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Free days for future? Longitudinal effects of working time reductions on individual well-being and environmental behaviour

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ABSTRACT

Working time reductions (WTR) are a promising strategy to foster both environmental behaviour and individual well-being. It is unclear, however, whether these possible effects are more likely due to reduced income or to more discretionary time. Moreover, prior studies have only tested the environmental effects of WTR cross-sectionally, and have only tested the well-being effects of WTR including wage compensations. We conducted a longitudinal three-wave study with Swiss employees, including one group who voluntarily reduced their working hours following the first questionnaire. Between-subject analysis suggested that decreased working time is associated with decreased GHG-related behaviours, and increased individual well-being. While the improved GHG-related behaviour is mainly due to reduced income, the well-being effects arise despite lower income. Analyses over time revealed that after reducing their working hours, participants reported increased well-being, more intent-related pro-environmental behaviour, less car commuting, and decreased clothing expenditures. However, no improvement was found regarding other GHG-related behaviours, which are strongly linked to income levels. Thus, reducing standard working time, and simultaneously reducing income, may be a promising strategy. However, voluntarily working a day less per week will probably not reach the full ecological potential of a societal-level WTR.

1. Introduction

To date, no country in the world has succeeded in achieving and maintaining a high level of prosperity without massively exceeding planetary boundaries according to their appropriate share of natural resources (O'Neill et al., 2018). Global North countries, in particular, must greatly reduce their consumption-related environmental impact, especially in terms of greenhouse gas emissions (GHG; IPCC, 2021). This task requires a radical transformation of our consumption and lifestyle patterns, supported by far-reaching cross-sectoral policies (Independent Group of Scientists appointed by the Secretary-General, 2019). However, such policies will likely only obtain public approval if they produce co-benefits, that is, not only benefit the environment, but also benefit people's well-being (Verhofstadt et al., 2016). One such policy that has gained increasing interest in sustainability debates is *working time reduction* (Coote et al., 2010; King & van den Bergh, 2017; Mastini et al., 2021; Schor, 2008), that is, reductions to the hours worked for payment per week or per year. It has been argued that working time reductions (hereafter, WTR) could provide multiple benefits – increasing environmental sustainability, social justice, gender equality, and well-being (e.g. Coote et al., 2010; Fitzgerald, 2022; Stronge et al., 2019). Several empirical studies have found that countries with shorter working hours have lower per capita environmental impacts (Fitzgerald et al., 2018; Knight et al., 2013; Rosnick & Weisbrot, 2007; Shao & Shen, 2017). Studies at the level of the individual show a similar relationship between working hours and personal GHG emissions (e.g. Buhl & Acosta, 2016; Devetter & Rousseau, 2011; Nässén & Larsson, 2015; see Antal et al., 2021, for a review).

So far, however, it has remained unclear how, exactly, working less affects individual consumption patterns. In the past, two different processes have been proposed (Bader et al., 2020; Buhl & Acosta, 2016; Nässén & Larsson, 2015): On the one hand, individuals with more working hours tend to have higher income on average, causing more consumption and thus higher consumption-related GHG emissions (*income effect*). On the other hand, individuals with more working hours have less discretionary time, resulting in different time use and consumption patterns (*time effect*).

With the present study, we seek to improve understanding of the

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effects of WTR on individual consumption patterns and thus impact-oriented environmental behaviour. In addition, we aim to improve understanding of the potential co-benefits of WTR in terms of individual well-being. We do this using a quasi-experimental design that enables us to observe not only differences between employees with different levels of working hours, but also the longitudinal effects of WTR among employees who voluntarily reduce their working time. The results shed light on the potential environmental and well-being benefits of WTR policies.

1.1. Working time reduction and environmental behaviour

It has been argued that WTR improves personal environmental behaviour both because of decreased income and of increased discretionary time. At the same time, it is important to distinguish between *impact*-oriented environmental behaviour (GHG-behaviour; e.g. measurements of energy consumption, ecological footprint, or GHG footprint) and *intent*-oriented pro-environmental behaviour (PEB). The latter encompasses behaviours intended by individuals to protect the environment, regardless of whether these behaviours actually reduce their environmental impacts (Nielsen et al., 2021; Stern, 2000). The link between individual and household income and impact-oriented GHG-behaviour is largely agreed upon at this point. Income has been repeatedly found to predict individual- and household-level GHG emissions resulting from mobility, housing, and general consumption of goods and services (Bleys et al., 2018; Bruderer Enzler & Diekmann, 2019; Huddart Kennedy et al., 2015; Ivanova et al., 2018; Moser & Kleinhückelkotten, 2018; Wiedenhofer et al., 2018). Accordingly, studies simulating the potential effects of WTR policies estimate that a reduction in working hours of 1% could produce an income-induced reduction in GHG emissions between 0.3% and 0.82% (Buhl & Acosta, 2016; Fremstad et al., 2019; Nässén & Larsson, 2015). As for predicting PEB, income appears to play a less important role; PEB is mainly influenced by motivational variables, like environmental self-identity and environmental concern (Bruderer Enzler & Diekmann, 2019; Huddart Kennedy et al., 2015; Moser & Kleinhückelkotten, 2018).

Findings on environmental impacts derived from WTR *time effects* are less clear. Some observers argue that decreased working hours benefit PEB, as many motivational pro-environmental actions require time, and the conscious process of breaking out of environmentally harmful habits might also require time. However, the evidence regarding this claim is mixed: Chai et al. (2015) found supporting empirical evidence, while another more rigorous study did not find any objective or subjective work–life balance impact on PEB (Melo et al., 2018). As for the time effect on GHG emissions, studies have not found evidence for a clear link when controlling for income (e.g. Ivanova et al., 2018). However, there may be time effects regarding specific GHG-relevant behaviours such as eating out or owning energy-intensive time-saving equipment (Devetter & Rousseau, 2011), use of energy-consuming household devices (Whillans et al., 2017), or commuting (Kallis et al., 2013; King & van den Bergh, 2017). Conversely, several studies estimate a WTR-related *time rebound effect*, whereby new free time is spent on activities (e.g. travel) that cause *higher* GHG emissions per hour than working would have (Hanbury et al., 2019; Jalas, 2002). Studies estimating this time rebound effect have concluded that a WTR of 1% could lead to increases in GHG emissions due to shifts in time use – namely, increases of 0.02% (Nässén & Larsson, 2015) or 0.48% (Buhl & Acosta, 2016). Notably, these estimates suggest that the time rebound effect does not fully neutralize the income effect.

In conclusion, the direction and magnitude of WTR-related time effects are subject to ongoing debate, whereas the income effect is relatively well established. However, virtually all the available evidence has been derived from cross-sectional studies. To our knowledge, only one study has longitudinally tested the environmental effects of WTR at the individual level – namely, the above-mentioned study on time rebound effects by Buhl and Acosta (2016). However, even in this study, the authors estimated the income effect cross-sectionally, limiting the validity of their conclusions about the overall environmental effects of WTR.

1.2. Working time reduction and individual well-being

Certain income and time effects of WTR can also be hypothesized regarding individual well-being: Generally, the more individuals work, the less discretionary time they have for other life domains, possibly influencing their overall well-being. It is known that involuntary unemployment, on the one side, and excessive workloads, on the other, can have detrimental effects on psychological and health-related well-being (Kamerāde et al., 2019; Virtanen et al., 2018). Between these two extremes, however, no linear relationship has been found between individual working time and well-being (Kamerāde et al., 2019; Pereira & Coelho, 2013). At the same time, individuals frequently express a desire to work less (e.g. Angrave & Charlwood, 2015; Bartoll & Ramos, 2020; Holly & Mohnen, 2012) and this subjective mismatch between desired and actual working hours has been associated with diminished well-being (Otterbach et al., 2016; Wooden et al., 2009). In this way, reduced working hours could benefit people's well-being by freeing up time for other domains of life – and increasing their well-being in these domains. Indeed, it has been reasoned that the effect of WTR on well-being might depend especially on how the new discretionary time is actually spent (Buhl & Acosta, 2016; Druckman et al., 2012; Jalas & Juntunen, 2015). In addition, there is evidence that the relationship between working time and well-being is partly influenced by people's materialistic orientation (Andersson et al., 2014; Andersson & Nässén, 2016). In conclusion, from a time perspective, shorter working hours (but not unemployment) might be beneficial for individual well-being because it satisfies the expressed desire of many employees to work less, prevents the health harms of overwork, and frees up time for other activities that benefit well-being.

