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WORKING PAPER SERIES

COMING OF AGE ON THE MARGINS: A LIFE COURSE PERSPECTIVE ON THE TIME-USE OF AUSTRALIAN ADOLESCENTS WITH DISABILITIES

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No. 2022-04

January 2022

Australian Government Australian Research Council

The University Of Queensland Australia

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NON-TECHNICAL SUMMARY

People with disabilities experience high rates of disadvantage, that emerge in childhood and persist throughout the life course. Adolescence may be a critical period in the emergence of disability related disadvantage: rapid physiological and cognitive development, occurring in parallel with secondary education and changing patterns of family and peer relationships, mean that the experiences of adolescents with disabilities are likely to play a crucial role in shaping their life chances into adulthood.

In this paper, we contribute to understanding the mechanisms and processes that drive disadvantage among people with disabilities by investigating the time-use of adolescents with disabilities in comparison to their peers without disabilities. Data for 7,905 children aged 10-15 (19,687 child-year observations) are drawn from the Longitudinal Study of Australian Children. As the first nationally representative time-diary study to identify disability-related gaps in adolescents time-use, we make an important methodological contribution to the literature on participation among children and adolescents with disabilities. We further investigate differences in disability-related gaps in time-use by age and gender.

We find substantively large disability-related gaps in time spent in activities and with companions, patterned in a way that is likely to be detrimental to the relationships, learning, and health of adolescents with disabilities. Consistent with previous studies, adolescents with disabilities spend substantially less time with peers and more time with mothers and alone, indicating that they are socially isolated. They also spend less time in educational activities (at school, homework, private lessons) and more time in sedentary leisure (screen time). Disability related gaps in time-use are largest among boys and older adolescents.

Our findings imply that social exclusion of adolescents with disabilities is pervasive and damaging for their social relationships, academic achievement, and health. Given the sensitivity of the developing body and brain in adolescence, harms resulting from the social exclusion of adolescents with disabilities are likely to persist over the life course. Broad social and institutional changes are necessary to ensure that adolescents with disabilities are fully included in peer groups and schools.

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Acknowledgements

Martin O'Flaherty's work on the paper was funded by the Australian Research Council Centre of Excellence (ARC) for Children and Families over the Life Course (CE140100027 and CE200100025). This paper uses unit record data from Growing Up in Australia: The Longitudinal Study of Australian Children

(LSAC). LSAC is conducted by the Australian Government Department of Social Services (DSS). The findings and views reported in this paper, however, are those of the authors and should not be attributed to the Australian Government, DSS, or any of DSS' contractors or partners.

ABSTRACT

Adolescents with disabilities experience multiple disadvantages spanning health, education, social capital, and emotional and cognitive development. Time-use may be an important determinant of these outcomes, but links between disability and adolescent time-use have not been adequately explored by previous research. Utilizing nationally representative time diary data for a cohort of Australian adolescents aged 10-15, this paper addresses this gap by comparing the time-use of adolescents with disabilities to their peers without disability. We further investigate how disability-related gaps in time-use differ by sex and age. Our results suggest that effects of disability on adolescent time-use are widespread and substantial in magnitude, particularly for boys and for older adolescents. Adolescents with disabilities spend more time alone and with their mothers, and boys with disabilities spend less time with peers. Gaps in time spent alone and with peers increase in magnitude for older adolescents. Time spent in activities also differs markedly: adolescents with disabilities spend less time in educational activities (schooling, homework, and lessons) and, for boys, structured leisure activities. Conversely, adolescents with disabilities spend more time on screen-based leisure activities. The gap in screen-based leisure increases in magnitude at older ages, with the increase driven primarily by time spent in video games. We conclude that differential time-use is a plausible mechanism contributing to multiple disadvantages experienced by adolescents with disabilities over the life course, and that boys and older adolescents with disabilities are likely to be most affected.

Keywords: Disability, Time-use, Participation, Adolescence

Suggested citation: O'Flaherty, M., King, T., & Kavanagh, A. (2022). 'Coming of Age on the Margins: A Life Course Perspective on the Time-Use of Australian Adolescents with Disabilities', Life Course Centre Working Paper Series, 2022-04. Institute for Social Science Research, The University of Queensland.

Introduction

Adolescents' time – *how* and *with whom* it is spent – matters for health, relationships, and cognitive and socioemotional development (Lam & McHale 2015; Larson & Verma 2001). Notwithstanding ongoing debates about the relative importance of time spent in specific activities or with specific activity partners (Hsin & Felfe 2014; Milkie, Nomaguchi, & Denny 2015), broad scholarly agreement on this overarching point has given rise to a burgeoning empirical literature documenting patterns and determinants of children's and adolescents' time-use. Previous work has, for example, documented differences in time-use by family socio-economic status (Guryan, Hurst, & Kearney 2008; O'Flaherty & Baxter 2020), family structure (Kalil, Ryan, & Chor 2014), child age and sex (Lam, McHale, & Crouter 2012, 2014), and adolescent sexual orientation (Perales, Campbell, & O'Flaherty 2020). Regrettably absent from this literature, however, is the experience of adolescents with disabilities.

Disability, broadly defined, may be understood as restrictions in *functioning* or *participation* that arise from the intersection of an underlying health condition and the social and physical environment (World Health Organization [WHO] 2001). In Australia, roughly one-in-ten children aged 5-14 have some level of disability, of whom slightly more than half experience severe or profound limitation in core daily activities (Australian Bureau of Statistics 2018). Children and adolescents with disabilities experience many disadvantages, including poorer academic achievement (Crump *et al* 2013; Chatzitheochari & Platt 2019), physical and mental health outcomes (Emerson *et al* 2016; King *et al* 2018), and lower social acceptance by peers (Locke *et al* 2010; Petrina, Carter, & Stephenson 2014). At the individual level, adolescence represents a critical period for social (Blakemore & Mills 2014), biological (Patton *et al* 2016; Viner *et al* 2015), and cognitive development (Larsen & Luna 2018), all set within the shifting social contexts of family, peer group, and schools (Crosnoe & Johnson 2011). It is likely, therefore, that the many challenges facing adolescents with disabilities will have far-reaching implications for many aspects of their wellbeing and life chances. Unsurprisingly then, disability related disadvantages persist throughout the life course – adults with disabilities are less likely to be employed or have a partner, are poorer, have lower levels of completed education, and have weaker and less supportive social networks (Janus 2009; Kavanagh *et al* 2015; Mithen *et al* 2015).

To understand the life course origins of disadvantage for people with disabilities, it is therefore crucially important for research to identify processes and mechanisms that may impact the development of adolescents with disabilities. In this paper, we contribute to this objective by studying disability-related gaps in adolescent time spent in/with a broad range of *activities* and *companions*. An extensive body of evidence links many varieties of time-use to an array of outcomes including academic achievement, cognitive development, emotional and behavioural adjustment, and physical and mental health (Barnes *et al* 2007; Farb & Matjasko 2012; Hsin & Felfe 2014; Milkie, Nomaguchi & Denny 2015; Stiglic & Viner 2019). Given the lack of previous evidence on the time-use of adolescents with disabilities, we therefore aim to present a broad picture of differences in time-use across activities and companions that may be developmentally important, in comparison to adolescents without disability. Motivated by the rapid changes in patterns of activities and relationships over the adolescent years (Crosnoe & Johnson 2011; Lam, McHale, & Crouter 2012, 2014), we further investigate how these gaps differ by child age and sex. In contrast to previous literature, we use high-quality time diary data from a large, nationally representative sample of adolescents with and without disability. Our analysis provides reliable estimates of disability-related gaps in time-use, marking an important milestone in scholarship on adolescents with disability.

Our results show substantively large gaps in educational time, screen time, and time alone and with peers that are likely disadvantageous to the development of adolescents with disabilities. These gaps are largest among boys and older adolescents. We conclude that developmentally significant gaps in time-use represent a plausible mechanism contributing to the ongoing challenges that confront adolescents with disabilities as they transition to adulthood, and highlight priorities for future investigation.

Disability, time-use, and adolescent development: A life course perspective

Understood as a window on the developmental contexts, threats, and opportunities encountered by an adolescent (Lam & McHale 2015; Larson & Verma 2001), time-use touches on many of the core themes of research on adolescence. We organize our discussion around three such themes, which we denote as (1) *changing connections*, (2) *learning journeys*, and (3) *the developing body*. For each theme, we discuss the role of time-use in development and how disability is linked to developmentally important dimensions of

adolescent time-use. The first theme, *changing connections*, highlights the ongoing renegotiation of peer- and family relationships as adolescents gain greater autonomy, spend more time outside the home, and establish new identities, roles, and relationships (Crosnoe & Johnson 2011; Lam, McHale, & Crouter 2012; 2014). Neurologically, changes in adolescents' relationships are underpinned by heightened sensitivity to social cues as the skills required to manage increasingly complex social interactions are developed (Blakemore & Mills 2014). Increasingly, adolescents' relationships are electronically mediated, as social media and video games create new forms of sociability (Subrahmanyam & Greenfield 2008).

For a great deal of time-use research, there is a tendency to approach adolescents' changing relationships through the prism of risks associated with diminished *social control* – substance use, delinquency, early sexual initiation, emotional problems, and aggression. To this way of thinking, unsupervised time with peers or in online environments represent contexts where parents and other adults have minimal ability to monitor their child's behaviour or counteract possible negative influences from peers. Conversely, time with family is thought to promote closer intergenerational relationships and enable effective parental monitoring, thereby averting many of the aforementioned problems. In this vein, Lam, McHale, & Crouter (2014) report that unsupervised time with peers is related to increases over time in behavioural problems and symptoms of depression and suggest 'strategies that promote adult involvement' (p1688) as the remedy. Barnes *et al* (2007) find that unsupervised time with peers predicts higher (and family time lower) adolescent substance use, sexual activity, and delinquency. They conclude that 'Social policies which encourage parents and adolescents to spend positive social time together and encourage peer socialization within adult-supervised settings may facilitate the prevention of substance use, delinquency and risky sexual behavior in older adolescents' (Barnes *et al* 2007: p709).

The social relationships of adolescents with disabilities, however, present rather a different problem. Instead of diminished *social control*, the predominant challenges for adolescents with disabilities are those of *social isolation*. Evidence indicates that adolescents with disabilities have fewer and poorer quality friendships, family dominated social networks, and higher levels of loneliness (Locke *et al* 2010; Kasari *et al* 2011; Petrina, Carter, & Stephenson 2014; Taheri, Perry, & Minnes 2016). In part, these differences may reflect poorer social skills among adolescents with disabilities, but they are also indicative of a

hostile social environment. Adolescents with disabilities experience markedly higher rates of bullying (Chatzitheochari, Parsons, & Platt 2016; King *et al* 2018; Sentenac *et al* 2013) and are subject to a range of negative stereotypes and stigma (Mazumder & Thompson-Hodgetts 2019; Shifrer 2013). In response, adolescents with disabilities may retreat to digital environments, with a wealth of evidence showing greater time spent on video games and television (Healy *et al* 2017; Mazurek & Engelhardt 2013; Ng, Augustine, & Inchley 2018).

We stress that, while adolescents with disabilities may in some cases self-select out of social interaction and into screen-based activities, this does not mean they do not also *benefit* from social interaction. Orsmond and Kuo (2011), for example, show that time spent conversing is linked to improvements over time in social skills among adolescents with autism spectrum disorders. Similarly, excessive screen time may contribute to atrophy in relational capabilities and social capital (Kowert *et al* 2014; Richards *et al* 2010). Thus, a negative feedback loop may exist for adolescents with disabilities, where exclusion or withdrawal from social interaction with peers diminishes social skills and connections, leading to further isolation. Because social processing capabilities are developing rapidly and sensitive to change during the adolescent years (Blakemore & Mills 2014), there is the potential for this harmful dynamic to contribute to social challenges into adulthood.

Our second theme, *learning journeys*, centres on the processes of education and skill formation that lay the foundations of future success in post-secondary education or employment. Schools, the preeminent institution of adolescence, play an outsized role in these processes through formal learning and as the nexus of friendship networks. Time engaged with schooling, in the form of consistent school attendance and homework, plays an important role in promoting academic achievement and cognitive development (Aucejo & Romano 2016; Kalenkoski & Pabilonia 2017). The school context may, however, be challenging for many adolescents with disabilities, resulting in high rates of non-attendance (Black & Zablotsky 2018; Totsika *et al* 2020). As noted above, relationships with peers are often of poorer quality and schools may be a location where adolescents with disabilities are exposed to bullying (Rose, Monda-Amaya, & Espelage 2011). Bullying victimization, in turn, likely contributes to absenteeism and poorer academic and behavioural outcomes (Gastic 2008). In their interactions with adults around schooling, adolescents with disabilities may be subject to a 'curse of low expectations', with teachers and parents expressing lower

educational expectations than warranted by prior academic performance (Chatzitheochari & Platt 2019; Shifrer 2013). Low educational expectations may translate to less parent/teacher encouragement to study, disengagement from school, and ultimately less time invested in schooling and homework among adolescents with disabilities.

Beyond the boundaries of formal learning, a large body of evidence suggests that adolescents' time use contributes to academic achievement and the development of cognitive and non-cognitive skills. A key distinction in the literature is between *structured* and *unstructured* leisure time, with the former generally thought to better support adolescent development (Farb & Matjasko 2012). Structured leisure time activities (such as participation in sports or clubs) provide contexts that are rules-based, goal-oriented, involve focussed practice of specific skills, and adult supervised (Larson 2000). These activity characteristics are thought to promote development of non-cognitive skills such as self-efficacy, self-control, or motivation (Coulangeon 2018; Hille & Schupp 2015) that are supportive of academic achievement. Structured activities may also encourage formation of pro-social peer networks and build student engagement with schools (O'Flaherty, Baxter, & Campbell 2022). Fitness gains associated with structured sporting activities may also contribute to improvements in cognitive performance, particularly executive functioning (Biddle *et al* 2019). Consistent with these arguments, multiple longitudinal studies have found that participation in structured leisure is linked to increased academic performance (Carbonaro & Maloney 2019; Coulangeon 2018; Hille & Schupp 2015). Unstructured leisure time, while not harmful *per se*, may crowd out productive activities and is associated with greater risk of negative peer interactions. The implications of unstructured leisure time for learning do, however, likely depend strongly on content. Passive activities such as television viewing require minimal effort and may therefore offer little opportunity for adolescents to exercise cognitive or non-cognitive skills. Depending on play time, content, and design, video games may contribute to a range of positive (e.g. problem solving, spatial reasoning) or negative (e.g. attention problems, aggression, social withdrawal) outcomes (Gentile 2011; Gentile *et al* 2012; Granic, Lobel, & Engels 2014; Kowert *et al* 2014; Richards *et al* 2010).

