the following:

- Assess the level of similarity/difference between people with respect to the order and/or timing of their activities (e.g., Elzinga 2003, Lesnard 2010)
- Measure the extent to which connected individuals' (e.g., spouses') schedules are synchronized with each other throughout the day (Chenu & Robinson 2002)
- Measure the extent to which individuals' activity sequences are repeated, or routinized, across multiple days (Cornwell 2015)
- Measure the extent to which different combinations of daily activity patterns lead to different weekly or higher-order temporal patterns (e.g., Lesnard & Kan 2011)
- Detect patterns with respect to how multiple channels of activity or other states—such as (*a*) what one is doing, (*b*) with whom, and (*c*) where—combine during the course of the day or longer periods (e.g., Gauthier et al. 2010, Piccarreta 2017, Pollock 2007, Robette et al. 2015)
- Model statistically what activity/state a particular individual will exhibit during a specific time period, given his/her recent activities/states and other related factors (e.g., Butts 2008)
- Depict activity, network-structural, or other sequences visually (e.g., Brzinsky-Fay 2014, Cornwell 2015)

These methods are uniquely suited to address emerging questions in the study of time structure, especially those that concern the prevalence and consequences of highly temporally patterned social behaviors.

EMERGING DATA COLLECTION METHODS AND APPLICATIONS

We close this article with a discussion of emerging developments in the field of time-use analysis that are likely to lead to new applications and areas of sociological study. There are two major and related themes developed in this section: (*a*) the continuing development of new methodologies of time-use data collection and (*b*) a brief sampling of the potential for extension of time-use data research into new substantive areas. The two inevitably interact—as we develop new technologies of collection, additional applications become evident—and similarly, new applications suggest the development of new instruments of data collection.

New Data Collection Methods

As much as in any area of research in the social sciences, the strong foundation of time-oriented research was developed over years of paper-and-pencil survey research. The basic multifield, own words, single-day paper-and-pencil methodology of time-diary data collection remained largely unchanged from Szalai (1972) to HETUS. This methodological conservatism reflected a desire to maintain comparability so as to compare time-use trends in the simplest way. Relatively minor changes involving computer-assisted personal interviewing and Internet registration of time-use data are likely to be easily integrated with the traditional methods, but now new and more radical alternatives are emerging on the horizon.

Many researchers in this area believe that continuing the classic paper-and-pencil data collection approach is problematic for the following reasons: (*a*) declining response rates to surveys

in general—partly because of their burdensome nature, partly because of the prevalence of sales pitches masquerading as surveys; and (b) the development of wearable or easily carried devices (particularly smartphones with accelerometers or GPS), which make it possible to identify some specific activities (either by location, as in the cases of restaurants, by motion sensing, as in the case of sleep, or by some combination of location and motion—e.g., if a user is at the gym) both passively and in real time. Combining these observations makes it increasingly clear that new time-diary-type collection methods must be developed.

The following is a brief overview of some of the newly emerging array of new nondiary sources of information about individual activity sequences:

- Real-time continuous recording of timed geolocational information from GPS instruments and/or smartphones, which can be combined with Google Maps-type information about the nature of particular addresses (restaurants, shops, gyms), and from which researchers may deduce the general nature of activities (eating out, shopping, physical exercise)
- Biomonitoring and motion sensing, either from specialized devices or smartphones running apps to monitor physical movement, heart rates, and skin conductivity (indicating biological or psychological stress)
- Wearing body cameras used to aid interpretation of these other records. A recent example is the Capture24 experiment involving worn cameras and accelerometers combined with HETUS diaries, collected over the same day (Thomas et al. 2016). Initial analyses reveal that total durations of time in each category of activity were nearly identical in the camera and diary records and correlate well with the variation in motion recorded by the accelerometer. The automatic interpretation of image sequences via artificial intelligence is, however, likely several years away.

There are also more distant alternatives on the horizon, relying on the Internet of Things [per Wikipedia (2018), “the network of physical devices...creating opportunities for more direct integration of the physical world into computer-based systems, resulting in efficiency improvements, economic benefits, and reduced human exertions”], which, in effect, reverses diary recording. Rather than the diarist recording his or her own activities, inanimate (but instrumented) objects—such as domestic devices in the home (cookers, televisions, refrigerators, and so on) or elsewhere in the built environment (e.g., ticket or road monitoring devices)—can be used to register the presence of, and any interactions with, human subjects. This development has some commonality with data mining methods that involve social media.