In contrast to time effects, the relationship between individual and household income and well-being has been thoroughly investigated: In general, income plays an important role in predicting well-being (Diener et al., 2018; Kahneman & Deaton, 2010). However, it has also been found that this only holds true as long as increases in income help to better satisfy needs (Pullinger, 2014). Further, there is evidence of satiation or turning points regarding the positive relationship between income and subjective well-being: While income increases enable substantial improvements in well-being among those with relatively little income, they do not enable similarly sized improvements among higher earners (Inglehart et al., 2008; Jebb et al., 2018). Whatever the case, from an income perspective, it is important to note that shorter working time could be detrimental to individual well-being when it leads to reduced income among lower earners in particular.

These potentially counter-directed WTR effects of income and time highlight the importance of directly testing the effects of WTR on well-being. Very few studies have explicitly focused on the potential effects of changes in working hours on well-being. Lepinteur (2019) used the European Community Household Panel to analyse the effects of a national reduction in standard working hours from 44 to 40 h per week in Portugal and from 39 to 35 h per week in France in 2002 (both with full wage compensation), respectively. He found positive effects for these reductions with regards to both leisure satisfaction and job satisfaction. Barck-Holst et al. (2017) analysed data of a longitudinal quasi-experimental WTR with full wage compensation in Sweden and found positive effects on various measures of psychosocial health, including sleep quality and quantity, stress, negative emotions, and fatigue. Schiller et al. (2017) conducted a randomized intervention looking at the effects of a 25% WTR with full wage compensation and found positive effects of WTR on stress and sleep. These studies generally support the conclusion that WTR benefits individual well-being, particularly people's health. However, these studies researched the effects of WTR on well-being including *full wage compensation*, thus only taking the time effect into account, but not testing the effect of reduced income. The question remains as to whether such well-being benefits also occur when WTR is accompanied by corresponding reductions in income. To our knowledge, the study by Buhl and Acosta (2016) is the only such research that also controls for income losses. They found no beneficial effects of WTR on life satisfaction. However, as mentioned, the time effect of WTR on well-being frequently manifests in connection with health measures, which the authors did not include in their study. The interaction of working time and income, as well as the possible effects of decreased working time, thus remain unclear.

1.3. The present research

With the present study, we seek to improve understanding of the possible co-benefits of decreased working time for the environment and individual well-being. Such co-benefits have been proposed by various scholars (Coote et al., 2010; Fitzgerald, 2022; Schor, 2008; Stronge et al., 2019). We aim to shed light on whether possible co-benefits are more likely to derive from time gains associated with reduced working hours, or to corresponding income losses (Buhl & Acosta, 2016; Nässén & Larsson, 2015). We investigated these relationships using a quasi-experimental longitudinal design. Specifically, we surveyed Swiss employees who voluntarily reduced their working hours, and thus experienced a reduction in income, and compared them with a control group who did not change their working time.

With an average working time of 42.8 h per week among full-time workers, Switzerland has one of the highest standard weekly work rates in Europe (Eurostat, 2020a). Meanwhile, at 39.1%, Switzerland also has the second-highest proportion of part-time workers in Europe (Eurostat, 2020b), mainly due to part-time working women (59% of female workers work part-time, whereas only 18% of working men do; Federal Statistical Office, 2020). Not only working time, but also Swiss disposable household income is one of the highest worldwide (OECD, 2019). Notably, Swiss residents also cause GHG emissions of about 14t CO_2eq per capita and year, of which more than half are caused indirectly – namely, by means of imported goods from other countries (Frischknecht et al., 2018). As a result, Switzerland has one of the world's highest levels of consumption-based GHG emissions per capita (Federal Office for the Environment, 2020).

1.4. Hypotheses

Based on the results of previous studies (e.g. Buhl & Acosta, 2016; Devetter & Rousseau, 2011; Nässén & Larsson, 2015), we assume that people with lower working hours display more environmental behaviour, i.e. our first hypothesis assumes that:

H1.1: Working hours positively predict GHG-relevant behaviour, and negatively predict pro-environmental behaviour (PEB).

Previous evidence suggests that such a relationship can be explained in particular by reduced income (Buhl & Acosta, 2016; Nässén & Larsson, 2015), at least in terms of impact-oriented environmental behaviour. It remains unclear whether the gain in time can also explain environmental behaviour beyond income effects, particularly in regards to intent-oriented PEB (see for example Chai et al., 2015). We therefore also test the assumption that:

H1.2: Income positively predicts GHG-relevant behaviour (no relation is assumed for PEB). When controlling for income, working hours still positively predict GHG-relevant behaviour, and negatively predict PEB.

Previous studies have examined corresponding effects only cross-sectionally, comparing different individuals employed at different working levels. This limits the conclusions that can be drawn on behalf of WTR policies (Antal et al., 2021). The present study seeks to fill this research gap by longitudinally studying the effects of WTR on individual environmental behaviour. We thus aim at testing the assumption that:

H1.3: GHG-relevant behaviour decreases and PEB increases after a voluntary WTR.

Very few studies to date have examined both environmental and well-being effects simultaneously (Andersson et al., 2014; Nässén & Larsson, 2015), and only in one case using longitudinal data (Buhl & Acosta, 2016). Studies focusing on well-being effects of WTR have generally included wage compensations (Barck-Holst et al., 2017; Lepinteur, 2019; Schiller et al., 2017). Thus, we seek to better understand whether WTR increases personal well-being, and whether this effect remains in the absence of income compensation. Thus, analogous to the hypotheses described above, we assume that decreased working hours are associated with increased individual psychological and health-related well-being, or:

H2.1: Working hours negatively predict well-being.

Based on an assumed counter-directed effect of working hours and income on well-being we also assume that:

H2.2: Income positively predicts well-being. Controlling for income increases the negative effect of working hours on well-being.

Finally, we assume that a reduction in working hours over time leads to improved well-being, particularly health-related well-being. This effect should be larger for longer working hours at baseline:

H2.3: Well-being increases following voluntary WTR.

2. Methods

2.1. Procedure and participants

In the present study, we implemented a quasi-experimental longitudinal design comparing a group of Swiss employees who reduced their working hours (*reducers*, i.e. the intervention group) with a group who did not change their workload (*non-reducers*, i.e. the control group). Three online questionnaires were scheduled such that the *reducers* received the first questionnaire (baseline; t0) 1 month before their planned WTR; the second questionnaire (t1) assessing immediate effects 3 months after the reduction; and the last questionnaire (t2) assessing medium-term effects 9 months after the reduction. The first participants answered questionnaire t0 in May 2018, the last filled out questionnaire t2 in February 2020. This long period was necessary to obtain an adequate sample size of reducers, since they did not all reduce their workload on the same date. *Non-reducers* were randomly assigned so that their distribution of questionnaire dates was similar to that of reducers. Participants had 2 weeks to fill in each questionnaire and were issued two reminder emails per questionnaire.

Participants were recruited among employees of several larger cooperating Swiss employers ($n = 474$), via social media ($n = 78$), and a market research institute ($n = 215$). Another 108 participants were recruited from a company who cooperated only for the baseline questionnaire; these cases were included to improve the estimation of between-subject predictors. We aimed for at least $n = 100$ reducers at t0, to detect medium to small effect sizes in the group-time interaction. A total of 138 participants indicated at study registration that they planned to reduce their working hours. However, an inspection of their indicated effective working time at each questionnaire time point revealed that not all of them were able to realize their intentions. We therefore categorized participants into the two groups of reducers versus non-reducers as follows: Participants who were observed to have reduced their working hours by at least 4 h per week either at t1 or t2 (compared to t0) were coded as “reducers”; all others were coded as “non-reducers” (*WTR*; reducer = 1 and non-reducer = 0). Thus, the group of non-reducers contains workers with varying workloads who held their workload constant. This procedure resulted in $n = 110$ participants for whom a reduction in working hours was observable over the course of the study. Thirty-seven participants who were included with at least two points of measurement into the final analyses as non-reducers had originally planned to reduce their working time. They were still included to increase sample size.[1] In case of an observed increase in working hours of at least 6 h (either at t1 or t2 compared to t0), all outcome observations after this increase were excluded from our analyses. If participants retired or became unemployed over the course of the study, again only outcome observations prior to these events were included. Additionally, six participants were excluded from the analyses after indicating that they were retired or unemployed at baseline; and four participants were excluded due to many missing answers. Following these exclusions, outcome observations of $N = 865$ participants in total were subjected to data analyses ($n = 838$ for t0, $n = 627$ for t1, and $n = 571$ for t2), resulting in a maximum of 2036 observations suitable for analyses. The resulting sample was 59.5% female ($n = 515$), with an average age of 43.3 years (ranging from 17 to 72 years). Participants’ characteristics at baseline and completion rates for all three questionnaires are shown in Appendix A.1.