A range of contextual and attitudinal barriers may push adolescents with disabilities out of structured leisure and into unstructured leisure, with potential negative implications for learning. These effects appear across a range of disability types, although the barriers to

participation may vary (Bult *et al* 2011; Law *et al* 2007; Shields, Synnot & Barr 2012). For example, Solish, Perry, & Minnes (2010) report that typically developing children participate in roughly twice as many structured leisure activities in comparison to children with autism spectrum disorder or intellectual disability. They also find that typically developing children engage in structured leisure *with peers* much more often, suggesting that even when adolescents with disabilities engage in these activities, they may not obtain the same social benefits. There is some evidence to suggest that gaps in leisure participation vary by age. King *et al* (2010) analyse participation in a range of activities for children and adolescents with physical disabilities (in comparison to typically developing peers), finding that gaps in the diversity and intensity of participation in organized physical activities emerge or increase in magnitude among adolescents aged 12-14 compared to younger age groups. Lower rates of participation in structured leisure among adolescents with disabilities, in conjunction with high screen-based leisure time noted above, may limit opportunities for cognitive and non-cognitive development.

Time use is important also for adolescent physical and mental health, the focus of our third theme *the developing body*. Adolescence is generally a period of good health, but from a life course perspective there is a growing awareness that the physical and cognitive development occurring in adolescence are fundamentally important in shaping adult health (Larsen & Luna 2018; Patton *et al* 2016; Viner *et al* 2015). For physical health, the clearest link to time use is in terms of active vs sedentary leisure time. Physical activity contributes to healthy weight, bone and muscle development, and cardiorespiratory fitness, and these forms of adolescent health capital predict a range of later adult health outcomes (Patton *et al* 2016). Conversely, sedentary time (including screen time) carries no such benefits, may displace time for physical activity (Melkevik *et al* 2010), and may be independently harmful for cardiovascular health (Stiglic & Viner 2019; Carson *et al* 2016). Given the evidence linking disability to lower rates of sports participation (Healy *et al* 2017; King *et al* 2010) and higher screen-time (Healy *et al* 2017; Mazurek & Engelhardt 2013; Ng, Augustine, & Inchley 2018), it appears likely that the time use of adolescents with disabilities may carry unfavourable consequences for their physical development.

As a period of rapid cognitive and neurological change, adolescence may be a sensitive period for mental health also, perhaps contributing to the onset of many mental health

disorders during this time (Larsen & Luna 2018). The relationships of time-use to adolescents' mental health are less clear than for physical health, but there are nonetheless important links. First, chronic stress and social isolation have been shown to impact on the development of the prefrontal cortex in adolescence, potentially contributing to depression, schizophrenia, and low self-control (Larsen & Luna 2018). Thus, social exclusion of adolescents with disabilities may affect brain development, with long term consequences for mental health. Low physical activity and high sedentary behaviour may also contribute to mental health outcomes for adolescents with disabilities. Recent systematic reviews of sedentary behaviour generally (Hoare *et al* 2016) and screen-based sedentary behaviour specifically (Stiglic & Viner 2019) report consistent associations between large amounts of sedentary time and a range of outcomes including anxiety, loneliness, stress, and self-esteem. Biddle *et al* (2019) review a broad range of evidence on the relationship between physical activity and mental health in adolescents and conclude that there is moderate support for a causal effect of physical activity on reduced depression. We note, however, that the mechanisms linking time spent on physical activity or sedentary behaviour to mental health have not been fully elucidated, and effects likely depend on the content (cognitively challenging or not), context (social or non-social), and structure (cooperative or competitive) of the activity.

Time-use classification and research questions

The evidence reviewed above demonstrates pervasive links between many dimensions of adolescent time-use and social, academic, cognitive, physical, and emotional development. Based on this evidence, we classify adolescents' time in *activities* and with *companions*. For activities, our primary classification considers 'active leisure', 'screen-based leisure', 'non-active leisure' (excluding screen-based), 'time at school', 'private lessons and homework', and 'communication'. These groupings were chosen to reflect activities that are likely to be important for health ('active leisure', 'screen-based leisure'), learning ('time at school', 'private lessons and homework') and social relationships ('communication'). The categories are exclusive (because they are based on the child's primary activity) but not exhaustive.

We also consider two alternative classifications of activity time. First, *structured* and *unstructured* leisure time is created by recombining codes that form part of either 'active

leisure' or 'non-active leisure' in our primary activity classification. Structured leisure represents time in formal activity settings such as clubs, organized sports, or cultural activities. In contrast, unstructured leisure is free-play or unsupervised activities, such as playing with pets, reading, or listening to music. Second, we divide 'screen-based leisure' into three subcategories: 'TV', 'video games', and 'communication via an electronic device'. These categories represent an important distinction, as these activity types may each require (and contribute to) different cognitive and social skills. TV represents the largest component of screen-based leisure at all ages and for adolescents both with and without disability but, as a relatively passive activity, may have the least potential benefit. Video games often require greater cognitive effort and, in some instances, act as a platform for social interaction. Last, electronic communication is likely to be important for adolescents' engagement with friendship networks.

For companions, this includes time spent alone, with family (mother, father, siblings), and with peers. This reflects concerns that adolescents with disabilities may experience social isolation and limited peer networks, with potential implications for social skill development, mental health, and social capital. Because children may be with more than one companion simultaneously, and because they may also spend time with other adults, this classification is neither exclusive nor exhaustive.

Building on the preceding discussion, the paper seeks to address two primary research questions:

- *Research Question 1: How is disability related to adolescents' patterns of time spent in activities and with companions, in comparison to adolescents without disability?*
- *Research Question 2: How do disability-related gaps in adolescents' time-use differ by age and sex?*

Data and methods

Data for the paper are drawn from the Longitudinal Study of Australian Children (LSAC), a nationally representative cohort study of children resident in Australia. LSAC commenced data collection in 2004 with children aged 0-1 years ('B' cohort) or 4-5 ('K' cohort), with

biennial waves of data collection continuing to 2020 to date. At the first wave, data were collected for a total of 5,107 B cohort children and 4,983 K cohort children, representing a response rate of 57.2% for B cohort and 50.4% for K cohort (Soloff, Lawrence, & Johnstone 2005). Ethics approval for the LSAC study was provided by the Australian Institute of Family Studies Ethics Committee. Full details of LSAC survey methodology have been published elsewhere (Mohal *et al* 2020; Soloff, Lawrence, & Johnstone 2005).

Primary outcome data for the paper are drawn from waves 4-6 (2010-2014) for K cohort and 6-8 (2014-2018) for B cohort, corresponding to child ages 10-15 for both B and K cohorts. There were a total of 21,934 child-year observations (8,207 children) for the main data collection over these periods, with time-use data available for 20,059 child-year observations (7,979 children), a completion rate of 91.5% for the diary component. Diary completion rates are slightly higher among younger children (94% for 10-11 year-olds, compared to 88.6% for 14-15 year-olds). A further 192 child-years were excluded from analysis due to missing covariate data. The final main analysis sample is comprised of 19,867 child-day observations nested within 7,905 children.

Time Use Diary Measures: Children completed a time-use diary detailing all activities undertaken on the day prior to the main interview, including the starting time of each activity, location of the activity, and the presence of others. A paper diary was mailed to children in advance of the interview, with instructions for how to complete the diary. On the day of the interview, the interviewers recorded the child's diary electronically, with prompts for clarification and additional information from the child where required. The approach is consistent with best-practice methods for time-diary studies with adolescents (Chatzitheochari *et al* 2018). This information was then used to construct measures of time spent by children with *companions* or engaged in different types of *activities*. The set of activity codes used in our activity classification is presented in appendix table A3.

Notably, waves 4 and 5 of K cohort use a less detailed coding frame to record activities than wave 6 of K cohort and waves 4-6 of B cohort. In practice, the more detailed codes used for wave 6 K cohort and waves 4-6 B cohort are nested within the broader codes used at earlier waves of K cohort, meaning that the alternative coding frameworks are easily reconcilable. We stress also that the responding children did *not* use the coding framework to record their

activities directly (the raw activity data are free-text descriptions), suggesting that the change in coding is unlikely to have affected children's responses.

Child Disability Measures: LSAC includes multiple measures of disability for the study child. Two measures are recorded at each wave when children are aged 10-11, 12-13, and 14-15, and capture the presence of 1) long-term conditions or disabilities, and 2) restrictions in everyday activities. First, the presence of long-term conditions or disabilities is identified through parent responses to the question '*Does [child] have any medical conditions or disabilities that have lasted for six months or more?'*. Second, restrictions in core activities are recorded as follows: '*Still thinking of conditions lasting six months or more, is [child] restricted in everyday activities because any of the following?'* Showcard prompts for both questions are shown in table A3. Notably, wave 4 of K cohort used different wording for the showcards of both items, resulting in a considerably higher prevalence of 'disability' at this wave. We include observations from wave 4 of K cohort in our main analysis but conduct sensitivity analysis to assess the extent to which our findings may be affected. We define a child as having disability if their parent reports either long-term conditions or restrictions in everyday activities. Data are drawn from waves 4-6 (years 2010-2014) for K cohort and 6-8 (years 2014-2018) for B cohort.

Control Variables: Control variables for the analysis include the child's sex, age in years, the family's cultural background, the mother's age in years at the time of the child's birth, family structure (two biological parents; step families; single parent families; and other family structures), the number of siblings present in the household, the mother's highest level of education (degree, non-degree post-secondary or completed secondary, and less than completed secondary), residence in an urban location, deciles of Socio-Economic Index of Disadvantage for Areas (SEIFA) for the household's place of residence, type of day recorded in the time diary (weekday; weekend), and study cohort ('B' cohort; 'K' cohort). These controls were selected as they represent common determinants of child time-use in the literature.

Analysis: Following standard practice in the time-use literature, we use ordinary least squares regression to estimate differences in time-use for children with disability compared to their peers without disability. All models are weighted using the attrition weights developed by the

LSAC study team, and cluster-robust standard errors are used to allow for repeated observations within children. In the interest of brevity, we report only estimates from models adjusted for the set of controls described above.

Results

Table 1 shows descriptive sample statistics for covariates by disability status. Of the 19,687 child-year observations included in the analytic sample, roughly 6.6% (1,294) are classified as disabled. The 1,294 child-years classified as disabled are drawn from 1,076 unique children. Children with disability are more likely male (56.7% *vs* 50.4%), less likely to live with both biological parents (70.1% *vs* 77.1%), and have mothers with lower levels of education. They are also more likely to belong to a child in 'K' cohort, although this difference is limited to children in the 10-11 age group (when 'K' cohort children have a 9.9% prevalence of disability, compared to 5.7% for 'B' cohort children at the same age) and is attributable to the change in showcard wording described above.

Time-use summary statistics by age group and disability status are shown in table 2. In large part, age-related differences in time-use for children with disability mirror those found for children without disability. Notably, regarding companions, these include large increases among older children in time spent alone, alongside decreases in time spent with mothers and siblings. Children with disability also report less time with peers at older ages, while time spent with peers does not differ meaningfully for children without disability. Turning to activities, screen-based leisure time increases substantially for all children, but by a larger amount for children with disability. Active leisure time decreases for all children, while time spent on private lessons and homework or communication increases for all children. Non-active leisure time remains roughly constant, while time at school is lower at older ages for children with disability but not children without disability. In bivariate terms, these results suggest that children with disability exhibit patterns of time-use that would generally be considered disadvantageous, particularly at older ages – greater time alone and in screen-based leisure, less time with peers, at school, and in private lessons and homework. These results do not, however, address potential confounding of disability status, nor do they allow for selective attrition. To correct for these issues, we now turn to model results.

Table 1: Summary statistics: Covariates by disability status

	No disability		Disability	
	mean	sd	mean	sd
Child age in years	12.7	1.7	12.5	1.7
Female child	49.6%		43.2%	
Ethnicity				
Australian born, non-Indigenous	95.5%		95.6%	
Non-Australian born	2.2%		1.5%	
Indigenous	2.3%		2.9%	
Either parent non-Australian born	32.4%		24.7%	
Mother age at birth of child	30.7	5	30.1	5.1
Family structure				
2 biological parents	77.1%		70.1%	
1 biological parent and 1 non-biological parent	7.4%		10.2%	
1 biological parent	15.2%		19.6%	
Other family structure	.2%		.2%	
Number of siblings in household	1.5	.9	1.6	1
Mother's education (wave 1)				
Degree	36.4%		28%	
Completed secondary or non-Degree post-secondary	49%		52.3%	
Incomplete secondary	14.6%		19.7%	
Urban location	84.8%		84.3%	
SEIFA score	10.2	.7	10	.7
Weekend diary day	21.3%		20.9%	
Cohort 'K' child	52.7%		58.6%	
N (observations)	18,573		1,294	

Tables 3-6 presents estimates for the effect of disability on time-use from ordinary-least squares regressions. All models adjust for demographic and socio-economic background, diary day, and study cohort, and are weighted to correct for selective attrition. Standard errors are clustered by child to allow for repeated measurements. For each outcome, we report estimates from three models. First, panel A shows effects of disability from a model with no interactions between disability status and other covariates. Panels B and C show estimates from models where disability status is interacted with child sex and age respectively. Note that because of the interactions, parameters for 'disability' in in these models effectively represent effects of disability for boys (Panel B) and children at the sample mean age 12.7 years (Panel C) respectively. Effects of disability for girls or for children of different ages are obtained by combining the 'main effect' of disability with the relevant interaction terms.