New Applications

A number of new substantive applications of time-use research are being facilitated by these developments in data collection.

Public health. Of particular note are applications in public health. In contrast to the nonexhaustive questionnaire batteries often used by public health researchers, diary surveys provide fully comprehensive coverage of all activities throughout the 24-hour day. The long history, national representativeness, and largely standardized format of time-diary data allow social epidemiological research into both cross-national differences and trends.

The ancillary questionnaire materials in the HETUS studies, and many of the other surveys in the MTUS, include summary indicators of respondents’ health and well-being. Furthermore, the diaries provide specific measures of various physiologically necessary activities. With respect to eating, they show the timing of meals, their location (home, workplace, restaurant/pub), and their

social context (family, workmates, friends). For exercise, they allow researchers to compare intentional exercise (gym, sports) with physical activity involved in paid and unpaid work and travel. For sleep research, diaries show historical representative samples of durations and timing not available from any other source (for example, the MTUS trend data show that, contrary to previous research relying on retrospective evidence, sleep time across the developed world does not appear to have declined as a result of the perceived shift to 24/7 lifestyles; Robinson & Michelson 2010).

Time-diary data are now starting to be used to describe socioeconomic inequalities in physical activity patterns (Bauman et al. 2019), as well as in applications in the study of environmental exposure (Isaacs et al. 2013) and circadian rhythms (Lamote de Grignon Pérez et al. 2018).

Other outcome studies. Time-use surveys have been, with a very few exceptions, cross-sectional. However, the opportunity is arising to combine time-use data with longitudinal panel data in order to analyze outcomes in various measures. In the United States, there are diaries collected from the children of respondents in the Panel Study of Income Dynamics (Hofferth & Sandberg 2001). In the United Kingdom, there are diary records at age 16 for the 1970 Birth Cohort, age 14 for the Millennium Cohort study, and on the 2013 Innovation Panel of the Understanding Society Longitudinal study. Such data provide scholars with the opportunity to investigate associations between the aggregate amount, timing, and sequencing of activities in the diary with longitudinal records of cohort/panel members' subsequent health, educational success, social class position, and other outcomes.

CONCLUSION

The past three decades have seen considerable growth in research on the use and structure of time, providing key insights into important substantive sociological topics. Time-use diary data have made a key contribution to research on the distribution of time between women and men, for example, enabling detailed analysis across countries of a slow and halting reduction of gender inequalities in the division of labor. General analyses of time-use trends run, in some respects, rather contrary to expectations. True, women's core housework has been reduced, men's and women's unpaid work totals have converged somewhat, and information technology use has grown explosively. But the broadest summary result is of a certain consistency in time-use patterns. The totals of (paid and unpaid) work, the amount of sleep, and hence the total of leisure/consumption time—over our 55-year observation window—all changed much less than was expected by the futurologists of the 1960s.

At the same time, sociologists have begun to look more closely at the timing and sequencing of these activities in order to understand how time plays a role in the structuring of individuals' daily and weekly routines. Ultimately, these studies highlight a need for additional research on the individual and societal origins of time-use patterns, as well as the consequences of these patterns for individuals and for larger society. The order and timing of everyday action matters for crucial social processes such as coordinating household divisions of labor and other productive activity, scheduling network contacts, real-time diffusion, and other policy-relevant processes.

Considerable headway continues to be made both in standardizing time-stamped data to facilitate comparative cross-time analysis and in employing new technologies and methods for data collection and analysis. This has included the development of a very large set of harmonized time-diary data across numerous countries and time periods via the MTUS. A key challenge for time-use scholars in the coming decade will be to reconcile this existing data corpus with data that will be collected via newer technologies. There remains a major difference in the nature of the data collected from whole-day diary accounts from nationally representative samples versus point

estimate measures across much larger but nonrepresentative populations. Prospectively, the two will likely converge. But time-use researchers need to construct an adequate bridge between current diary-based measures and these new possibilities that will allow the estimation of real change in daily activity patterns across the historical divide between traditional and newer methods.

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