2.2. Measures

All three questionnaires contained the same set of questions (with slightly adapted wording, e.g. “at the moment” at t1 and t2 instead of “in general” at t0). Each of the three questionnaires took 20 min on average to complete. The psychometric properties of the scales used can be found in Appendix A.2. All psychometric scales displayed medium to good internal consistency with Cronbach’s Alpha between .81 and .91. A description of the items can be found in Appendix A.3. A correlation table of all baseline study measures can be found in S.1.

Outcome variables for environmental behaviour were assessed twofold: First, a measure for *intent-related PEB* was assessed. Five items were used for this (selected from a scale of Kaiser, 2020, and own item constructions), which we assumed to be particularly sensitive to sufficiency or lack of time. The mean value was used for further analyses. Second, *GHG-relevant behaviour*, i.e. impact-oriented environmental behaviour, was measured using four questions from a Swiss carbon footprint calculator (WWF Switzerland, 2017): Participants were asked for their monthly clothing expenditure as a proxy for consumption behaviour. Moreover, they were asked to indicate their living space (which we weighted based on the number of persons living in the same household), whether and how many kilometres they had travelled by car in recent months, and whether and how many hours they had travelled by airplane in recent months. Additionally, participants indicated whether and how many hours they had commuted by car per week in recent weeks (own item wording). We used these questions as single-item outcome variables.

We assessed four different measures as outcome variables for well-being. The Satisfaction with Life Scale (SWLS; five items; Diener et al., 1985) was used as a measure of cognitive well-being. A positive subscale of the Scale of Positive and Negative Experience (SPANE-p; six items; Diener et al., 2010) and an adapted negative subscale of the SPANE (*SPANE-n;* six items) were used to assess positive, and negative emotional well-being. The work-related burnout subscale of the Copenhagen Burnout Inventory (CBI; seven items; Kristensen et al., 2005) was used to assess health-related burnout tendency. For analyses, the respective items were combined into scales by calculating their mean value.

Our main predictors of interest were working hours, income and WTR. In addition to the binary variable described above – namely, whether a working time reduction (*WTR)* had been experienced (either at t1 or t2) or not (i.e. reducers vs. non-reducers) – we considered the absolute amount of paid *weekly working hours*. Participants indicated how many hours they worked per week on average. If they were not able to indicate an average, they were asked for their categorial most frequent weekly working hours, and the category mean was used for analyses. For income, participants indicated their categorial per-capita *annual gross income*. Category means were used for analyses. In addition to these independent variables, we considered a set of socio-demographic (gender; *female* vs. *other gender*, age, education; *university degree* vs. *no university degree*, household size, parenthood; *parent* vs. *non-parent*, and residence area; *urban* vs. *non-urban*), and psychological control variables. The latter included a three-item measure of environmental self-identity (ESI; Van der Werff et al., 2014) and a six-item measure of materialistic values (MVS; Richins, 2004). Additionally, to check whether participants were secondary household earners (possibly decreasing WTR income effects), they were asked whether they were in an income partnership and, if yes, were asked to indicate categorically how much they contributed to their household income. Only 6 reducers indicated that they were in an income partnership and were contributing less than 40% of household income. As a result, this variable was not included in the main analyses. Means of household income contribution by group can be found in Appendix A.1.

2.3. Data preparation and data analysis

As 32 participants would have been excluded due to missing values for one or multiple control and predictor variables, missing values were imputed (number of missing values can be found in Appendix A.3).[2] For binary control variables (i.e. education and residence area), missing values were imputed using Bayesian logistic regression. For age and income, missing values were replaced using a single imputation procedure with predictive mean matching (Kleinke et al., 2020). One of the control variables (materialistic values) was used logarithmically to decrease deviations from normality. Numeric predictors were z-standardized, binary predictors were used as 0/1. Distributions of the outcome variables were visually inspected. The single-item measures of GHG-relevant behaviour were susceptible to skewed distributions as were three of the well-being measures. We thus applied the following transformations to reduce the deviations from normal distribution: living space, hours of air travel, SPANE-p, and CBI were log-transformed; general car travel was fourth root transformed; and car commuting and SWLS were square-root transformed. Afterwards, all outcome variables were z-standardized using the baseline (t0) mean and standard deviation.

To test our hypotheses, we calculated a series of four regression models for each of our numeric outcome variables. We applied Linear Mixed-Effects Regression Models (LMER) using R Statistics version 3.6.1 (R Core Team, 2019) and the package lme4 (Bates et al., 2015). Significance tests of fixed effects coefficients were calculated with the package lmerTest using the Satterthwaite’s degrees of freedom method (Kuznetsova et al., 2017). We first calculated a control model *(M0)*, which included the random intercept, two time dummy variables (indicating whether answers stem from t1 or from t2 as compared to t0), and all control variables (gender, age, education, household size, parenthood, residence area, environmental self-identity, and

[1] A re-analysis excluding all participants that had planned to reduce their working time but for whom no reduction was observable ($n = 47$) showed similar results to the analyses reported in section 3, see Supplementary Materials S.16 – S.19. These participants were thus kept in the sample to increase the overall sample.

[2] A re-analysis using listwise deletion of missing values showed similar results to the analyses reported in section 3, see Supplementary Materials S.20 – S.23.

materialistic values). The next model (model 1 *M1)* tests for hypotheses H1.1 and H2.1 by adding baseline (t0) working hours. Next, model 2 (*M2)* tests for hypotheses H1.2, H2.2 by adding baseline (t0) income. Finally, model 3 (*M3)* tests for hypotheses H1.3 and H2.3 by adding the binary variable of whether participants had reduced their working hours during the study (WTR), as well as two interaction terms between this binary WTR variable and the time dummy variables (WTR x t1 and WTR x t2). This stepwise process made it possible to test whether working hours had a between-subject effect on the outcome variable of interest (M1), whether this influence was (partly) due to an effect of income (M2), and whether a working time reduction (WTR) had a dynamic within-subject effect on the outcome variable of interest (M3).

The goodness of fit of these four different LMER-models were compared with ANOVA and multi-model inference interpreting the indices of Akaike's corrected Information Criterion (AICc), and Weight of Evidence (WoE): The WoE estimate indicates the probability that, *of all tested models*, the chosen model is the best to describe the data (Long, 2012). LMER was chosen over repeated-measure analysis of variance (ANOVA) to enable inclusion of participants with incomplete data. A random intercept model accounting for within-subject means was used because although a model including all possible random effects was of (minor) interest, it would have resulted in overfitting (Long, 2012).

The two binary outcome variables – the probabilities of air travel and car commuting – were tested by means of a hurdle model. This procedure made it possible to account for many participants indicating values of zero for each of these variables. We thereby followed an approach of Bruderer Enzler (2017): First, binominal generalized LMERs were fitted with the binary variable indicating whether at least 1 h had been travelled by air or commuted by car. Next, regular LMERs as described above were conducted using the original variables, with values of zero treated as missing values.

3. Results

3.1. Observed working time reduction

Before testing our hypotheses, we checked for differences at baseline (t0) between the two WTR groups (reducers vs. non-reducers; see Appendix A.1). Participants who reduced their working hours (reducers) did not statistically significantly differ from non-reducers with respect to gender, parenthood, urbanity of residence area, education, age, environmental self-identity, materialistic values, or baseline income. However, reducers lived in significantly smaller households ($t = 2.13$, $p < .05$) and worked significantly more hours per week ($t = -4.47$, $p < .001$) at baseline than non-reducers.