Table 2: Daily time use (minutes) by age and disability status

	Ages 10-11				Ages 12-13				Ages 14-15			
	No disability		Disability		No disability		Disability		No disability		Disability	
	mean	*s.d.*	mean	*s.d.*	mean	*s.d.*	mean	*s.d.*	mean	*s.d.*	mean	*s.d.*
Companions												
Alone	154.7	*135.4*	158.3	*133.9*	199.7	*162.3*	209.9	*176.5*	271.5	*190.6*	313.9	*226.6*
Mother	195	*155.1*	197.6	*172.2*	181.1	*154*	198.2	*164.5*	157.1	*149.4*	170.6	*158*
Father	115.4	*139.1*	113	*134.3*	116.5	*143*	111.5	*150.5*	105.6	*139.1*	94.1	*123.5*
Siblings	260.1	*212.8*	251.1	*203.9*	206.5	*193.3*	210.3	*212.4*	157.9	*177.8*	143.6	*167.1*
Peers	198.2	*177*	187.2	*170.9*	194.9	*176.2*	183.9	*182*	198.9	*188.4*	168.9	*182.5*
Activities												
Active leisure	84.8	*97.8*	85.6	*94.8*	68.1	*90.8*	68.6	*99.6*	57.6	*87.2*	46.1	*77.6*
Screen-based leisure	168.5	*143*	178.6	*141.1*	184.8	*153.1*	221	*175.8*	212.2	*176.9*	251.4	*188*
Non-active leisure	84.1	*96.6*	80.3	*89.6*	73.6	*94.6*	79.6	*107.5*	70.1	*96.3*	78.5	*106.4*
Time at school	196.4	*197.9*	197.4	*194.6*	212.3	*203.8*	187.7	*197.1*	186.2	*204.2*	167.2	*195.7*
Private lessons and homework	18.5	*40.1*	14.9	*36.1*	27.2	*52*	19.8	*49.1*	34	*68.6*	21.5	*55.8*
Communication	30.1	*67.9*	26.1	*55.7*	43	*87.3*	37.4	*79.5*	81.2	*113.9*	73.3	*95.8*
Structured vs. unstructured												
Active leisure - structured	22.4	*50.2*	24.7	*54.4*	23.9	*55.8*	14.6	*41.6*	24.6	*56.6*	16.4	*52.3*
Active leisure - unstructured	62.4	*89.2*	60.9	*85.9*	44.3	*76.3*	54	*90.7*	32.9	*69.5*	29.7	*57.7*
Non-active leisure – structured	11.8	*41.2*	9.1	*36.4*	7	*33*	5.6	*26.8*	8.7	*36.7*	7.8	*32.8*
Non-active leisure – unstructured	72.3	*87.7*	71.2	*83.6*	61.5	*84.6*	67.9	*97.3*	61.4	*89.6*	70.7	*103.8*
Leisure – structured	34.2	*64.2*	33.8	*64.6*	30.9	*65.3*	20.2	*48.5*	33.3	*66.9*	24.2	*63.1*
Leisure – unstructured	134.8	*124.6*	132.1	*124.1*	105.8	*114.3*	121.8	*131.7*	94.3	*112.4*	100.3	*117.6*
Screen-based leisure subtypes												
TV	113.5	*108.2*	121.5	*110.6*	118.8	*115.7*	140.3	*132*	124.9	*130.5*	140.9	*138.4*
Video games	50.1	*85.6*	52.5	*82.8*	48.3	*91.3*	62.3	*106*	63.7	*120.2*	85	*148.8*
Electronic device – communication	2.4	*13.3*	2.6	*17*	13.9	*44.9*	6.1	*28.6*	28.3	*61.1*	27.5	*65.7*
N (observations)	6,788		582		6,282		361		5,503		351	

Regarding time with companions (table 3), our results reconfirm disadvantages reported in the bivariate analysis. We find that on average (Panel A) children with disability spend roughly one quarter-hour more alone (17.1, $p < 0.01$) and with their mothers (15.9, $p < 0.01$), and one quarter-hour less with peers (-15.3, $p < 0.01$) per day net of controls for demographic and socio-economic background. Panels B and C report results from models that allow the effect of disability to be moderated by age or sex. For time with peers, our results show that the size of gaps depends on *both* sex and age. Specifically, the reduced time with peers for children with disability appears to be confined to boys, who spend on average nearly half-an-hour less per day with peers (Panel B: -27.0, $p < 0.001$). For girls, the gap is very close to zero, as the 'main effect' of disability is offset by the interaction of disability with female (26.2, $p < 0.05$). Disability-related gaps in time with peers also increase at older ages, by a margin of roughly 7 seven minutes less per day for every year of age (Panel C: -6.7, $p < 0.05$). This pattern is mirrored by increases in time spent alone, equivalent to slightly less than 10 minutes per day for every year of child age (8.5, $p < 0.05$). In practice, our results imply that the effects of disability on time alone and time with peers are close to zero for children in the younger (10-11) age group, and substantial in magnitude for older children. Disability-related gaps in time spent with mothers were constant over child age and sex, and we found no evidence that disability is related to either time with fathers or time with siblings.

Table 4 shows estimated effects of disability on time spent in various activities. We did not find effects of disability on time spent in active leisure or non-active leisure, and only a slight difference in time spent in communication at older ages (Panel C: -3.4, $p < 0.05$). For reference, the gap in communication time equates to 10 minutes per day for a 15-year-old child. Notably, children with disability spend substantially less time on formal educational activities, including time at school (Panel A: -16.4, $p < 0.01$) and time on private lessons or homework (Panel A: -4.4, $p < 0.01$). The combined total of these gaps is equivalent to slightly more than 20 minutes per day and appears to be roughly constant over age and sex. Finally, we find higher time spent on screen-based leisure among children with disability (Panel A: 16.2, $p < 0.01$). This gap increases in size with age, amounting to nearly 40 minutes per day for a fifteen-year-old child. Conversely, our results imply minimal differences in screen time among children in the younger age group (10-11). In sum, results for time with

Table 3: Time with companions

	Alone	Mother	Father	Siblings	Peers
		Panel A: Main effect of disability only			
Disability	17.1**	15.9**	-1.9	-1.0	-15.3**
	(5.7)	(5.7)	(4.3)	(6.1)	(5.5)
		Panel B: Effects of disability moderated by sex			
Disability	15.4*	21.3**	-3.2	5.1	-27.0***
	(7.7)	(7.8)	(5.8)	(8.2)	(7.0)
Disability * Female	3.9	-12.2	2.9	-13.7	26.2*
	(11.5)	(11.4)	(8.5)	(12.2)	(11.2)
Female	-18.3***	15.5***	-18.6***	-3.1	14.9***
	(3.0)	(2.7)	(2.3)	(3.5)	(3.2)
		Panel C: Effects of disability moderated by age			
Disability	18.6**	16.6**	-2.2	-1.0	-16.5**
	(6.0)	(5.7)	(4.2)	(6.0)	(5.6)
Disability * Age	8.5*	4.0	-1.7	-0.1	-6.7*
	(3.4)	(3.2)	(2.2)	(3.3)	(3.3)
Age	28.5***	-10.0***	-2.6***	-24.1***	0.8
	(0.8)	(0.7)	(0.6)	(0.9)	(0.9)

N = 19,867; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; All models control for child age in years (centered at the sample mean age), child gender, ethnic background, mother's age at the time of child's birth, family structure, number of resident siblings, mother's education at wave 1, residence in an urban area, area-level socioeconomic disadvantage, diary day (weekend vs. weekday), and cohort membership. Models are weighted to correct for attrition, and standard errors are clustered by child to allow for repeated measurements.

companions and for our primary activity classifications largely confirm the bivariate analysis: children with disability display gaps in time-use that appear broadly disadvantageous for the development of their human and social capital.

Structured vs. unstructured leisure: Table 5 shows estimated effects of disability on time spent in structured and unstructured leisure, which we further categorize as active, non-active (excluding screen time), and total non-screen leisure (the sum of active and non-active categories). Results from models with no moderation of effects of disability (Panel A) show minimal differences: we find only a slightly lower amount of time spent in total structured leisure (-3.8, $p < 0.05$) for children with disability. However, these average results conceal important differences in the effects of disability by child sex – boys with disability spend less time in structured active leisure (-4.1, $p < 0.05$), structured non-active leisure (-3.6, $p < 0.05$), and structured total leisure (-7.7, $p < 0.001$). They also spend more time in unstructured non-active leisure (8.8, $p < 0.05$). For girls, these gaps are very close to zero in all cases. We find comparatively minimal moderation of effects of disability on these activities by age, although there is a marginally significant increase in the effect of disability on structured active leisure at older ages (-2.2, $p < 0.05$).

Screen-based leisure subtypes: Given the large differences in screen-based leisure time by disability status, it is of interest to distinguish further between distinct types of screen-based leisure. Here, we divide total screen-based leisure time into three subcategories: TV, video games, and communication. Estimated effects of disability on these categories are presented in table 6. On average, these results suggest that slightly less than two-thirds of the gap in screen-based leisure is attributable to time spent on TV (9.9, $p < 0.05$). Notably, however, the *increase* in effects of disability on screen-based leisure at older ages appears to be driven largely by growing gaps in time spent playing video games, equivalent to roughly an additional five minutes per day for each year of age (5.4, $p < 0.05$). No significant differences in effects of disability by child sex were observed, and we found no evidence of any gaps in time spent on communication via electronic devices.

Table 4: Time in activities

	Active leisure	Screen-based leisure	Non-active leisure	Time at school	Private lessons and homework	Communication
			Panel A: Main effect of disability only			
Disability	-1.0	16.2**	4.1	-16.4**	-4.4**	-1.5
	(2.9)	(5.3)	(2.9)	(5.6)	(1.5)	(2.5)
			Panel B: Effects of disability moderated by sex			
Disability	-5.8	15.7*	5.4	-13.7	-3.1	2.7
	(3.8)	(7.6)	(3.8)	(7.3)	(1.7)	(3.3)
Disability * Female	10.8	1.2	-2.9	-6.0	-2.9	-9.5
	(5.8)	(10.5)	(5.8)	(11.3)	(3.2)	(5.1)
Female	-11.3***	-63.9***	21.9***	-0.2	8.7***	17.7***
	(1.6)	(2.8)	(1.6)	(2.9)	(1.0)	(1.6)
			Panel C: Effects of disability moderated by age			
Disability	-1.4	17.8**	4.5	-17.0**	-4.7**	-2.1
	(2.9)	(5.5)	(2.9)	(5.6)	(1.6)	(2.7)
Disability * Age	-2.3	8.9**	1.9	-3.5	-1.8	-3.4*
	(1.6)	(3.0)	(1.7)	(3.3)	(1.0)	(1.6)
Age	-6.4***	10.0***	-3.5***	-2.0*	3.7***	12.3***
	(0.4)	(0.8)	(0.5)	(0.9)	(0.3)	(0.5)

N = 19,867; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; All models control for child age in years (centered at the sample mean age), child gender, ethnic background, mother's age at the time of child's birth, family structure, number of resident siblings, mother's education at wave 1, residence in an urban area, area-level socioeconomic disadvantage, diary day (weekend vs. weekday), and cohort membership. Models are weighted to correct for attrition, and standard errors are clustered by child to allow for repeated measurements.

Table 5: Structured vs. unstructured leisure time (excl. screen time)

	Active leisure - structured	Active leisure - unstructured	Non-active leisure - structured	Non-active leisure - unstructured	All leisure - structured	All leisure - unstructured
			Panel A: Main effect of disability only			
Disability	-2.4	1.4	-1.4	5.5*	-3.8*	6.9
	(1.5)	(2.6)	(1.0)	(2.8)	(1.8)	(3.8)
			Panel B: Effects of disability moderated by sex			
Disability	-4.1*	-1.7	-3.6**	9.0*	-7.7***	7.4
	(2.0)	(3.5)	(1.1)	(3.6)	(2.2)	(4.9)
Disability * Female	3.8	7.0	5.1*	-8.0	9.0*	-1.0
	(3.0)	(5.2)	(2.0)	(5.6)	(3.7)	(7.6)
Female	-2.0*	-9.3***	0.5	21.4***	-1.5	12.1***
	(0.9)	(1.4)	(0.6)	(1.5)	(1.1)	(2.0)
			Panel C: Effects of disability moderated by age			
Disability	-2.8	1.4	-1.3	5.7*	-4.1*	7.1
	(1.5)	(2.5)	(1.0)	(2.8)	(1.8)	(3.8)
Disability * Age	-2.2*	-0.1	0.4	1.5	-1.8	1.4
	(0.9)	(1.4)	(0.6)	(1.7)	(1.1)	(2.2)
Age	0.4	-6.9***	-0.8***	-2.6***	-0.4	-9.5***
	(0.2)	(0.4)	(0.2)	(0.4)	(0.3)	(0.6)

N = 19,867; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; All models control for child age in years (centered at the sample mean age), child gender, ethnic background, mother's age at the time of child's birth, family structure, number of resident siblings, mother's education at wave 1, residence in an urban area, area-level socioeconomic disadvantage, diary day (weekend vs. weekday), and cohort membership. Models are weighted to correct for attrition, and standard errors are clustered by child to allow for repeated measurements.

Table 6: Screen-based leisure subtypes

	TV	Video games	Electronic device – communication
	Panel A: Main effect of disability only		
Disability	9.9*	6.2	-1.5
	(4.1)	(3.6)	(1.4)
	Panel B: Effects of disability moderated by sex		
Disability	6.2	9.7	-0.8
	(5.4)	(6.0)	(1.6)
Disability * Female	8.2	-7.9	-1.5
	(8.2)	(6.8)	(3.0)
Female	-6.4**	-59.5***	10.6***
	(2.2)	(1.8)	(0.8)
	Panel C: Effects of disability moderated by age		
Disability	10.5*	7.2	-1.5
	(4.2)	(3.8)	(1.6)
Disability * Age	3.4	5.4*	-0.2
	(2.3)	(2.4)	(1.1)
Age	2.4***	2.8***	6.6***
	(0.6)	(0.5)	(0.3)

N = 19,867; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; All models control for child age in years (centered at the sample mean age), child gender, ethnic background, mother's age at the time of child's birth, family structure, number of resident siblings, mother's education at wave 1, residence in an urban area, area-level socioeconomic disadvantage, diary day (weekend vs. weekday), and cohort membership. Models are weighted to correct for attrition, and standard errors are clustered by child to allow for repeated measurements.