Moreover, we checked how WTR affected weekly working hours and income – our two predictors of interest (for details see Appendix A.4). Reducers significantly decreased their working hours in comparison with non-reducers at t1 and t2 by about one standard deviation. Their income significantly decreased as compared to that of non-reducers by about 0.25 standard deviations. In absolute terms, the working hours of reducers decreased from 38.9 h at baseline by 8.85 h per week in comparison with non-reducers at t1, and by 9.92 h in comparison with non-reducers at t2. This corresponds to approximately 1 full-time working day per week in Switzerland. Their income decreased by CHF 8313 per year in comparison with non-reducers at t1, and by CHF 10,900 per year in comparison with non-reducers at t2[3].

3.2. The effects of WTR on environmental behaviour

To test our hypotheses 1.1–1.3, we ran a series of four LMER models predicting the seven different indicators of environmental behaviour (for air travel and car commuting, probabilities as binary values and numeric outcomes were used as described above). Table 1 shows the indices of the model comparisons. Testing for H1.1 – i.e. the predictive power of baseline working hours in models (M1) – revealed mixed evidence, as can be seen by ANOVA test statistics as well as model comparison based on AICc. The inclusion of baseline working hours

Table 1
Model comparison indices for the environmental behaviour models using LMER.

Model	ANOVA			Multimodel Inference		
	df	deviance	χ^2	AICc	WoE	R^2
	Clothing Expenditure ($n = 864$, Observations = 2026)					
M0: Control	13	5185		5211	.00	.10
M1: Baseline Working Hours	14	5182	2.78†	5210	.00	.10
M2: Baseline Income	15	5165	16.78***	5196	.02	.12
M3: WTR	18	5152	13.54**	5188	.98	.12
	Living Space ($n = 865$, Observations = 2036)					
M0: Control	13	1944		1970	.00	.44
M1: Baseline Working Hours	14	1944	0.49	1972	.00	.44
M2: Baseline Income	15	1914	29.52***	1944	.85	.46
M3: WTR	18	1912	2.71	1948	.15	.46
	Probability of Air Travel [a] ($n = 862$, Observations = 2023)					
M0: Control	12	2381		2405	.00	.13
M1: Baseline Working Hours	13	2373	7.45**	2399	.01	.14
M2: Baseline Income	14	2361	11.76***	2390	.78	.15
M3: WTR	17	2358	3.47	2392	.21	.15
	Air Travel [b]($n = 589$, Observations = 942)					
M0: Control	13	2834		2860	.08	.24
M1: Baseline Working Hours	14	2829	5.06*	2857	.36	.25
M2: Baseline Income	15	2826	2.83†	2857	.53	.25
M3: WTR	18	2825	0.86	2862	.04	.25
	Car Travel ($n = 865$, Observations = 2031)					
M0: Control	13	4820		4846	.01	.21
M1: Baseline Working Hours	14	4812	7.49**	4840	.09	.22
M2: Baseline Income	15	4806	6.34*	4836	.81	.22
M3: WTR	18	4804	1.72	4840	.09	.22
	Probability of Car Commuting [a]($n = 861$, Observations = 2021)					
M0: Control	12	1480		1504	.60	.15
M1: Baseline Working Hours	13	1480	0.33	1506	.26	.15
M2: Baseline Income	14	1479	0.81	1507	.14	.15
M3: WTR	17	1478	0.62	1513	.01	.16
	Car Commuting [b]($n = 345$, Observations = 692)					
M0: Control	13	1751		1778	.00	.10
M1: Baseline Working Hours	14	1724	26.75***	1753	.64	.15
M2: Baseline Income	15	1724	0.00	1755	.23	.15
M3: WTR	18	1719	5.23	1756	.13	.15
	Pro-Environmental Behaviour (PEB) ($n = 862$, Observations = 2019)					
M0: Control	13	3350		3376	.26	.55
M1: Baseline Working Hours	14	3350	0.05	3378	.10	.55
M2: Baseline Income	15	3349	1.11	3379	.06	.55
M3: WTR	18	3338	10.61*	3374	.58	.56

Note. Model names of the models with the highest Weight of Evidence are shown in bold. LMER = Linear Mixed-Effects Regression; WTR = Working Time Reduction; AICc = Akaike's corrected Information Criterion; WoE = Weight of Evidence; PEB = pro-environmental behaviour.
[a]Generalized Binomial Linear Mixed-Effects Regression; values > 0 are treated as 1
[b]Values of 0 are treated as missing.
$^{\dagger}p < .10$
$^{*}p < .05$
$^{**}p < .01$
$^{***}p < .001$

[3] The USD exchange rate in May 2018 was 0.99, i.e. CHF 8313 (CHF 10,900) equalled USD 8230 (USD 10,790).

significantly improved prediction of the probability of having travelled by plane (as well as hours travelled by plane), of car travel, weekly hours commuted by car, and marginally significantly clothing expenditure; however, it did not improve the prediction of living space, probability of commuting by car, or PEB. In line with H1.2, the inclusion of baseline income (M2) significantly improved prediction of clothing expenditures, living space, probability of air travel, and (marginally significantly) hours of air travel and car travel; however, it did not significantly improve prediction of the probability of commuting by car or hours commuted by car, nor did it predict PEB.

The inclusion of WTR and interaction terms of interest (M3) significantly improved the prediction of clothing expenditure and PEB but did not significantly improve prediction of any other outcome variable, thus providing only mixed evidence for H1.3. Accordingly, WoE indicated that M3 was the best model included in the analyses only for clothing expenditure (WoE = 0.98) and PEB (WoE = 0.59). For living space, probability and hours of air travel, and general car travel, WoE pointed to M2 as the best model tested; for hours of car commuting, M1 was the best model included; and for the probability of car commuting, the control model M0 was the best model as indicated by WoE. The predictive quality of M3 ranged from moderate for clothing expenditure ($R^2 = 0.12$) to very high for PEB ($R^2 = 0.56$) and for living space ($R^2 = 0.46$; although this is likely inflated due to the inclusion of household size both as a predictor and a denominator of the dependent variable; see Ivanova et al., 2018).

Regression coefficients of Models 0–3 for all environmental behaviours can be found in Supplementary Materials S.2–9. In line with H1.1 assuming that longer working hours foster environmentally harmful behaviour (see coefficients of M1), baseline working hours were significantly predictive of higher probability of air travel, $OR = 1.29^{**}$; more hours of air travel, $b^* = 0.10^{*}$; more car travel, $b^* = 0.08^{**}$; more hours of car commuting, $b^* = 0.24^{***}$; and marginally significantly predictive of more clothing expenditure, $b^* = 0.06$, $p = .095$. Contrary to H1.1, baseline working hours did not significantly predict the size of living space, the probability of car commuting, or PEB.

In line with H1.2 (see coefficients of M2 in the Supplementary Materials), baseline income significantly predicted all environmental behaviours (in case of hours travelled by plane, prediction was only marginally significant) except for probability and hours of car commuting and PEB. Moreover, only for hours of car commuting, baseline working hours continued to explain variance despite inclusion of income ($b^* = 0.24^{***}$). Contrary to our assumptions in H1.2, the inclusion of income decreased the effects of baseline working hours initially found in M1 to $b^* = -0.04^{n.s.}$ for clothing expenditure; to $OR = 1.03^{n.s.}$ for the probability of air travel; to $b^* = 0.05^{n.s.}$ for hours of air travel, and to $b^* = 0.03^{n.s.}$ for car travel. For living space, the inclusion of baseline income even inverted the direction of the regression coefficients of baseline working hours to $b^* = -0.09^{**}$. Thus, except for car commuting and PEB, it must be presumed that the initially found effects of working hours in M1 explain environmental behaviour entirely due to the associated higher income.

Table 2 reports the regression coefficients for the Models 3 (M3). As the model indices in Table 1 already suggest, the change in hours worked over time (WTR) did not significantly improve explained variance for living space, probability and hours travelled by plane, and car travel. These measures are mainly explained by differences in baseline income. However, in accordance with the model indices in Table 1 and our H1.3, reducers reported significantly higher clothing expenditure at t0 compared to non-reducers, and their clothing expenditure decreased significantly at t1 and t2 compared to non-reducers. Notably, part of this significant decrease in comparison with non-reducers was due to an increase in clothing expenditure over time found among non-reducers (see Fig. 1B). Further, in line with H1.3, reducers displayed higher pro-environmental behaviour at t1 when compared to non-reducers,

Table 2
LMER fixed effects estimation for environmental behaviour measures for model M3.

Predictors	Clothing Expenditure		Living Space		Probability of Air Travel [a]		Air Travel [b]		Car Travel		Probability of Car Commuting [a]		Car Commuting [b]		Pro-Environmental Behaviour (PEB)	
	b[d]	SE	b[d]	SE	OR	SE	b[d]	SE	b[d]	SE	OR	SE	b[d]	SE	b[d]	SE
Intercept	−0.39[f]	0.08	0.23[f]	0.06	1.84[e]	0.41	0.01	0.11	0.42[f]	0.07	2181.01[f]	1933.07	0.16	0.11	−0.18[f]	0.06
t1	0.19[f]	0.04	0.00	0.01	0.11[f]	0.02	1.40[f]	0.10	−0.16[f]	0.04	0.76	0.26	−0.08	0.07	−0.03	0.02
t2	0.23[f]	0.04	0.02	0.01	0.26[f]	0.04	0.40[f]	0.09	−0.03	0.04	0.55[c]	0.19	−0.10	0.07	−0.07[e]	0.02
Gender: female	0.47[f]	0.07	0.06	0.06	1.35[c]	0.25	0.14	0.09	−0.07	0.06	1.34	0.88	−0.06	0.10	0.17[f]	0.05
Age	0.07[d]	0.03	0.14[f]	0.03	0.73[e]	0.07	0.07	0.05	−0.02	0.03	1.15	0.40	0.06	0.05	0.06[d]	0.02
Parent: Yes	−0.04	0.08	−0.13[c]	0.07	0.76	0.17	−0.46[f]	0.11	0.09	0.07	1.31	1.10	−0.18	0.12	0.01	0.06
Household Size	−0.04	0.04	−0.59[f]	0.03	0.70[e]	0.08	0.03	0.05	0.08[d]	0.04	1.14	0.46	0.01	0.06	0.08[e]	0.03
Urban Residence Area	0.10	0.06	−0.27[f]	0.05	1.28	0.22	0.08	0.08	−0.57[f]	0.06	0.00[f]	0.00	−0.16[c]	0.09	0.06	0.04
Education: University	0.09	0.07	−0.09	0.06	1.06	0.20	0.22[e]	0.09	−0.22[f]	0.06	0.21[d]	0.16	−0.21[c]	0.11	0.09[c]	0.05
Environmental Self-Identity	−0.13[f]	0.03	−0.09[e]	0.03	0.73[f]	0.07	−0.06	0.04	−0.20[f]	0.03	0.50[d]	0.17	0.03	0.05	0.65[f]	0.02
Materialistic Values	0.15[f]	0.03	0.02	0.03	1.16	0.10	0.04	0.04	0.08[e]	0.03	1.37	0.42	0.13[e]	0.04	−0.10[f]	0.02
Baseline Working Hours	−0.05	0.04	−0.09[e]	0.03	0.99	0.11	0.04	0.06	0.03	0.04	1.01	0.44	0.23[f]	0.05	0.00	0.03
Baseline Income	0.19[f]	0.04	0.20[f]	0.04	1.56[f]	0.19	0.10[c]	0.06	0.10[d]	0.04	1.49	0.70	0.01	0.06	−0.03	0.03
WTR (non-reducers vs. reducers)	0.27[e]	0.10	0.02	0.08	1.57	0.52	−0.01	0.14	−0.08	0.09	0.55	0.59	0.21	0.16	0.03	0.07
WTR x t1	−0.21[d]	0.10	−0.03	0.03	1.00	0.40	0.12	0.23	0.07	0.09	0.85	0.65	−0.18	0.18	0.16[e]	0.06
WTR x t2	−0.35[f]	0.10	0.02	0.03	0.98	0.40	0.15	0.21	−0.02	0.09	1.28	1.02	−0.42[d]	0.18	0.10	0.06

Note. Numeric predictors were z-standardized, binary predictors were coded as 0/1. LMER = Linear Mixed-Effects Regression; WTR = Working Time Reduction, bd = regression coefficient with z-standardized numeric outcome variables using the mean and standard deviation at baseline.

[a] Generalized Linear Mixed-Effects Binomial Regression; values > 0 are treated as 1.
[b] Values of 0 are treated as missing.
[c] $p < .10$.
[d] $p < .05$.
[e] $p < .01$.
[f] $p < .001$.

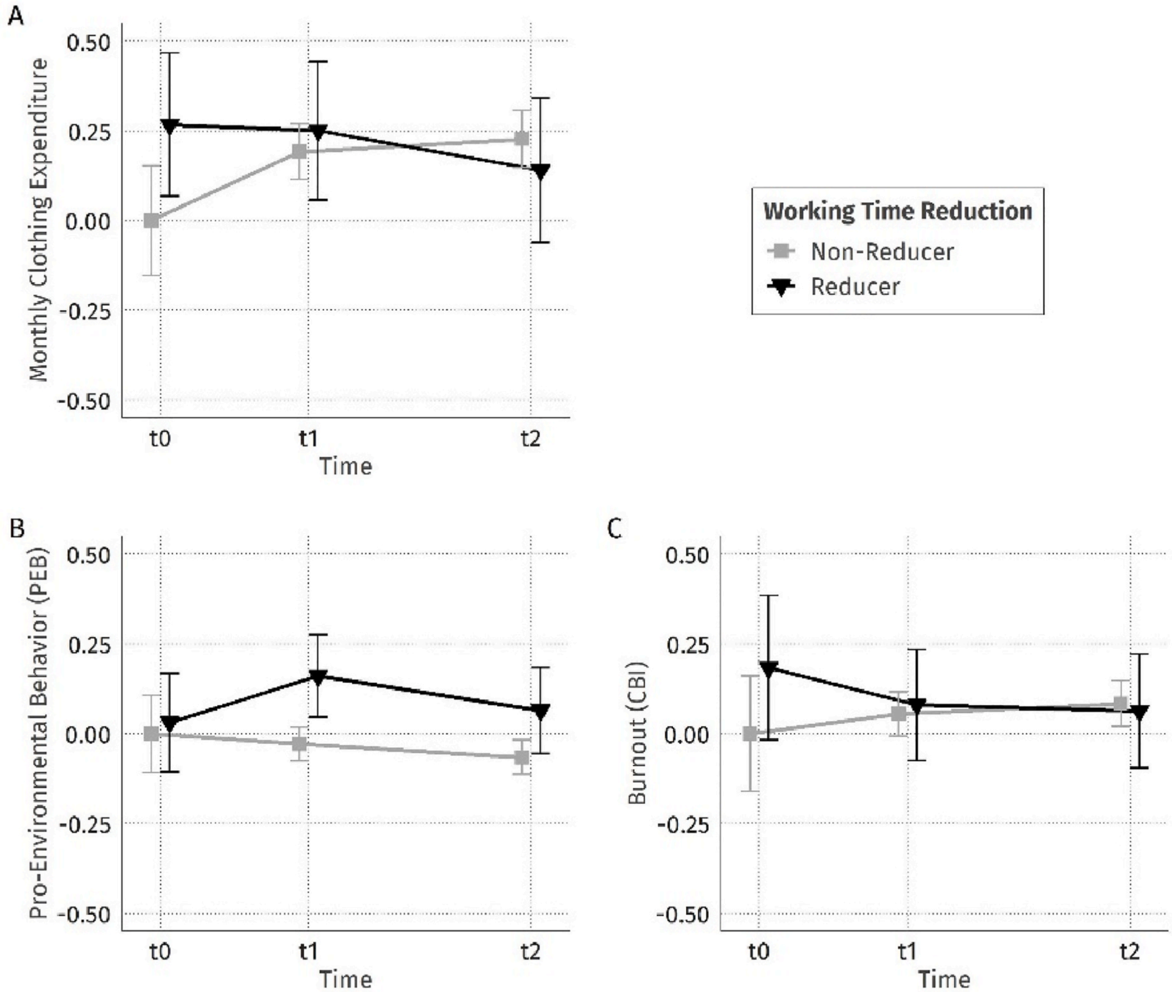

Fig. 1. Linear Mixed-Effects Regression Estimates of a Working Time Reduction (M3) *Note*. Baseline-standardized parameter estimations are shown for model M3 for baseline (t0), 4 months (t1), and 10 months (t2). Reducers lowered their working hours between t0 and t1. Error bars represent 95% confidence intervals. Panel A: Estimation of monthly clothing expenditure. Panel B: Estimation of pro-environmental behaviour (PEB). Panel C: Estimation of Burnout Tendency (CBI).

though this difference disappeared at t2; meanwhile, non-reducers displayed significantly lower PEB at t2 when compared to t0 (see Fig. 1C). Finally, car commuting showed an interesting pattern: The probability of whether a person commuted by car or not mainly depended on the urban or non-urban quality of their residential area, education level, and environmental self-identity (i.e. control variables in M0). However, the number of hours per week a person commuted by car mainly depended on the level of baseline working time (M1 which displayed better model indices than M3, probably due to the decreased sample size), and was found to be affected by WTR (M3). As shown in Table 2, reducers exhibited significantly fewer hours of car commuting at t2 compared to non-reducers.