Sensitivity and supplemental analysis: We conducted multiple sensitivity analyses to check the robustness of our results to data quality and model specification. First, we excluded observations from 'K' cohort children in the 10-11 age group, as this wave of data collection both used different show-card wording for the disability questions and a less detailed coding frame for the time-use diaries (Appendix B). We found no substantive differences in results, apart from the disability-by-age interactions for screen-based leisure and communication time – in both instances these parameters are marginally smaller in magnitude and non-significant. Second, we excluded diaries with less than ten reported activity episodes (3.2% of all diaries), as these are likely to be poor quality diaries (Appendix C). Third, because many time-use outcomes are positively skewed and include zeros, we transformed all outcomes using an inverse hyperbolic sine transformation to minimize the potential influence of outliers (Appendix D). We found minimal substantive differences in results from any of these sensitivity analyses, suggesting that our results are not driven by differences in disability measures, data quality, or outlying time-use observations.

Supplemental analysis was undertaken to address several additional issues that were not able to be considered in the main analysis. First, separate analyses were conducted for weekend diaries and weekday diaries (Appendix E). For weekdays, findings from these analyses mirror our main results. Weekends are underrepresented in the data, and the much smaller number of available diaries means that results are noisy and most effects of disability are non-significant. The direction of effects is, however, consistent with our main analysis in most cases. Second, we considered an alternative set of analyses comparing children with *persistent disability* (defined as children with disability at two or more time points over the 10-11, 12-13, and 14-15 data collections) to children who are *never disabled* (over the same age interval) (Appendix F). Children with persistent disability likely experience more severe impairments, and these kinds of disability may be more subject to stigma. Consistent with this conjecture, the persistently disabled vs. never disabled comparison produces generally larger estimates of the effects of disability on time-use, without changing the types of companion/activity time that are affected or the direction of results. Notably, persistent disability was also linked to lower time in structured *active* leisure specifically and (particularly at older ages) less time spent on communication. Third, we considered a range of additional companion- and activity-categories (Codes in tables A2 and A4, results in Appendix G). Additional companion codes considered included time *alone* with parents, peers, and siblings, and other adults. Activity codes included sleep, travel, medical appointments, reading, and 'other activities' (such as religious ceremonies). Apart from slightly higher (2 minutes/day) time in medical appointments, we did not find any effects of disability on alternative activity categories. For companions, the most notable result from these analyses was the effects of disability on time with peers only – these effects mirror the analyses of total time with peers and are nearly equal magnitude, suggesting that gaps in time with peers is comprised primarily of *unsupervised* time.

Discussion

Our analysis marks the first nationally representative study to compare children with disabilities' time-use to their peers without disability. The findings, while largely unsurprising, are nonetheless sobering and indicate that children with disabilities encounter a social world that is substantially *narrower* in terms of their engagement with peers and their participation in activities that are likely to enhance their developmental trajectories and

academic achievement. Key findings include substitution of (less) time with peers for (more) time alone and with the child's mother, and (less) time in educational and structured activities for (more) screen-based leisure time. These disparities are particularly pronounced for boys and older children. Our results therefore suggest the importance of intersections of gender with disability and indicate that adolescence may represent a crucial period for the emergence of social exclusion related to disability.

Our results indicate an urgent need for research to understand both the *drivers* and *nature* of screen-based leisure time among adolescents with disabilities. This urgency stems in part from the sheer quantity of screen-based leisure time – in our data, screen-based leisure accounts for more than four hours per day among adolescents (aged 14-15) with disabilities, roughly 50% more time than is spent at school. Available evidence shows that excessive screen-time is linked to poor health outcomes (including for example obesity, diet, sleep, and depression), problematic behaviour, and lost opportunities for social and cognitive development (Carson *et al* 2016; Hoare *et al* 2016; Stiglic & Viner 2019). Clearly, the substantially increased time spent on screen-based leisure among children (particularly adolescent boys) with disabilities may represent an important pathway linking child disability and disadvantage. There is consequently a *prima facie* need for intervention to reduce screen-based leisure among children with disabilities. However, reductions in screen-time are unlikely to be realized without due consideration of 1) what it is to be replaced with, and 2) the reasons why children with disabilities spend such large amounts of time on screen-based leisure. Alternative activity contexts (e.g. schools, sporting clubs, or peer networks) may be unwelcoming for children with disabilities (Bult *et al* 2011; Law *et al* 2007; Petrina *et al* 2014; Shields, Synnot & Barr 2012), whereas screen-based leisure activities such as video games might enable children to avoid stigmatizing behaviour, exercise mastery and control, and enact positive identities. Efforts to reduce screen-time should therefore be accompanied by increased support for integration and social acceptance of children with disabilities in mainstream settings, to avoid pushing children with disabilities into unstructured leisure time that may have similarly limited developmental value.

Alternatively (or additionally), research could explore opportunities to understand and improve the *quality* of experiences that adolescents with disabilities encounter within screen-based leisure environments. Effects of video game play on cognitive and emotional

development, in particular, have been shown to vary enormously depending on the content and design of games (Gentile 2011; Granic, Lobel, & Engels 2014). For example, game designs that require cooperation between players may build pro-social behaviour, while games that require competition between players contributes to aggression (Gentile 2011). With regard to content, there is a need to ensure that people with disabilities are positively represented in the game world. Encouraging better content and encouraging social engagement in conjunction with screen-based leisure may therefore offer an important avenue to support children with disabilities' development.

The counterpoint to high screen time for children with disabilities is reduced time in structured activities and formal learning. Combining homework and time at school, we found a gap of about twenty minutes per day in activities directly related to schooling. The magnitude of this gap was approximately constant for children of different genders or ages, suggesting that exclusion of children with disabilities from educational settings is pervasive. Strong evidence indicates that time spent on these types of learning is important for cognitive development and academic achievement (Aucejo & Romano 2016; Kalenkoski & Pabilonia 2017). For boys with disability, we found additional gap of approximately eight minutes less per day in structured leisure – such as clubs or organized sport – and eight minutes more in unstructured leisure. While the size of this gap may appear small, we note that 1) eight minutes per day is equivalent to roughly one-quarter of the average daily time spent in structured leisure for children without disability, and 2) evidence indicates that structured activities may be valuable for the development of both noncognitive and cognitive skills crucial for later life success (Carbonaro & Maloney 2019; Coulangeon 2018; Hille & Schupp 2015; O'Flaherty, Campbell, & Baxter 2022). In conjunction with our findings regarding screen-time, it appears that children with disabilities experience a trade-off in their activity participation that is likely to be detrimental to many aspects of their development, including health and cognitive- and non-cognitive skills.

Notably, we did *not* find evidence that children with disabilities spend less time in active leisure. This finding is somewhat surprising given the existing evidence base linking disability to low physical activity and associated health outcomes such as obesity (Emerson *et al* 2016; Healy *et al* 2017; King *et al* 2010). We note, however, that our analysis is unable to distinguish *intensity* of activity. It may be that children with disabilities spend similar

amounts of time in 'active' activities, but this time is of a lower intensity. Large amounts of screen-based sedentary time are also likely to contribute to cardiovascular health outcomes of adolescents with disabilities.

For time with companions, our key findings were that, on average, children with disabilities spend *less* time with peers and *more* time alone and with mothers. Differences in time spent with peers and alone were particularly pronounced among boys and older children. These findings are unsurprising given evidence that children with disabilities generally have smaller and more family-dominated social networks (Locke *et al* 2010; Petrina *et al* 2014). The implications of these gaps for the development and wellbeing of children with disabilities is, however, ambiguous. On one hand, the results suggest that children with disabilities are denied opportunities to develop interactional skills and friendship networks that could support short- and long-term wellbeing (Blakemore & Mills 2014; Lam *et al* 2015). On the other, a certain amount of solitary time may in fact be beneficial to mental health (Larson 1990) and unsupervised time with peers is commonly associated with delinquency and poor socio-emotional outcomes (Lam *et al* 2014). Adjudicating between these interpretations will require further study. In particular, we stress the importance of understanding 1) how the emotional valence of time spent alone/with peers may differ for children with disabilities in comparison to their peers without disabilities, and 2) the role of children's agency in *choosing* to spend time alone (and their reasons for doing so), as distinct from being *excluded* from social settings with peers. It may be that solitary time represents an important coping mechanism for children with disabilities in settings where they are likely subject to stigma or bullying. While this strategy may help children with disabilities to cope in the short-term, it is likely to carry negative implications for their longer-term social development. Broad-based approaches to intervention that aim to increase both the *quantity* and *quality* – for instance by addressing negative social attitudes – of peer interactions for children with disabilities are therefore likely to be of considerable importance.

An important limitation of our data is the collection of only single-day diaries for each child. Diary completion day is unrelated to child disability, and so these data likely provide reliable estimates of *group* differences in average time allocation – they do not, however, speak to individual children's time-use over longer periods. It is therefore unclear whether group differences reflect the experiences of children with disability broadly or are driven by smaller

groups of children with disabilities who are subject to deeper social exclusion – although the generally larger effects of 'persistent' disability reported in appendix F suggest the latter explanation may be of considerable importance. The reliance on single day diaries – which represent 'noisy' estimates of individual time-use over longer periods (Kan & Pudney 2008) – may also prove problematic for several other important research directions. Notably, large day-to-day variations in activities and companions is likely to produce bias to the null in studies estimating *effects* of time-use on child outcomes. High day-to-day variance can also be expected to have a deleterious effect on 'person-centred' approaches aiming to identify groups of children with similar patterns or developmental trajectories of time-use. These limitations suggest the importance of studies collecting diary data for children over longer periods – for example over a week. Longer observation windows would support both substantive (e.g. effects of time-use on child development; person-centred approaches to time-use) and methodological (e.g. reliability of 1- or 2-day diary data as an indicator of individual's longer-term time-use) goals.

Sample size considerations did not permit us to address variation in the effects of disability on time-use by weekday/weekend, nor by type of disability/restriction. Weekends – when children generally have much greater discretionary and unstructured time – may be of key importance in understanding the participation of children with disabilities in *informal* social settings such as friendship networks. This represents an important direction for future research on time-use of children with disabilities. Similarly, extensive previous work indicates that different types of disability are linked to varying degrees of disadvantage over the life course, with intellectual or psychological disabilities generally most negatively affected (e.g. Kavanagh *et al* 2015; Mithen *et al* 2015). It is likely that this is true also for time-use and investigating this possibility will be an important objective in understanding the ways in which children's time-use is implicated in the emergence of differential disadvantage across types of disability. Last, we stress that our analyses should be viewed as descriptive in nature. Although we control for common child and family characteristics that may confound the association between childhood disability and time-use, the purpose of doing so is primarily to exclude these factors as alternative explanations for our findings rather than produce credible estimates of causal effects of child disability. We show, in other words, that the associations between child disability and child time-use are *not* attributable to family

economic resources, family structure, or demographic background, but these factors alone are unlikely to eliminate all possible confounding.

As the first nationally representative study to compare the time-use of children with disabilities to their peers, our work represents an important advance in understanding how the experience of disability is implicated in the production of inequality and disadvantage over the life course. It is nonetheless a *preliminary* step, and much remains to be done in understanding how children with disability become disadvantaged and the implications of disadvantage over the transition to adulthood and beyond. Disability, particularly among children, remains a relatively marginal subject of enquiry within sociology – where inequalities of class, race, and gender have taken centre stage. This is unfortunate for both sociology and disability studies. For sociology, integrating the experiences of children with disabilities offers much to our understanding of inequalities. This is both because children with disability represent a distinct (and often deeply disadvantaged) subpopulation, and because there are clear empirical overlaps between disability and many other areas of ongoing importance to sociology, such as inequality by class, race, and across generations. For the study of children with disabilities – which continues to be dominated by medical and health disciplines – a sociological lens can assist in separating the *social* production of disadvantage from the narrow *medical* implications of particular health conditions. Life course approaches within sociology (Crosnoe & Johnson 2011) that characterize disadvantage as fundamentally *dynamic, cumulative*, and *shaped by individual agency* may also carry considerable value for disability studies, where the predominant conceptual frameworks have been criticized as predominantly static and inattentive to the agency of people with disabilities (Mitra & Shakespeare 2019). Realizing these opportunities will require a broad program of sociological research that extends well beyond the empirical concerns of the present study – we invite our colleagues to join us in this endeavour.

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Appendix A: Time-use coding

Table A1. Companion coding

Variable	Time spent with
Companions (not exhaustive or mutually exclusive)	
Mother	Mother/female guardian regardless of who else (if anyone) was present
Father	Father/male guardian regardless of who else (if anyone) was present
Siblings	Sibling/s regardless of who else (if anyone) was present
Peers	Peers regardless of who else (if anyone) was present
Alone	On their own (excludes whilst sleeping)

Table A2. Companion coding for supplementary analysis (Appendix H)

Variable	Time spent with
Companions (not exhaustive or mutually exclusive)	
Mother only	Mother/female guardian only
Mother and others	Mother/female guardian *and* others (*not* Father/male guardian)
Father only	Father/male guardian only
Father and others	Father/male guardian *and* others (*not* Mother/female guardian)
Either parent	Mother/female guardian *or* Father/male guardian, regardless of others
Both parents	Mother/female guardian *and* Father/male guardian, regardless of others
Peers only	Peers only
Siblings only	Siblings only
Other adults	Other adults, regardless of others

Table A3. Activity coding

Variable	**Time spent doing**		
Activities	K4	K5	K6 & B4-6
		Main activity codes	
Active leisure	Active activities; Organised team sports and training i.e. football, basketball, netball etc; Organised individual sport i.e. swimming, dancing, martial arts, etc.; Ball games, riding a bike, scooter, skateboard, skipping, running, games and other free activities; Taking pet for a walk; Scouts, girl guides, etc.	Organised team sports and training; Organised individual sports and training; Unstructured active play; Walking pets/playing with pets; Active club activities.	Archery/Shooting sports; Athletics/Gymnastics; Fitness/Gym/Exercise; Ball Sports; Martial arts/Dancing; Motor Sports/Roller Sports/Cycling; Water/Ice/Snow Sports; Organised team sports and training (other); Organised individual sport and training (other); Unstructured active play (other); Walking pets/playing with pets; Active club activities; Active activities NEC
Screen-based leisure	Electronic media, games, computer use; Computer games – internet; Computer games – not internet; Xbox, Playstation, Nintendo, WII, etc.; Internet not covered elsewhere; TV/DVD.	Playing games; Watching TV programs or movies/videos; Spending time on social networking sites; Downloading/posting media (e.g. music, videos, applications); Internet shopping (excluding downloading/posting media); General internet browsing (excluding homework); Creating/maintaining websites (excluding social networking profile); General application use (e.g. Microsoft Office excluding homework); Electronic device use NEC.	Playing games (electronic device); Playing games (electronic device) no further details; Watching TV programs or movies/videos; Spending time on social networking sites; Downloading/posting media; Internet shopping; General Internet browsing; Creating/maintaining websites; General application use; Electronic device use NEC.

Non-active leisure	Shopping; Going out to museums, cultural events, fairs, community events, church, etc.; Cinema; Live sporting events; Non active activities; Listening to music, CDs, playing music for leisure; Reading or being read to for leisure; Board or card games, puzzles, toys, art and craft, etc.; Non-active club activities i.e. chess club; Doing nothing.	Shopping; Going out to a concert, play, museum, art gallery, community or school event, an amusement park, etc.; Attending live sporting events; Listening to music; Playing musical instruments or singing for leisure; Reading or being read to for leisure; Unstructured non-active play; Non-active club activities; Doing nothing; Non-active activities NEC.	Shopping; Attendance at movies/cinema; Attendance at concert/theatre; Attendance at museum/exhibition/art gallery; Attendance at zoo/animal park/botanic garden; Attendance at other mass events; Going out NEC; Attending live sporting events; Listening to music; Playing musical instruments or singing for leisure; Reading or being read to for leisure; Chess, card, paper and board games/crosswords; Games of chance/gambling; Hobbies, collections; Handwork crafts (excludes clothes making); Arts; Unstructured non-active play NEC; Clubs; Doing nothing; Non-active activities NEC
At school	Any activity that took place at school; School lessons.	Any activity that took place at school; School lessons.	Any activity that took place at school; School lessons.
Private lessons & homework	Private music, language, religion, tutoring lessons; Homework (not on computer) including music practise; Computer for homework – internet; Computer for homework – not internet.	Private music lessons/practice, academic tutoring; Doing homework (not via electronic devices); Doing homework	Private music lessons/practice, academic tutoring; Attend courses (excluding school/university); Doing homework (not via electronic devices); Doing homework (electronic device)
Communication	Communication; Talking face to face; Talking on a landline phone; Talking on a mobile phone; Texting, email, social networking such as Facebook or Twitter. Skype or webcam.	Talking face to face; Talking on a landline phone; Talking on a mobile phone; Video chatting; Texting/emailing; Online chatting/Instant messaging; Non-verbal interaction; Negative face-to-face communication; Communication NEC	Talking face-to-face; Talking on a landline phone; Talking on a mobile phone; Video chatting; Texting/emailing; Online chatting/Instant messaging; Non-verbal interaction; Negative face-to-face communication; Communication NEC
Screen-based leisure activity subtype codes			
TV	TV/DVD	Watching TV programs or movies/videos;	Watching TV programs or movies/videos;

Video games	Computer games – internet; Computer games – not internet; Xbox, Playstation, Nintendo, WII, etc.	Playing games	Playing games (electronic device); Playing games (electronic device) no further details;
Electronic device - communication	Talking on a landline phone; Talking on a mobile phone; Texting, email, social networking such as Facebook or Twitter. Skype or webcam.	Spending time on social networking sites; Talking on a landline phone; Talking on a mobile phone; Video chatting; Texting/emailing; Online chatting/Instant messaging;	Spending time on social networking sites; Talking on a landline phone; Talking on a mobile phone; Video chatting; Texting/emailing; Online chatting/Instant messaging;
Structured and unstructured leisure activity codes			
Active leisure – structured	Organised team sports and training i.e. football, basketball, netball etc; Organised individual sport i.e. swimming, dancing, martial arts, etc.; Scouts, girl guides, etc.	Organised team sports and training; Organised individual sports and training; Active club activities.	*Sport categories as above* (team/individual); Active club activities
Active leisure - unstructured	Active activities; Ball games, riding a bike, scooter, skateboard, skipping, running, games and other free activities; Taking pet for a walk	Unstructured active play; Walking pets/playing with pets; Active activities NEC	*Sport categories as above* (unstructured); Unstructured active play; Walking pets/playing with pets; Active activities NEC
Non-active leisure - structured	Going out to museums, cultural events, fairs, community events, church, etc.; Cinema; Live sporting events; Non-active club activities i.e. chess club	Going out to a concert, play, museum, art gallery, community or school event, an amusement park, etc.; Attending live sporting events; Non-active club activities;	Attendance at movies/cinema; Attendance at concert/theatre; Attendance at museum/exhibition/art gallery; Attendance at zoo/animal park/botanic garden; Attendance at other mass events; Going out NEC; Attending live sporting events; Clubs

Non-active leisure - unstructured	Shopping; Non active activities; Listening to music, CDs, playing music for leisure; Reading or being read to for leisure; Board or card games, puzzles, toys, art and craft, etc.; Doing nothing.	Shopping; Listening to music; Playing musical instruments or singing for leisure; Reading or being read to for leisure; Unstructured non-active play; Doing nothing; Non-active activities NEC.	Shopping; Listening to music; Playing musical instruments or singing for leisure; Reading or being read to for leisure; Chess, card, paper and board games/crosswords; Games of chance/gambling; Hobbies, collections; Handwork crafts (excludes clothes making); Arts; Unstructured non-active play NEC; Doing nothing; Non-active activities NEC
All leisure - structured	*Active leisure – structured; Non-active leisure – structured*	*Active leisure – structured; Non-active leisure – structured*	*Active leisure – structured; Non-active leisure – structured*
All leisure - unstructured	*Active leisure – unstructured; Non-active leisure – unstructured*	*Active leisure – unstructured; Non-active leisure – unstructured*	*Active leisure – unstructured; Non-active leisure – unstructured*

Table A4. Activity coding for supplementary analysis (Appendix H)

Variable	**Time spent doing**		
Activities	K4	K5	K6 & B4-6
Paid work, volunteering, chores	Chores	Chores; Paid work	Chores; Paid work
Travel	By foot; By bike, scooter, skateboard, etc.; By private car; By public transport.; Travel NEC	By foot; By bike, scooter, skateboard, etc.; By private motor vehicle/bike; By public/chartered transport; Travel NEC	By foot; By bike, scooter, skateboard, etc.; By private motor vehicle/bike; By public/chartered transport; Travel NEC
Reading	Reading or being read to for leisure	Reading or being read to for leisure	Reading or being read to for leisure
Medical appointments	Dentist, doctor, chiropractor, physio, etc.	Doctor; Dentist; Physiotherapist/ chiropractor; Medical/health care NEC	Doctor; Dentist; Physiotherapist/ chiropractor; Medical/health care NEC
Sleep (incl. naps)	Sleeping/napping	Sleeping/napping	Sleeping/napping

Other activities	Other	Other; Religious activities/ritual ceremonies; Filling out the diary	Other; Religious activities/ritual ceremonies; Filling out the diary; Illegal activities; Uncodeable activity

Table A5: Disability showcard wording

Disabilities and long-term conditions		**Restrictions in daily activities**	
		Question stem	
Does [study child] have any medical conditions or disabilities that have lasted, or are likely to last, for six months or more?		*Still thinking of conditions lasting six months or more, is [study child] restricted in everyday activities because of any of the following?*	
		Showcard prompts	
K cohort, wave 4	**K cohort, waves 5-6, and B cohort waves 6-8**	**K cohort, wave 4**	**K cohort, waves 5-6, and B cohort waves 6-8**
Loss of sight (not corrected by glasses or contact lenses)	**Sight problems** (not corrected by glasses or contact lenses)	Shortness of breath or breathing difficulties **causing restriction**	Shortness of breath or breathing difficulties
Loss of hearing (where communication is restricted, or an aid to assist with or substitute for hearing is used)	**Hearing problems** (where communication is restricted, or an aid to assist with or substitute for hearing is used)	Chronic or recurring pain **or discomfort causing restriction**	Chronic or recurring pain
Speech **difficulties**	Speech **problems**	A nervous or emotional condition **causing restriction**	A nervous or emotional condition **(requiring treatment)**
Blackouts, fits, or loss of consciousness	Blackouts, fits, or loss of consciousness	**Mental illness or condition requiring help or supervision**	**Any mental illness for which help or supervision is required long-term**
Difficulty learning or understanding things	Difficulty learning or understanding things	**Long-term effects of head injury, stroke, or other brain damage causing restriction**	**Long-term effects as a result of a head injury, stroke, or other brain damage**
Incomplete use of arms or fingers	**Limited** use of arms or fingers	**Receiving treatment or medication for any long-term conditions or ailments**	**Any other long-term condition, such as arthritis, asthma, heart disease,**

		and still restricted	**Alzheimer's, dementia, etc.**
Difficulty gripping **or holding** things	Difficulty gripping things	Any other long-term **disease or condition that requires treatment or medication**	Any other long-term **conditions resulting in a restriction**
Incomplete use of legs or feet	**Limited** use of legs or feet		
Restriction in physical activities or doing physical work	**Any condition that restricts physical activity or physical work**		
Disfigurement or deformity	**Any disfigurement or deformity**		

Bold text used to indicate differences in showcard wording comparing wave 4 of K cohort to waves 5-6 of K cohort and waves 6-8 of B cohort. No bold text used in showcards.

Appendix B – Sensitivity analysis excluding age 10-11 data for 'K' cohort children

Table B1: Time with companions (Excluding age 10-11 data for 'K' cohort)

	Alone	Mother	Father	Siblings	Peers
		Panel A: Main effect of disability only			
Disability	22.0**	24.2***	-2.7	1.7	-17.1**
	(7.4)	(7.0)	(5.3)	(7.2)	(6.6)
		Panel B: Effects of disability moderated by sex			
Disability	20.7*	32.9***	-4.3	5.3	-28.4***
	(9.8)	(9.5)	(7.2)	(9.9)	(8.3)
Disability * Female	2.7	-19.4	3.7	-8.1	25.3
	(14.9)	(13.9)	(10.5)	(14.5)	(13.3)
Female	-21.2***	16.4***	-18.3***	-3.1	17.5***
	(3.4)	(3.1)	(2.6)	(3.7)	(3.5)
		Panel C: Effects of disability moderated by age			
Disability	16.8*	24.9**	-1.7	3.2	-12.1
	(7.1)	(7.6)	(6.0)	(8.0)	(6.9)
Disability * Age	10.2*	-1.4	-2.0	-2.9	-9.9*
	(4.4)	(4.4)	(3.3)	(4.5)	(4.3)
Age	29.7***	-12.5***	-4.0***	-26.2***	2.8*
	(1.1)	(1.0)	(0.8)	(1.1)	(1.2)

N = 15,950; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; All models control for child age in years (centered at the sample mean age), child gender, ethnic background, mother's age at the time of child's birth, family structure, number of resident siblings, mother's education at wave 1, residence in an urban area, area-level socioeconomic disadvantage, diary day (weekend vs. weekday), and cohort membership. Models are weighted to correct for attrition, and standard errors are clustered by child to allow for repeated measurements.

Table B2: Time in activities (Excluding age 10-11 data for 'K' cohort)

	Active leisure	Screen-based leisure	Non-active leisure	Time at school	Private lessons and homework	Communication
			Panel A: Main effect of disability only			
Disability	-3.0	24.2***	7.3*	-21.0**	-5.2**	-3.9
	(3.5)	(6.8)	(3.5)	(6.8)	(1.8)	(3.4)
			Panel B: Effects of disability moderated by sex			
Disability	-9.8*	25.7**	10.2*	-20.9*	-3.1	2.0
	(4.5)	(9.8)	(4.6)	(8.9)	(2.1)	(4.5)
Disability * Female	15.1*	-3.4	-6.4	-0.3	-4.7	-13.2
	(6.9)	(13.5)	(7.2)	(13.8)	(3.8)	(6.9)
Female	-11.6***	-69.6***	24.0***	0.8	9.9***	21.3***
	(1.8)	(3.2)	(1.8)	(3.3)	(1.2)	(2.0)
			Panel C: Effects of disability moderated by age			
Disability	-1.9	20.9**	7.3*	-20.2**	-4.3**	-2.4
	(3.7)	(6.9)	(3.7)	(7.2)	(1.6)	(3.5)
Disability * Age	-2.1	6.6	0.0	-1.6	-1.9	-3.0
	(2.2)	(4.0)	(2.4)	(4.4)	(1.1)	(2.2)
Age	-6.5***	8.9***	-3.6***	-2.0	3.9***	13.6***
	(0.6)	(1.0)	(0.6)	(1.1)	(0.3)	(0.7)

N = 15,950; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; All models control for child age in years (centered at the sample mean age), child gender, ethnic background, mother's age at the time of child's birth, family structure, number of resident siblings, mother's education at wave 1, residence in an urban area, area-level socioeconomic disadvantage, diary day (weekend vs. weekday), and cohort membership. Models are weighted to correct for attrition, and standard errors are clustered by child to allow for repeated measurements.