Lastly, it is worth noting that the various environmental behaviours also appear to be related to psychological values and attitudes. As shown in Table 2, individuals with high environmental self-identity report lower spending on clothing, lower per capita living space, fewer car trips, and higher intent-oriented PEB (though they also show a higher likelihood for air travel and commuting by car). People with high materialistic values spend more on clothing, travel more kilometres by car, commute more by car, and report less intent-oriented PEB.

3.3. The effects of WTR on well-being

To test our hypotheses 2.1–2.3, we ran a similar series of the four LMER models explaining the four well-being outcome variables satisfaction with life (SWLS), positive emotions (SPANE-p), negative emotions (SPANE-n), and burnout symptoms (CBI). Model comparisons using ANOVA and AICc, as displayed in Table 3, showed strong evidence that the inclusion of every subsequent model improved the prediction of the well-being measures, except for M1 for SPANE-p. For all four well-being measures, Model 3 (M3) significantly improved the prediction, with WoE of 0.75 for SWLS, 0.71 for SPANE-p, .79 for SPANE-n, and 0.66 for CBI. This indicates that M3 with both the baseline level of working hours and income, as well as with the change in working hours over time (WTR), are relevant explanatory variables of all four well-being measures. The predictive quality of M3 was small to moderate, ranging from $R^2 = 0.06$ for SPANE-p to $R^2 = 0.14$ for SWLS.

Regression coefficients of Models 0–3 for each of the four well-being outcome variables can be found in Supplementary Materials S.10–S.13. As expected, higher working hours at baseline were significantly detrimental to individual well-being. By testing H2.1, i.e. the effect of baseline working hours without controlling for income in M1, we found that higher baseline working hours were significantly predictive of lower satisfaction with life (SWLS, $b^* = -0.08^*$); more negative emotions (SPANE-n, $b^* = 0.08^*$), and higher burnout tendency (CBI, $b^* = 0.15^{***}$). However, no significant effect was found for positive emotions (SPANE-p, $b^* = -0.04^{n.s.}$). Next, when baseline income was included (M2, testing for H2.2), we found a statistically significant positive effect of income on all four well-being measures, as expected (ranging from $b^* = -0.11^*$ for CBI and SPANE-n to $b^* = 0.29^{***}$ for SWLS). Moreover, as

Table 3
Model Comparison Indices for the Well-Being Models using LMER.

Model	ANOVA			Multimodel Inference		
	df	deviance	χ^2	AICc	WoE	R^2
	Satisfaction with Life (SWLS) (n = 864, Observations = 2029)					
M0: Control	13	4497		4524	.00	.10
M1: Baseline Working Hours	14	4492	5.63[b]	4520	.00	.11
M2: Baseline Income	15	4450	41.92[d]	4480	.25	.14
M3: WTR	18	4442	8.35[b]	4478	.75	.15
	Positive Emotions (SPANE-p) (n = 864, Observations = 2016)					
M0: Control	13	5030		5056	.02	.05
M1: Baseline Working Hours	14	5029	1.24	5057	.01	.05
M2: Baseline Income	15	5020	8.11[c]	5051	.22	.06
M3: WTR	18	5012	8.51[b]	5048	.75	.06
	Negative Emotions (SPANE-n) (n = 863, Observations = 2013)					
M0: Control	13	4904		4930	.00	.11
M1: Baseline Working Hours	14	4898	6.15[b]	4926	.02	.11
M2: Baseline Income	15	4892	6.46[b]	4922	.19	.12
M3: WTR	18	4883	9.01[b]	4919	.79	.12
	Burnout (CBI) (n = 864, Observations = 2009)					
M0: Control	13	4676		4702	.00	.06
M1: Baseline Working Hours	14	4657	19.06[d]	4685	.04	.08
M2: Baseline Income	15	4651	5.91[b]	4681	.28	.09
M3: WTR	18	4643	7.88[b]	4679	.68	.09

Note. Model names of the models with the highest Weight of Evidence are shown in bold. LMER = Linear Mixed-Effects Regression WTR = Working Time Reduction; AICc = Akaike's corrected Information Criterion; WoE = Weight of Evidence; SWLS = Satisfaction with Life Scale; SPANE-p = Scale of Positive and Negative Experiences – positive subscale; -n = negative subscale; CBI = Copenhagen Burnout Inventory – work-related burnout.
[a] $p < .10$.
[b] $p < .05$.
[c] $p < .01$.
[d] $p < .001$.

expected, the inclusion of baseline income in M2 increased the detrimental effect of working time for all four well-being variables, to $b^* = -0.24^{***}$ for SWLS; to $b^* = -0.11^*$ for SPANE-p; to $b^* = 0.14^{***}$ for SPANE-n; and to $b^* = 0.22^{***}$ for CBI. In line with our H2.2, this suggests a counter-directed effect of working hours and income: As working hours are negatively correlated with income, higher working hours mean higher well-being due to increased income, but lower well-being due to higher working time.

Table 4 reports the regression coefficients for Models 3 (*M3*) for each of the well-being outcomes. Again, M3 shows significant detrimental effects of baseline working hours for each of the four well-being measures, and positive effects of baseline income. Moreover, as expected in H2.3, experiencing WTR was found to lead to increased immediate well-being at t1, when comparing reducers to non-reducers: Reducers reported increased satisfaction with life (SWLS), more positive emotions (SPANE-p), less negative emotions (SPANE-n), and decreased burnout tendency (CBI) at t1 compared to non-reducers. The effect sizes by which the well-being measures improved at t1 for participants who reduced their working hours are similar to the well-being difference predicted by a baseline working hours difference of one standard deviation (i.e. about 9 working hours per week). However, the positive effects of WTR disappeared in the medium-term, 9 months after beginning the WTR (t2), except with regards to decreased burnout (CBI). The CBI values of reducers were still significantly lower at t2 when compared to those of non-reducers. As shown in Fig. 1A, the slightly higher initial values of burnout tendency (CBI) among reducers gradually converged with those of non-reducers over time.

Worthy of note are the consistently detrimental effects of materialistic values regarding all four well-being measures (see Table 4). By contrast, environmental self-identity displayed zero significant relationships with the well-being measures.

4. Discussion

With the present study, we sought to improve understanding of the possible co-benefits of WTR for individual well-being and the environment. Such co-benefits have been hypothesized by various researchers (Bader et al., 2020; Coote et al., 2010; Fitzgerald, 2022; Mastini et al., 2021; Stronge et al., 2019). We aimed to shed light on whether possible co-benefits are more likely due to time gains associated with reduced working hours, or to corresponding income losses. We added to this research field by conducting a longitudinal, three-wave survey of Swiss employees, including one group that voluntarily reduced their working hours over the course of the study. In line with previous research (e.g. Andersson et al., 2014; Buhl & Acosta, 2016; Devetter & Rousseau, 2011; Nässén & Larsson, 2015) – cross-sectionally comparing employees

Table 4
LMER fixed effects estimation for well-being measures for model M3.