Table B3: Structured vs. unstructured leisure time (excl. screen time) (Excluding age 10-11 data for 'K' cohort)

	Active leisure - structured	Active leisure - unstructured	Non-active leisure - structured	Non-active leisure - unstructured	All leisure - structured	All leisure - unstructured
			Panel A: Main effect of disability only			
Disability	-5.2**	2.1	-1.3	8.7*	-6.5**	10.8*
	(1.8)	(3.0)	(1.1)	(3.5)	(2.1)	(4.6)
			Panel B: Effects of disability moderated by sex			
Disability	-6.7**	-3.0	-2.5*	12.7**	-9.3***	9.7
	(2.4)	(4.1)	(1.2)	(4.5)	(2.7)	(6.0)
Disability * Female	3.5	11.6	2.7	-9.1	6.2	2.5
	(3.5)	(6.1)	(2.2)	(7.1)	(4.2)	(9.3)
Female	-2.0	-9.7***	1.4*	22.6***	-0.6	13.0***
	(1.0)	(1.5)	(0.6)	(1.7)	(1.2)	(2.2)
			Panel C: Effects of disability moderated by age			
Disability	-4.6*	2.6	-1.5	8.9*	-6.1**	11.5*
	(1.8)	(3.4)	(1.1)	(3.7)	(2.1)	(5.0)
Disability * Age	-1.2	-0.9	0.4	-0.4	-0.8	-1.4
	(1.3)	(1.8)	(0.8)	(2.2)	(1.5)	(2.9)
Age	0.4	-6.9***	-0.1	-3.5***	0.2	-10.3***
	(0.3)	(0.5)	(0.2)	(0.6)	(0.4)	(0.7)

N = 15,950; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; All models control for child age in years (centered at the sample mean age), child gender, ethnic background, mother's age at the time of child's birth, family structure, number of resident siblings, mother's education at wave 1, residence in an urban area, area-level socioeconomic disadvantage, diary day (weekend vs. weekday), and cohort membership. Models are weighted to correct for attrition, and standard errors are clustered by child to allow for repeated measurements.

Table B4: Screen-based leisure subtypes (Excluding age 10-11 data for 'K' cohort)

	TV	Video games	Electronic device – communication
	Panel A: Main effect of disability only		
Disability	14.5**	8.2	-2.1
	(5.2)	(4.7)	(2.0)
	Panel B: Effects of disability moderated by sex		
Disability	9.9	14.9	-2.5
	(6.9)	(7.9)	(2.1)
Disability * Female	10.2	-15.0	0.8
	(10.4)	(8.8)	(4.1)
Female	-6.1*	-66.1***	12.8***
	(2.5)	(2.0)	(1.0)
	Panel C: Effects of disability moderated by age		
Disability	14.0**	4.8	-2.3
	(5.3)	(4.4)	(1.5)
Disability * Age	0.9	6.7*	0.4
	(3.1)	(3.0)	(1.4)
Age	2.1**	3.0***	6.6***
	(0.8)	(0.7)	(0.3)

N = 15,950; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; All models control for child age in years (centered at the sample mean age), child gender, ethnic background, mother's age at the time of child's birth, family structure, number of resident siblings, mother's education at wave 1, residence in an urban area, area-level socioeconomic disadvantage, diary day (weekend vs. weekday), and cohort membership. Models are weighted to correct for attrition, and standard errors are clustered by child to allow for repeated measurements.

Appendix C: Sensitivity analysis excluding diaries with less than 10 activity episodes

Table C1: Time with companions (excluding diaries with less than 10 activity episodes)

	Alone	Mother	Father	Siblings	Peers
		Panel A: Main effect of disability only			
Disability	17.7**	13.0*	-1.5	-2.2	-16.3**
	(5.5)	(5.5)	(4.3)	(6.1)	(5.6)
		Panel B: Effects of disability moderated by sex			
Disability	19.5**	15.3*	-1.8	2.4	-29.8***
	(7.4)	(7.2)	(6.0)	(8.3)	(7.0)
Disability * Female	-4.1	-5.0	0.7	-10.1	29.9**
	(11.0)	(11.0)	(8.7)	(12.2)	(11.3)
Female	-13.3***	14.1***	-18.8***	-5.4	12.7***
	(2.9)	(2.7)	(2.3)	(3.4)	(3.2)
		Panel C: Effects of disability moderated by age			
Disability	19.6***	13.8*	-2.1	-2.2	-17.9**
	(5.8)	(5.5)	(4.3)	(6.0)	(5.6)
Disability * Age	9.1**	3.5	-2.6	-0.3	-7.5*
	(3.4)	(3.1)	(2.3)	(3.3)	(3.3)
Age	27.1***	-9.7***	-2.3***	-23.9***	1.4
	(0.8)	(0.7)	(0.6)	(0.9)	(0.9)

N = 19,235; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; All models control for child age in years (centered at the sample mean age), child gender, ethnic background, mother's age at the time of child's birth, family structure, number of resident siblings, mother's education at wave 1, residence in an urban area, area-level socioeconomic disadvantage, diary day (weekend vs. weekday), and cohort membership. Models are weighted to correct for attrition, and standard errors are clustered by child to allow for repeated measurements.

Table C2: Time in activities (excluding diaries with less than 10 activity episodes)

	Active leisure	Screen-based leisure	Non-active leisure	Time at school	Private lessons and homework	Communication
			Panel A: Main effect of disability only			
Disability	-0.8	16.8**	2.0	-17.9**	-4.5**	-2.2
	(2.9)	(5.2)	(2.8)	(5.7)	(1.6)	(2.4)
			Panel B: Effects of disability moderated by sex			
Disability	-5.2	16.5*	3.3	-16.0*	-3.1	1.3
	(3.9)	(7.4)	(3.6)	(7.5)	(1.8)	(2.9)
Disability * Female	9.6	0.6	-2.8	-4.1	-3.0	-7.9
	(5.8)	(10.2)	(5.6)	(11.5)	(3.3)	(4.8)
Female	-11.5***	-59.2***	22.1***	-3.0	8.5***	16.4***
	(1.6)	(2.7)	(1.6)	(3.0)	(1.1)	(1.6)
			Panel C: Effects of disability moderated by age			
Disability	-1.4	18.9***	2.1	-18.8**	-4.9**	-2.9
	(2.9)	(5.3)	(2.8)	(5.8)	(1.7)	(2.5)
Disability * Age	-2.8	10.1***	0.4	-4.4	-1.9	-3.2*
	(1.7)	(3.0)	(1.7)	(3.3)	(1.0)	(1.6)
Age	-6.2***	8.0***	-3.2***	-0.0	3.9***	12.4***
	(0.4)	(0.7)	(0.5)	(0.9)	(0.3)	(0.5)

N = 19,235; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; All models control for child age in years (centered at the sample mean age), child gender, ethnic background, mother's age at the time of child's birth, family structure, number of resident siblings, mother's education at wave 1, residence in an urban area, area-level socioeconomic disadvantage, diary day (weekend vs. weekday), and cohort membership. Models are weighted to correct for attrition, and standard errors are clustered by child to allow for repeated measurements.

Table C3: Structured vs. unstructured leisure time (excl. screen time) (excluding diaries with less than 10 activity episodes)

	Active leisure - structured	Active leisure - unstructured	Non-active leisure - structured	Non-active leisure - unstructured	All leisure - structured	All leisure - unstructured
			Panel A: Main effect of disability only			
Disability	-2.7	1.8	-1.3	3.3	-4.0*	5.1
	(1.5)	(2.6)	(1.0)	(2.7)	(1.8)	(3.8)
			Panel B: Effects of disability moderated by sex			
Disability	-4.1*	-1.1	-3.5**	6.8*	-7.6***	5.7
	(2.0)	(3.5)	(1.2)	(3.4)	(2.3)	(4.9)
Disability * Female	3.2	6.5	5.0*	-7.8	8.1*	-1.3
	(3.1)	(5.2)	(2.1)	(5.4)	(3.7)	(7.6)
Female	-2.2*	-9.3***	0.5	21.5***	-1.7	12.3***
	(0.9)	(1.3)	(0.6)	(1.5)	(1.1)	(2.0)
			Panel C: Effects of disability moderated by age			
Disability	-3.2*	1.8	-1.2	3.3	-4.4*	5.1
	(1.5)	(2.6)	(1.0)	(2.7)	(1.8)	(3.8)
Disability * Age	-2.5**	-0.3	0.4	0.0	-2.1	-0.3
	(1.0)	(1.4)	(0.7)	(1.6)	(1.1)	(2.1)
Age	0.6*	-6.8***	-0.8***	-2.5***	-0.2	-9.2***
	(0.2)	(0.4)	(0.2)	(0.4)	(0.3)	(0.6)

N = 19,235; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; All models control for child age in years (centered at the sample mean age), child gender, ethnic background, mother's age at the time of child's birth, family structure, number of resident siblings, mother's education at wave 1, residence in an urban area, area-level socioeconomic disadvantage, diary day (weekend vs. weekday), and cohort membership. Models are weighted to correct for attrition, and standard errors are clustered by child to allow for repeated measurements.

Table C4: Screen-based leisure subtypes (excluding diaries with less than 10 activity episodes)

	TV	Video games	Electronic device – communication
	Panel A: Main effect of disability only		
Disability	10.1**	6.7	-1.6
	(3.9)	(3.5)	(1.4)
	Panel B: Effects of disability moderated by sex		
Disability	6.6	10.0	-0.5
	(4.9)	(5.8)	(1.7)
Disability * Female	7.7	-7.3	-2.6
	(7.8)	(6.6)	(2.9)
Female	-4.8*	-55.9***	10.3***
	(2.1)	(1.6)	(0.8)
	Panel C: Effects of disability moderated by age		
Disability	11.1**	7.7*	-1.6
	(4.0)	(3.7)	(1.6)
Disability * Age	4.9*	4.7*	0.0
	(2.3)	(2.3)	(1.2)
Age	1.3*	1.9***	6.7***
	(0.6)	(0.5)	(0.3)

N = 19,235; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; All models control for child age in years (centered at the sample mean age), child gender, ethnic background, mother's age at the time of child's birth, family structure, number of resident siblings, mother's education at wave 1, residence in an urban area, area-level socioeconomic disadvantage, diary day (weekend vs. weekday), and cohort membership. Models are weighted to correct for attrition, and standard errors are clustered by child to allow for repeated measurements.

Appendix D: Sensitivity analysis using inverse hyperbolic sine (IHS) transformation of time

Table D1: Time with companions (IHS transformation of time-use outcomes)

	Alone	Mother	Father	Siblings	Peers
		Panel A: Main effect of disability only			
Disability	0.08	0.09	-0.10	-0.07	-0.19*
	(0.05)	(0.06)	(0.08)	(0.07)	(0.08)
		Panel B: Effects of disability moderated by sex			
Disability	0.11	0.13	-0.08	0.07	-0.33**
	(0.07)	(0.07)	(0.10)	(0.09)	(0.11)
Disability * Female	-0.07	-0.10	-0.04	-0.31*	0.31
	(0.11)	(0.11)	(0.15)	(0.14)	(0.16)
Female	-0.10***	0.14***	-0.27***	0.03	0.09*
	(0.03)	(0.03)	(0.04)	(0.04)	(0.04)
		Panel C: Effects of disability moderated by age			
Disability	0.08	0.10	-0.10	-0.07	-0.20*
	(0.05)	(0.06)	(0.08)	(0.07)	(0.08)
Disability * Age	0.03	0.06	-0.03	-0.04	-0.07
	(0.03)	(0.03)	(0.04)	(0.04)	(0.05)
Age	0.20***	-0.13***	-0.07***	-0.23***	-0.04***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)

N = 19,867; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; All models control for child age in years (centered at the sample mean age), child gender, ethnic background, mother's age at the time of child's birth, family structure, number of resident siblings, mother's education at wave 1, residence in an urban area, area-level socioeconomic disadvantage, diary day (weekend vs. weekday), and cohort membership. Models are weighted to correct for attrition, and standard errors are clustered by child to allow for repeated measurements.

Table D2: Time in activities (IHS transformation of time-use outcomes)

	Active leisure	Screen-based leisure	Non-active leisure	Time at school	Private lessons and homework	Communication
			Panel A: Main effect of disability only			
Disability	-0.02	0.14*	0.12	-0.22*	-0.29***	0.05
	(0.08)	(0.06)	(0.08)	(0.09)	(0.06)	(0.08)
			Panel B: Effects of disability moderated by sex			
Disability	-0.12	0.11	0.08	-0.16	-0.22**	0.06
	(0.11)	(0.07)	(0.11)	(0.12)	(0.08)	(0.10)
Disability * Female	0.24	0.07	0.09	-0.14	-0.14	-0.02
	(0.17)	(0.11)	(0.16)	(0.19)	(0.13)	(0.15)
Female	-0.25***	-0.58***	0.66***	-0.00	0.43***	0.56***
	(0.05)	(0.03)	(0.04)	(0.05)	(0.04)	(0.04)
			Panel C: Effects of disability moderated by age			
Disability	-0.02	0.15**	0.14	-0.23*	-0.30***	0.04
	(0.08)	(0.06)	(0.08)	(0.09)	(0.07)	(0.08)
Disability * Age	-0.05	0.07*	0.07	-0.05	-0.07	-0.07
	(0.05)	(0.03)	(0.05)	(0.06)	(0.04)	(0.04)
Age	-0.25***	0.03***	-0.15***	-0.05***	0.06***	0.38***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)

N = 19,867; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; All models control for child age in years (centered at the sample mean age), child gender, ethnic background, mother's age at the time of child's birth, family structure, number of resident siblings, mother's education at wave 1, residence in an urban area, area-level socioeconomic disadvantage, diary day (weekend vs. weekday), and cohort membership. Models are weighted to correct for attrition, and standard errors are clustered by child to allow for repeated measurements.

Table D3: Structured vs. unstructured leisure time (excl. screen time) (IHS transformation of time-use outcomes)

	Active leisure - structured	Active leisure - unstructured	Non-active leisure - structured	Non-active leisure - unstructured	All leisure - structured	All leisure - unstructured
			Panel A: Main effect of disability only			
Disability	-0.12*	0.14	-0.05	0.13	-0.16*	0.17*
	(0.06)	(0.08)	(0.04)	(0.08)	(0.07)	(0.07)
			Panel B: Effects of disability moderated by sex			
Disability	-0.18*	0.01	-0.16***	0.18	-0.31***	0.13
	(0.08)	(0.11)	(0.05)	(0.11)	(0.09)	(0.10)
Disability * Female	0.13	0.26	0.24**	-0.07	0.34*	0.08
	(0.13)	(0.16)	(0.09)	(0.16)	(0.14)	(0.14)
Female	-0.10**	-0.22***	0.05*	0.68***	-0.05	0.32***
	(0.04)	(0.04)	(0.02)	(0.04)	(0.04)	(0.04)
			Panel C: Effects of disability moderated by age			
Disability	-0.14*	0.13	-0.04	0.15	-0.17*	0.18*
	(0.06)	(0.08)	(0.04)	(0.08)	(0.07)	(0.07)
Disability * Age	-0.10**	0.05	0.03	0.05	-0.07	0.07
	(0.04)	(0.05)	(0.03)	(0.05)	(0.04)	(0.04)
Age	-0.02	-0.28***	-0.05***	-0.14***	-0.06***	-0.22***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)

N = 19,867; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; All models control for child age in years (centered at the sample mean age), child gender, ethnic background, mother's age at the time of child's birth, family structure, number of resident siblings, mother's education at wave 1, residence in an urban area, area-level socioeconomic disadvantage, diary day (weekend vs. weekday), and cohort membership. Models are weighted to correct for attrition, and standard errors are clustered by child to allow for repeated measurements.

Table D4: Screen-based leisure subtypes (IHS transformation of time-use outcomes)

	TV	Video games	Electronic device – communication
	Panel A: Main effect of disability only		
Disability	0.17*	0.07	-0.15**
	(0.07)	(0.08)	(0.05)
	Panel B: Effects of disability moderated by sex		
Disability	0.12	0.16	-0.14*
	(0.10)	(0.12)	(0.06)
Disability * Female	0.11	-0.20	-0.02
	(0.14)	(0.16)	(0.11)
Female	-0.07	-1.63***	0.58***
	(0.04)	(0.04)	(0.03)
	Panel C: Effects of disability moderated by age		
Disability	0.18*	0.09	-0.16**
	(0.07)	(0.08)	(0.06)
Disability * Age	0.07	0.11*	-0.06
	(0.04)	(0.05)	(0.04)
Age	-0.07***	-0.09***	0.35***
	(0.01)	(0.01)	(0.01)

N = 19,867; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; All models control for child age in years (centered at the sample mean age), child gender, ethnic background, mother's age at the time of child's birth, family structure, number of resident siblings, mother's education at wave 1, residence in an urban area, area-level socioeconomic disadvantage, diary day (weekend vs. weekday), and cohort membership. Models are weighted to correct for attrition, and standard errors are clustered by child to allow for repeated measurements.

Appendix E: Separate analysis by weekday/weekend day

Table E1: Time with companions - weekdays

	Alone	Mother	Father	Siblings	Peers
		Panel A: Main effect of disability only			
Disability	19.2**	14.0*	-2.1	-6.3	-19.5***
	(6.4)	(5.9)	(4.3)	(6.5)	(5.8)
		Panel B: Effects of disability moderated by sex			
Disability	14.9	18.6*	-3.3	-0.7	-29.4***
	(8.6)	(8.1)	(5.8)	(8.7)	(7.4)
Disability * Female	9.7	-10.2	2.5	-12.6	21.9
	(12.9)	(11.9)	(8.6)	(13.2)	(11.6)
Female	-21.1***	12.5***	-13.7***	-1.6	17.5***
	(3.3)	(2.9)	(2.2)	(3.6)	(3.3)
		Panel C: Effects of disability moderated by age			
Disability	20.8**	14.8*	-2.5	-7.0	-21.2***
	(6.7)	(5.9)	(4.2)	(6.4)	(5.8)
Disability * Age	8.5*	4.5	-2.1	-3.6	-8.9*
	(3.8)	(3.4)	(2.2)	(3.5)	(3.5)
Age	29.0***	-9.0***	-1.5*	-22.3***	0.7
	(0.9)	(0.8)	(0.6)	(1.0)	(1.0)

N = 15,631; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; All models control for child age in years (centered at the sample mean age), child gender, ethnic background, mother's age at the time of child's birth, family structure, number of resident siblings, mother's education at wave 1, residence in an urban area, area-level socioeconomic disadvantage, diary day (weekend vs. weekday), and cohort membership. Models are weighted to correct for attrition, and standard errors are clustered by child to allow for repeated measurements.

Table E2: Time with companions - weekends

	Alone	Mother	Father	Siblings	Peers
		Panel A: Main effect of disability only			
Disability	9.4	22.8	-1.8	19.4	0.7
	(12.7)	(14.3)	(11.4)	(15.1)	(14.8)
		Panel B: Effects of disability moderated by sex			
Disability	16.2	31.7	-3.1	25.6	-17.7
	(15.3)	(18.2)	(15.1)	(20.2)	(17.6)
Disability * Female	-16.2	-21.2	3.0	-14.6	43.4
	(26.3)	(28.9)	(22.7)	(30.0)	(31.1)
Female	-7.8	26.1***	-36.4***	-8.4	3.8
	(6.5)	(6.6)	(6.5)	(7.9)	(7.7)
		Panel C: Effects of disability moderated by age			
Disability	10.6	22.8	-2.2	21.2	1.0
	(13.1)	(14.4)	(11.4)	(15.2)	(14.9)
Disability * Age	8.8	0.1	-2.6	13.5	2.2
	(8.0)	(8.4)	(6.7)	(8.3)	(8.2)
Age	26.8***	-13.8***	-6.4**	-31.4***	1.1
	(1.9)	(1.9)	(2.0)	(2.4)	(2.4)

N = 4,236; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; All models control for child age in years (centered at the sample mean age), child gender, ethnic background, mother's age at the time of child's birth, family structure, number of resident siblings, mother's education at wave 1, residence in an urban area, area-level socioeconomic disadvantage, diary day (weekend vs. weekday), and cohort membership. Models are weighted to correct for attrition, and standard errors are clustered by child to allow for repeated measurements.

Table E3: Time in activities - weekdays

	Active leisure	Screen-based leisure	Non-active leisure	Time at school	Private lessons and homework	Communication
			Panel A: Main effect of disability only			
Disability	2.1	17.3**	4.1	-19.8**	-4.1*	-2.1
	(3.1)	(6.0)	(3.0)	(7.1)	(1.7)	(2.6)
			Panel B: Effects of disability moderated by sex			
Disability	-0.5	21.2*	1.8	-17.3	-3.7	1.2
	(4.3)	(8.6)	(3.7)	(9.4)	(1.9)	(3.0)
Disability * Female	5.7	-8.7	4.9	-5.5	-0.8	-7.2
	(6.3)	(11.8)	(6.1)	(14.3)	(3.5)	(5.3)
Female	-7.4***	-61.2***	19.4***	-0.6	7.9***	18.8***
	(1.6)	(3.1)	(1.7)	(3.7)	(1.0)	(1.7)
			Panel C: Effects of disability moderated by age			
Disability	1.5	19.2**	4.5	-20.6**	-4.5*	-2.7
	(3.1)	(6.2)	(3.1)	(7.2)	(1.7)	(2.7)
Disability * Age	-2.8	10.2**	2.4	-4.2	-2.2*	-3.5*
	(1.8)	(3.3)	(1.9)	(4.1)	(1.0)	(1.7)
Age	-5.4***	10.2***	-2.8***	-2.5*	3.2***	11.8***
	(0.5)	(0.9)	(0.5)	(1.1)	(0.3)	(0.5)

N = 15,631; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; All models control for child age in years (centered at the sample mean age), child gender, ethnic background, mother's age at the time of child's birth, family structure, number of resident siblings, mother's education at wave 1, residence in an urban area, area-level socioeconomic disadvantage, diary day (weekend vs. weekday), and cohort membership. Models are weighted to correct for attrition, and standard errors are clustered by child to allow for repeated measurements.

Table 4: Time in activities - weekends

	Active leisure	Screen-based leisure	Non-active leisure	Time at school	Private lessons and homework	Communication
			Panel A: Main effect of disability only			
Disability	-11.4	11.3	5.1	-4.0	-5.7	0.4
	(6.7)	(10.9)	(7.4)	(2.1)	(3.3)	(7.1)
			Panel B: Effects of disability moderated by sex			
Disability	-24.0**	-5.3	18.1	-1.1	-1.1	8.7
	(8.0)	(14.1)	(10.2)	(3.5)	(3.7)	(10.1)
Disability * Female	29.8*	39.4	-30.6*	-6.8	-11.0	-19.6
	(13.8)	(21.7)	(14.1)	(3.9)	(7.0)	(13.8)
Female	-25.6***	-73.9***	31.1***	1.3	11.8***	13.9***
	(4.0)	(5.9)	(3.7)	(1.8)	(2.6)	(3.7)
			Panel C: Effects of disability moderated by age			
Disability	-11.4	11.8	5.1	-4.1*	-5.7	-0.0
	(6.7)	(11.0)	(7.4)	(2.0)	(3.5)	(7.3)
Disability * Age	0.1	3.7	-0.1	-1.0	-0.0	-3.2
	(3.9)	(7.0)	(4.3)	(1.2)	(2.4)	(4.1)
Age	-10.7***	9.6***	-6.0***	-0.1	5.8***	14.6***
	(1.2)	(1.8)	(1.1)	(0.5)	(0.7)	(1.2)

N = 4,236; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; All models control for child age in years (centered at the sample mean age), child gender, ethnic background, mother's age at the time of child's birth, family structure, number of resident siblings, mother's education at wave 1, residence in an urban area, area-level socioeconomic disadvantage, diary day (weekend vs. weekday), and cohort membership. Models are weighted to correct for attrition, and standard errors are clustered by child to allow for repeated measurements.

Table E5: Structured vs. unstructured leisure time (excl. screen time) - weekdays

	Active leisure - structured	Active leisure - unstructured	Non-active leisure - structured	Non-active leisure - unstructured	All leisure - structured	All leisure - unstructured
			Panel A: Main effect of disability only			
Disability	-2.0	4.1	-0.6	4.7	-2.6	8.7*
	(1.7)	(2.8)	(1.0)	(2.9)	(2.0)	(4.1)
			Panel B: Effects of disability moderated by sex			
Disability	-3.7	3.2	-3.5***	5.3	-7.2**	8.5
	(2.2)	(4.0)	(1.0)	(3.6)	(2.4)	(5.4)
Disability * Female	3.7	1.9	6.4**	-1.5	10.2*	0.4
	(3.4)	(5.6)	(2.1)	(5.9)	(4.0)	(8.4)
Female	0.2	-7.5***	0.5	18.9***	0.6	11.4***
	(1.0)	(1.4)	(0.6)	(1.6)	(1.1)	(2.2)
			Panel C: Effects of disability moderated by age			
Disability	-2.4	3.9	-0.5	5.0	-2.9	9.0*
	(1.7)	(2.8)	(1.0)	(3.0)	(2.0)	(4.1)
Disability * Age	-2.0	-0.8	0.3	2.1	-1.7	1.3
	(1.1)	(1.5)	(0.7)	(1.8)	(1.2)	(2.4)
Age	0.4	-5.7***	-0.7***	-2.1***	-0.4	-7.8***
	(0.3)	(0.4)	(0.2)	(0.5)	(0.3)	(0.6)

N = 15,631; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; All models control for child age in years (centered at the sample mean age), child gender, ethnic background, mother's age at the time of child's birth, family structure, number of resident siblings, mother's education at wave 1, residence in an urban area, area-level socioeconomic disadvantage, diary day (weekend vs. weekday), and cohort membership. Models are weighted to correct for attrition, and standard errors are clustered by child to allow for repeated measurements.

Table E6: Structured vs. unstructured leisure time (excl. screen time) - weekends

	Active leisure - structured	Active leisure - unstructured	Non-active leisure - structured	Non-active leisure - unstructured	All leisure - structured	All leisure - unstructured
			Panel A: Main effect of disability only			
Disability	-3.6	-7.8	-3.9	9.0	-7.5	1.2
	(3.3)	(5.9)	(2.6)	(7.0)	(4.1)	(8.4)
			Panel B: Effects of disability moderated by sex			
Disability	-5.0	-19.0**	-4.1	22.1*	-9.1	3.2
	(4.3)	(7.1)	(3.4)	(9.6)	(5.4)	(11.1)
Disability * Female	3.3	26.6*	0.5	-31.1*	3.7	-4.6
	(6.7)	(12.2)	(5.3)	(13.5)	(8.5)	(16.9)
Female	-10.1***	-15.6***	0.7	30.5***	-9.4***	14.9**
	(2.1)	(3.6)	(1.7)	(3.4)	(2.7)	(4.6)
			Panel C: Effects of disability moderated by age			
Disability	-4.0	-7.4	-3.7	8.8	-7.7	1.4
	(3.3)	(5.8)	(2.5)	(7.1)	(4.2)	(8.3)
Disability * Age	-2.6	2.7	1.1	-1.3	-1.5	1.4
	(1.9)	(3.5)	(1.7)	(4.2)	(2.6)	(5.0)
Age	0.6	-11.3***	-1.3*	-4.7***	-0.7	-16.0***
	(0.6)	(1.1)	(0.5)	(1.0)	(0.8)	(1.4)

N = 4,236; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; All models control for child age in years (centered at the sample mean age), child gender, ethnic background, mother's age at the time of child's birth, family structure, number of resident siblings, mother's education at wave 1, residence in an urban area, area-level socioeconomic disadvantage, diary day (weekend vs. weekday), and cohort membership. Models are weighted to correct for attrition, and standard errors are clustered by child to allow for repeated measurements.

Table E7: Screen-based leisure subtypes - weekdays

	TV	Video games	Electronic device – communication
	Panel A: Main effect of disability only		
Disability	7.4	9.4*	-0.9
	(4.5)	(4.1)	(1.6)
	Panel B: Effects of disability moderated by sex		
Disability	6.5	14.4*	-0.1
	(6.0)	(6.8)	(1.9)
Disability * Female	2.0	-11.1	-1.7
	(9.0)	(7.7)	(3.4)
Female	-6.9**	-55.8***	10.2***
	(2.4)	(1.9)	(0.9)
	Panel C: Effects of disability moderated by age		
Disability	7.9	10.9*	-0.9
	(4.6)	(4.3)	(1.8)
Disability * Age	2.6	7.9**	0.2
	(2.4)	(2.7)	(1.3)
Age	2.5***	2.9***	6.5***
	(0.7)	(0.5)	(0.3)

N = 15,631; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; All models control for child age in years (centered at the sample mean age), child gender, ethnic background, mother's age at the time of child's birth, family structure, number of resident siblings, mother's education at wave 1, residence in an urban area, area-level socioeconomic disadvantage, diary day (weekend vs. weekday), and cohort membership. Models are weighted to correct for attrition, and standard errors are clustered by child to allow for repeated measurements.