Predictors	Satisfaction with Life (SWLS)		Positive Emotions (SPANE-p)		Negative Emotions (SPANE-n)		Burnout (CBI)	
	b*	SE	b*	SE	b*	SE	b*	SE
Intercept	0.10	0.08	0.17[b]	0.08	−0.22[c]	0.08	−0.08	0.08
t1	−0.04	0.03	−0.07[a]	0.04	−0.02	0.04	0.05[a]	0.03
t2	−0.02	0.03	−0.09[b]	0.04	0.01	0.04	0.08[c]	0.03
Gender: female	−0.12[a]	0.07	−0.17[b]	0.07	0.36[d]	0.07	0.12[a]	0.07
Age	−0.17[d]	0.04	−0.14[d]	0.04	−0.03	0.03	0.05	0.04
Parent: Yes	0.05	0.08	0.08	0.08	−0.04	0.08	−0.20[b]	0.08
Household Size	−0.01	0.04	−0.04	0.04	0.12[c]	0.04	0.06	0.04
Urban Residence Area	−0.15[b]	0.06	−0.09	0.06	0.04	0.06	0.09	0.06
Education: University	0.05	0.07	−0.16[b]	0.07	−0.01	0.07	0.12	0.07
Environmental Self-Identity	0.06[a]	0.03	0.03	0.03	0.02	0.03	−0.01	0.03
Materialistic Values	−0.24[d]	0.03	−0.19[d]	0.03	0.26[d]	0.03	0.18[d]	0.03
Baseline Working Hours	−0.25[d]	0.04	−0.11[c]	0.04	0.14[d]	0.04	0.21[d]	0.04
Baseline Income	0.30[d]	0.04	0.13[c]	0.05	−0.11[b]	0.04	−0.11[b]	0.05
WTR (non-reducers vs. reducers)	0.04	0.10	−0.04	0.10	0.11	0.10	0.18[a]	0.10
WTR x t1	0.17[b]	0.07	0.25[c]	0.09	−0.25[c]	0.09	−0.16[b]	0.08
WTR x t2	−0.01	0.08	0.05	0.10	−0.03	0.09	−0.20[b]	0.08

Note. Numeric predictors were z-standardized, binary predictors were coded as 0/1. LMER = Linear Mixed-Effects Regression; WTR = Working Time Reduction, b* = regression coefficient with z-standardized numeric outcome variables using the mean and standard deviation at baseline.
[a] $p < .10$.
[b] $p < .05$.
[c] $p < .01$.
[d] $p < .001$.

with different working times and incomes – we found that working hours and income are important factors determining both individual well-being and environmental behaviour. Moreover, we observed differentiated patterns of change over time.

4.1. Working hours, income, and environmental behaviour

Based on the results of previous studies (Buhl & Acosta, 2016; Nässén & Larsson, 2015), we assumed that employees with lower workloads would have smaller ecological footprints, and that this could at least partly be attributed to the lower incomes associated with working less. Consistent with these prior insights and our hypotheses, we found such an income effect cross-sectionally for most of the indicators considered, namely the amount spent on clothing, the size of living space, kilometres of air travel, and hours of car travel. For all these indicators, any effect of working time can be fully explained by the associated higher income. Two exceptions to this were intent-oriented PEB and commuting by car. PEB was found to be influenced neither by the amount of working time nor by the amount of income when comparing workers (it was mainly predicted by environmental self-identity and materialistic values). Whether people commuted by car depended on the urban character of their residential area, their education level, and their environmental self-identity. However, according to our results, weekly hours spent commuting by car depended on their level of working hours (also when controlling for income). In this way, commuting by car was the only environmental measure in our study associated with the so-called time effect of working hours postulated by other researchers (Kallis et al., 2013; King & van den Bergh, 2017).

Regarding behavioural changes over time, the income-dependent environmental behaviours proved to be rather resistant to change, except for spending on clothing. However, in addition to clothing expenditures, we found effects of reduced working hours over time on commuting and intent-oriented PEB. These findings suggest that in our study's observation time of 9 months following a voluntary WTR, the time-related effects were more important than income-related effects, as PEB and commuting are assumed to be mainly influenced by the time effect rather than decreased income; commuting, for example, is primarily dependent on the days worked per week (Chai et al., 2015; Kallis et al., 2013; King & van den Bergh, 2017). One explanation for the apparent lack of the income effect in our longitudinal results could be that our group of voluntary reducers experienced income reductions that were too small to impact their GHG-relevant behaviour. Relatedly, for participants living in an income partnership, the percentual income reductions were likely even weaker when considered at the household level. A second explanation could be that many of the behaviours surveyed are subject to lock-in effects, that is, they "depend to a significant degree on external factors such as infrastructure and technology, institutions (e.g. social conventions, power structures, laws, and regulations) and unsustainable habits" (Ivanova et al., 2018, p. 117). People's dwelling, for example, has a large impact on their ecological footprint, and a working time reduction will not change this – unless it eventually causes one to move to a more energy-efficient (e.g. smaller) home. The situation may be similar regarding car travel: The place where one lives and works determines the daily routes that must be taken, and the availability of low-carbon alternatives such as public transport may be constrained, such that the GHG emissions caused by car travel are largely fixed. Accordingly, in our study, a change in working hours led to improvements in those environmental behaviours (clothing expenditure, car commuting hours, and PEB) that are less influenced by fixed infrastructure and people's chosen place of living, whereas no change could be seen in behaviours (car travel, living space, and air travel) that are subject to stronger lock-in dynamics. Future studies should thus particularly focus on the time- and income-sensitivity of different impact-related behaviours.

As for intent-oriented PEB, we found a short-term increase after the reduction of working time. It has been argued that more discretionary time might especially influence PEB for those with high environmental values, as they might be freed up to use this new discretionary time according to underlying environmental values (Chai et al., 2015). However, an ex-post analysis (see Supplementary Material S.14) showed no significant interaction effect between environmental self-identity and baseline working hours or between environmental self-identity and WTR when predicting PEB. The evidence that PEB is influenced by discretionary time is thus mixed in our study: Whereas baseline working hours did not predict PEB, we found an increase after the reduction of working hours. Future studies should thus look closer at the relationship between PEB, motivational variables, and discretionary time.

4.2. Working hours, income, and well-being

When cross-sectionally comparing employees with different working times and income, we expected that working hours and income would exhibit counter-directed effects on individual well-being. Taken together, our results support these expected effects: We found that employees with lower weekly work hours reported higher life satisfaction, fewer negative emotions, and lower symptoms of burnout and exhaustion. When controlling for income, these positive effects became even more pronounced, and also observable for the indicator of positive emotions. In turn, the level of income showed positive effects on all measures of well-being. Thus, our results suggest that lower working hours are beneficial for individual well-being, with an associated loss of income diminishing but not nullifying this effect. It can thus be argued that a working time reduction with full wage compensation would be more beneficial for well-being (as found by Barck-Holst et al., 2017; Lepinteur, 2019; Schiller et al., 2017), but positive, albeit smaller, effects could also be expected without corresponding wage compensation. Previous studies have reported detrimental effects on well-being when working particularly long hours (Virtanen et al., 2018), but indicated that longer working times – remaining in the range of normal working hours – are not detrimental to well-being (Pereira & Coelho, 2013). By contrast, our study suggests that this relationship is also evident in the range of normal working hours, but is partly buffered by the associated higher income. Positive effects of income on well-being have already been found by other researchers, but without explicitly controlling for the effect of working time (Diener et al., 2018). Some studies have also found satiation points for the positive effects of more income on well-being, and it has been argued that such plateauing may be due to increasing workload and concomitant decreased time available for other positive experiences (Jebb et al., 2018). Our results point in the same direction, especially since we did not find any higher-order effects of income on well-being in our sample in an ex-post analysis when controlling for working time, which would have pointed to a possible saturation of the income effect as suggested by previous research (Jebb et al., 2018; see Supplementary Material S.15). Nevertheless, future studies should explore the interaction of income and working time on well-being in more detail, especially to identify to what extent WTR should be accompanied by wage compensation to optimize beneficial effects for individual well-being.

Observations of changes in well-being over time among those who voluntarily reduced their working hours revealed a differentiated picture: Reducers' well-being improved in the first 3 months following WTR, even though their income also decreased over the course of the study. This supports our hypothesis that the time effect outweighs the income effect regarding individual well-being. After 9 months, we still observed improved burnout symptoms, however life satisfaction and positive and negative emotions decreased relative to their original levels. The lasting positive effect of WTR vis-à-vis burnout in our study is in line with previous research (e.g. Schiller et al., 2017) and shows an effect size comparable to intervention programs to reduce burnout among workers, physicians, and teachers, as found in meta-analyses (Ahola et al., 2017; Iancu et al., 2018; Panagioti et al., 2017). However, as can be seen in Fig. 1, the relative decrease in burnout linked to

WTR was partly due to an *increase* for non-reducers. As about half of the sample was recruited from several larger Swiss employers, this increase in burnout might stem from a greater workload falling to the co-workers of those who reduced their working hours. Indeed, an ex-post analysis comparing burnout amongst non-reducers from larger Swiss employers (i.e. with reducing co-workers; $n = 441$) with those recruited via social media and a market research institute (i.e. for whom it is unknown whether their co-workers reduced; $n = 216$) revealed a (non-significant) increase in burnout among those with reducing co-workers, see Supplementary Material S.24. Also, when excluding non-reducers recruited from larger Swiss employers, M3 was no longer significant for burnout, see Supplementary Material S.25. The interaction effect was still descriptively prevalent, and the insignificance might be due to a smaller sample size. Future research should further examine the company-wide effects of WTR policies on those who do not reduce their working hours. Nevertheless, at the individual level, WTR still represents a suitable approach for prevention of burnout.