Table E8: Screen-based leisure subtypes – weekends

	TV	Video games	Electronic device – communication
	Panel A: Main effect of disability only		
Disability	18.8*	-6.0	-3.7
	(9.1)	(7.0)	(2.9)
	Panel B: Effects of disability moderated by sex		
Disability	4.9	-7.3	-3.2
	(11.1)	(11.3)	(2.3)
Disability * Female	32.8	3.1	-1.1
	(18.7)	(13.0)	(6.2)
Female	-4.7	-73.1***	12.5***
	(4.9)	(3.9)	(1.8)
	Panel C: Effects of disability moderated by age		
Disability	19.6*	-6.6	-4.0
	(9.3)	(7.1)	(3.2)
Disability * Age	6.1	-4.1	-2.0
	(5.9)	(4.3)	(2.1)
Age	2.0	2.2	6.9***
	(1.5)	(1.2)	(0.6)

N = 4,236; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; All models control for child age in years (centered at the sample mean age), child gender, ethnic background, mother's age at the time of child's birth, family structure, number of resident siblings, mother's education at wave 1, residence in an urban area, area-level socioeconomic disadvantage, diary day (weekend vs. weekday), and cohort membership. Models are weighted to correct for attrition, and standard errors are clustered by child to allow for repeated measurements.

Appendix F: Comparing persistent disability to never disability

Table F1: Time with companions (comparing *persistent disability* to *never disability*)

	Alone	Mother	Father	Siblings	Peers
		Panel A: Main effect of disability only			
Disability	21.8*	32.9***	-5.0	-6.7	-20.3*
	(9.7)	(9.7)	(6.9)	(9.3)	(8.3)
		Panel B: Effects of disability moderated by sex			
Disability	29.9*	35.7**	-6.2	-4.1	-40.0***
	(12.9)	(11.9)	(8.9)	(11.9)	(10.1)
Disability * Female	-21.0	-7.2	3.1	-6.8	50.6**
	(19.2)	(20.4)	(14.0)	(19.0)	(16.3)
Female	-17.2***	17.3***	-18.0***	-1.2	12.2***
	(3.3)	(3.0)	(2.5)	(3.7)	(3.4)
		Panel C: Effects of disability moderated by age			
Disability	21.1*	32.9***	-4.9	-6.6	-19.7*
	(9.6)	(9.7)	(6.9)	(9.3)	(8.3)
Disability * Age	11.1**	0.3	-1.8	-2.7	-9.4*
	(4.2)	(4.3)	(2.7)	(4.6)	(4.4)
Age	28.4***	-9.5***	-2.7***	-24.3***	1.1
	(0.8)	(0.8)	(0.7)	(0.9)	(1.0)

N = 16,957; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; All models control for child age in years (centered at the sample mean age), child gender, ethnic background, mother's age at the time of child's birth, family structure, number of resident siblings, mother's education at wave 1, residence in an urban area, area-level socioeconomic disadvantage, diary day (weekend vs. weekday), and cohort membership. Models are weighted to correct for attrition, and standard errors are clustered by child to allow for repeated measurements. Excludes children with only 1 wave of data, and children with 2 or 3 waves of data who experience disability at only one wave.

Table F2: Time in activities (comparing *persistent disability* to *never disability*)

	Active leisure	Screen-based leisure	Non-active leisure	Time at school	Private lessons and homework	Communication
			Panel A: Main effect of disability only			
Disability	-7.5	29.5**	5.0	-23.4**	-5.8*	-7.3*
	(4.2)	(9.7)	(4.4)	(8.8)	(2.4)	(3.6)
			Panel B: Effects of disability moderated by sex			
Disability	-13.4**	33.8*	6.3	-23.2*	-2.8	-2.1
	(4.8)	(13.2)	(5.5)	(10.7)	(2.8)	(4.5)
Disability * Female	15.2	-11.0	-3.4	-0.4	-7.6	-13.4
	(8.9)	(18.9)	(9.2)	(18.4)	(5.2)	(7.4)
Female	-11.1***	-63.5***	21.8***	-0.3	8.6***	19.2***
	(1.7)	(3.0)	(1.7)	(3.1)	(1.2)	(1.8)
			Panel C: Effects of disability moderated by age			
Disability	-7.5	29.0**	5.0	-23.2**	-5.7*	-6.9
	(4.2)	(9.6)	(4.5)	(8.8)	(2.4)	(3.6)
Disability * Age	1.6	7.6	-0.6	-2.7	-1.2	-6.9***
	(2.4)	(3.9)	(2.3)	(4.6)	(1.3)	(2.0)
Age	-6.3***	9.7***	-3.6***	-2.3*	3.8***	12.7***
	(0.5)	(0.8)	(0.5)	(0.9)	(0.3)	(0.5)

N = 16,957; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; All models control for child age in years (centered at the sample mean age), child gender, ethnic background, mother's age at the time of child's birth, family structure, number of resident siblings, mother's education at wave 1, residence in an urban area, area-level socioeconomic disadvantage, diary day (weekend vs. weekday), and cohort membership. Models are weighted to correct for attrition, and standard errors are clustered by child to allow for repeated measurements. Excludes children with only 1 wave of data, and children with 2 or 3 waves of data who experience disability at only one wave.

Table F3: Structured vs. unstructured leisure time (excl. screen time) (comparing *persistent disability* to *never disability*)

	Active leisure - structured	Active leisure - unstructured	Non-active leisure - structured	Non-active leisure - unstructured	All leisure - structured	All leisure - unstructured
			Panel A: Main effect of disability only			
Disability	-5.7**	-1.8	-0.6	5.6	-6.3*	3.8
	(2.1)	(3.5)	(1.5)	(4.3)	(2.6)	(5.3)
			Panel B: Effects of disability moderated by sex			
Disability	-4.7	-6.4	-1.4	5.0	-6.2*	-1.4
	(2.7)	(3.8)	(1.5)	(4.9)	(3.1)	(5.6)
Disability * Female	-3.2	16.0	2.7	2.0	-0.4	17.9
	(4.0)	(8.6)	(3.3)	(9.7)	(5.5)	(13.1)
Female	-2.1*	-8.8***	0.7	20.8***	-1.4	12.0***
	(1.0)	(1.4)	(0.6)	(1.6)	(1.2)	(2.1)
			Panel C: Effects of disability moderated by age			
Disability	-5.7**	-1.9	-0.7	5.7	-6.4*	3.8
	(2.1)	(3.5)	(1.4)	(4.3)	(2.6)	(5.3)
Disability * Age	-0.3	1.9	1.3	-2.0	1.0	-0.1
	(1.4)	(2.0)	(0.8)	(2.2)	(1.6)	(2.9)
Age	0.4	-6.7***	-0.9***	-2.7***	-0.5	-9.4***
	(0.3)	(0.4)	(0.2)	(0.5)	(0.3)	(0.6)

N = 16,957; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; All models control for child age in years (centered at the sample mean age), child gender, ethnic background, mother's age at the time of child's birth, family structure, number of resident siblings, mother's education at wave 1, residence in an urban area, area-level socioeconomic disadvantage, diary day (weekend vs. weekday), and cohort membership. Models are weighted to correct for attrition, and standard errors are clustered by child to allow for repeated measurements. Excludes children with only 1 wave of data, and children with 2 or 3 waves of data who experience disability at only one wave.

Table F4: Screen-based leisure subtypes (comparing *persistent disability* to *never disability*)

	TV	Video games	Electronic device – communication
	Panel A: Main effect of disability only		
Disability	22.1**	10.3	-5.4**
	(7.2)	(6.4)	(1.8)
	Panel B: Effects of disability moderated by sex		
Disability	19.4*	14.4	-3.9
	(8.3)	(8.3)	(2.2)
Disability * Female	9.3	-14.3	-5.2
	(15.4)	(9.9)	(3.5)
Female	-5.9*	-59.9***	11.0***
	(2.4)	(1.8)	(0.9)
	Panel C: Effects of disability moderated by age		
Disability	22.0**	9.7	-5.2**
	(7.1)	(6.2)	(1.7)
Disability * Age	1.1	9.4**	-2.2
	(3.0)	(3.1)	(1.3)
Age	2.3***	2.5***	6.7***
	(0.6)	(0.5)	(0.3)

N = 16,957; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; All models control for child age in years (centered at the sample mean age), child gender, ethnic background, mother's age at the time of child's birth, family structure, number of resident siblings, mother's education at wave 1, residence in an urban area, area-level socioeconomic disadvantage, diary day (weekend vs. weekday), and cohort membership. Models are weighted to correct for attrition, and standard errors are clustered by child to allow for repeated measurements. Excludes children with only 1 wave of data, and children with 2 or 3 waves of data who experience disability at only one wave.

Appendix H: Additional companion/activity categories

Table H1: Time with parents – alternative codes

	Mother only	Mother and others (excl. father)	Father only	Father and others (excl. mother)	Either parent	Both parents
			Panel A: Main effect of disability only			
Disability	10.7***	4.2	1.8	-4.6*	13.1*	0.9
	(3.2)	(3.8)	(1.7)	(1.8)	(5.8)	(3.4)
			Panel B: Effects of disability moderated by sex			
Disability	12.5**	9.2	2.5	-5.2	18.5*	-0.4
	(4.5)	(5.4)	(2.6)	(2.8)	(8.0)	(4.3)
Disability * Female	-4.0	-11.2	-1.5	1.5	-12.3	2.9
	(6.4)	(7.7)	(3.3)	(3.4)	(11.7)	(7.0)
Female	8.3***	11.2***	-9.1***	-5.5***	0.8	-4.0*
	(1.4)	(1.9)	(0.9)	(1.1)	(2.9)	(1.7)
			Panel C: Effects of disability moderated by age			
Disability	11.3***	4.4	1.8	-4.9**	13.4*	0.9
	(3.3)	(3.8)	(1.8)	(1.7)	(5.8)	(3.4)
Disability * Age	3.1	0.6	-0.1	-1.9	2.0	0.3
	(1.9)	(2.0)	(1.1)	(1.1)	(3.2)	(1.7)
Age	-0.8*	-7.6***	0.2	-1.2***	-11.0***	-1.6***
	(0.4)	(0.5)	(0.2)	(0.3)	(0.8)	(0.5)

N = 19,867; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; All models control for child age in years (centered at the sample mean age), child gender, ethnic background, mother's age at the time of child's birth, family structure, number of resident siblings, mother's education at wave 1, residence in an urban area, area-level socioeconomic disadvantage, diary day (weekend vs. weekday), and cohort membership. Models are weighted to correct for attrition, and standard errors are clustered by child to allow for repeated measurements.

Table H2: Time with siblings, peers, and other – alternative codes

	Peers only	Siblings only	Other adults
	Panel A: Main effect of disability only		
Disability	-15.5***	0.3	-0.9
	(3.8)	(3.2)	(3.9)
	Panel B: Effects of disability moderated by sex		
Disability	-19.4***	4.8	-4.2
	(4.9)	(4.5)	(5.2)
Disability * Female	8.8	-10.1	7.3
	(7.6)	(6.4)	(7.9)
Female	3.0	-3.7*	8.2***
	(2.3)	(1.8)	(2.3)
	Panel C: Effects of disability moderated by age		
Disability	-16.5***	0.2	-1.3
	(3.8)	(3.2)	(3.9)
Disability * Age	-6.0**	-0.9	-1.9
	(2.2)	(1.8)	(2.4)
Age	3.4***	-9.9***	0.2
	(0.7)	(0.5)	(0.6)

N = 19,867; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; All models control for child age in years (centered at the sample mean age), child gender, ethnic background, mother's age at the time of child's birth, family structure, number of resident siblings, mother's education at wave 1, residence in an urban area, area-level socioeconomic disadvantage, diary day (weekend vs. weekday), and cohort membership. Models are weighted to correct for attrition, and standard errors are clustered by child to allow for repeated measurements.

Table H3: Time in activities – alternative codes

	Paid work, volunteering, chores	Travel	Reading	Medical appointments	Sleep (incl. naps)	Other activities
			Panel A: Main effect of disability only			
Disability	2.5	-0.5	-0.3	2.0**	1.1	0.2
	(2.2)	(2.2)	(1.2)	(0.7)	(3.0)	(0.8)
			Panel B: Effects of disability moderated by sex			
Disability	1.5	-4.0	1.5	2.9**	0.7	-0.3
	(2.5)	(2.9)	(1.5)	(1.0)	(4.0)	(1.2)
Disability * Female	2.2	7.8	-4.0	-2.1	1.0	1.2
	(4.6)	(4.6)	(2.4)	(1.3)	(6.0)	(1.7)
Female	9.4***	3.0*	7.6***	0.2	-1.4	-0.2
	(1.1)	(1.2)	(0.7)	(0.4)	(1.5)	(0.5)
			Panel C: Effects of disability moderated by age			
Disability	2.4	-0.3	-0.0	2.0**	1.2	0.3
	(2.3)	(2.3)	(1.2)	(0.7)	(3.1)	(0.9)
Disability * Age	-0.6	1.3	1.3	0.3	0.5	0.6
	(1.4)	(1.3)	(0.8)	(0.5)	(1.9)	(0.5)
Age	4.4***	-0.6	-0.9***	0.6***	-11.4***	-0.2
	(0.3)	(0.3)	(0.2)	(0.1)	(0.4)	(0.1)

N = 19,867; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; All models control for child age in years (centered at the sample mean age), child gender, ethnic background, mother's age at the time of child's birth, family structure, number of resident siblings, mother's education at wave 1, residence in an urban area, area-level socioeconomic disadvantage, diary day (weekend vs. weekday), and cohort membership. Models are weighted to correct for attrition, and standard errors are clustered by child to allow for repeated measurements.