Regarding the question of why a reduction of working time did not produce lasting increases in well-being for other measures (i.e. aside from burnout), there are at least three possible explanations. First, research on happiness adaptation suggests that many changes in well-being are only temporary, with well-being returning to its original level after some time (Sheldon & Lyubomirsky, 2006). These lines of research suggest that the reducers in our sample may have gradually become used to the time-related benefits of working less, following an initial boost in well-being. Secondly, and relatedly, some observers argue that WTR enables lasting increases in well-being primarily when they lead to increased time spent on enjoyable activities (Buhl & Acosta, 2016). As Sheldon and Lyubomirsky (2006) argue, changes in activities may be less prone to happiness adaptation than changes in circumstances. According to this reasoning, the participants in our sample who reduced their working time might only have spent more time on enjoyable activities in the short-term, eventually shifting to spending less time on enjoyable activities and more time on other tasks (e.g. childcare or other care work; see Lane et al., 2020). Lastly, it might be that the counter-directional effects of working time versus income came into play. Whereas the benefit of working less might have increased well-being immediately, the decrease in income might have had a delayed negative effect on well-being, eventually causing it to fall back to its initial level in the medium term. This delay could result from spending slowly adapting to income loss, with participants only gradually becoming aware of the reality of their reduced income. Additionally, participants may have used savings in the short term, only lowering their spending after several months.

4.3. Limitations

Our findings are subject to several limitations. First, participants in the WTR condition differed significantly from other participants at baseline: They lived in larger households, worked longer hours without earning higher incomes, and reported higher burnout values and more negative affect at baseline. Although we used a random intercept model in our analyses to account for between-subject differences and controlled for these variables, these differences might have nevertheless influenced the change in well-being and environmental behaviour over time, limiting the validity of our results to a certain degree. Relatedly, our sample was recruited from multiple larger Swiss companies with diverging WTR policies and via social media and a market research institute, the latter involving WTR company policies whose specifics were not entirely clear. This limits the conclusions that can be drawn concerning specific WTR policies. Future research should try to conduct randomized trials with a WTR condition and quasi-experimental field studies following the implementation of WTR policies in specific companies, as has been done for well-being measures (e.g. Barck-Holst et al., 2017; Schiller et al., 2017), but not for environmental behaviour. Second, our study was not representative of the Swiss population or the general populations of Western industrialized nations that future WTR policies might be applied to. Indeed, the effects of WTR may differ for workers distinct from those in the current sample. For example, the positive effect of WTR on well-being might only or especially apply to high-income earners such as those in our sample (although a recent study suggests positive well-being effects especially for low-to mid-income workers, even though these might also experience financial hardship after WTR; Persson et al., 2022). Further, WTR benefits might be lower among those who already work part-time. Additionally, although a large proportion of full-time workers appears willing to work less even with corresponding income losses (Angrave & Charlwood, 2015; Bartoll & Ramos, 2020; Holly & Mohnen, 2012), the effects of WTR policies might be smaller or even negative for those who do not desire to reduce their working time. Future research should seek to study the effects of WTR vis-à-vis different income classes, different working times, and different overemployment or underemployment levels. Third, although we included different well-being measures and environmental behaviours, WTR may have different effects on other measures not included in our analyses. In particular, there could be effects on other health-related indicators, on behaviour in other consumption domains, and on non-private environmental behaviour, such as activism and political engagement. For example, workers who reduce their working hours might consume more domestic energy; meanwhile, company-wide energy use may not decrease when individual workers reduce their working hours (King & van den Bergh, 2017). Future studies should try to include a different set of behaviours to complement this research. Fourth, it is possible that many impact-related behaviours stay relatively stable in the short or medium term following WTR, but eventually change over a longer time period than that observed in the present study (Antal et al., 2021). It would thus be beneficial to study the effects of WTR over a longer period, for example by using existing panel data. Lastly, WTR may lead to effects in ways beyond the scope of the present analysis (Antal et al., 2021). For example, it has been argued that WTR could stabilize national GHG emissions by causing paid work to become more evenly distributed, lowering the pressure for environmentally harmful growth to provide employment for everyone (Bader et al., 2020; D'Alessandro et al., 2020). On the other hand, a reduction in consumption among those reducing their working hours could lead to increased consumption by others due to declining prices (Alcott, 2008). These economic effects, however, are beyond the scope of the present study.

4.4. Conclusion

To sum up, a reduction of standard working time, accompanied by decreasing income, may enable reductions in individual GHG emissions, benefitting the environment and individual well-being. WTR is a promising policy to bring consumption levels of countries in the global North in line with the planetary boundaries of natural resources. The key question here is the extent to which people's income decreases because of WTR. While decreased income is decisive for the positive effects of WTR vis-à-vis the environment, reductions in income can also diminish people's well-being. Future WTR policies will have to carefully consider trade-offs to achieve co-benefits for both the environment and human well-being, for example by financially compensating low-income workers, but only partly compensating high-income workers or not at all (Bader et al., 2020; Schumacher et al., 2019). A voluntary one-day reduction in the working hours by individual employees, as in the present study, has positive effects for well-being and certain environmental behaviours. However, we suspect that the income effect, which is relevant for large ecological savings, only plays a limited role in this case. Thus, voluntarily working one day less per week will probably not achieve the full ecological potential that various studies have proposed.

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CRediT authorship contribution statement

Sebastian Neubert: Conceptualization, Methodology, Formal analysis, Writing – original draft, Funding acquisition. **Christoph Bader:** Conceptualization, Writing – review & editing, Project administration, Funding acquisition. **Hugo Hanbury:** Conceptualization, Writing – review & editing. **Stephanie Moser:** Conceptualization, Methodology, Writing – review & editing, Project administration, Funding acquisition.

Declaration of competing interest

None.

The study procedure was considered ethically unobjectionable by the ethical committee of the German Society for Psychology prior to implementation.

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Appendix

Table A.1
Characteristics of Participants at Baseline (t0) and Available Data per Wave and Group

Characteristics (t0)	Reducers (n = 110)			Non-Reducers (n = 755)				Total (N = 865)		
	M	SD	%	M	SD	%	Comparison Statistic	M	SD	%
Gender: Female			58.2			59.7	$\chi2 = 0.04$			59.5
Parent: Yes			60.0			57.1	$\chi2 = 0.22$			57.5
Urban: Yes			55.5			56.4	$\chi2 = 0.01$			56.3
Education: University			49.1			40.8	$\chi2 = 2.39$			41.8
Age	41.6	11.5		43.6	10.5		t = 1.76†	43.4	10.7	
Household Size	2.5	1.2		2.7	1.3		t = 2.13*	2.7	1.3	
Environmental Self-Identity	3.41	0.77		3.46	0.81		t = 0.72	3.46	0.80	
Materialistic Values	2.03	0.63		1.98	0.67		t = −0.75	1.99	0.66	
Baseline Working Hours	38.9	7.8		35.2	9.2		t = −4.47***	35.7	9.1	
Baseline Income	80,674	36,381		81,600	37,825		t = 0.25	81,482	37,625	
Household Income Contribution (%)a	58.68	17.76		56.14	22.21		t = −0.95	56.41	21.78	
Available Data per Wave										
Baseline			99.1			96.6				96.9
t1			93.6			69.4				72.5
t2			83.6			63.4				66.0

a Only participants in an income partnership, nReducers = 53, nNon-Reducers = 446
† $p < .10$
*$p < .05$
** $p < .01$
*** $p < .001$

Table A.2
Properties for Psychometric Scales at Baseline

Variable	n	M	SD	Cronbach's α
Environmental Self-Identity	837	3.44	0.83	.91
Materialistic Values	831	1.98	0.68	.81
Satisfaction with Life (SWLS)	835	5.11	1.04	.87
Positive Emotions (SPANE-p)	828	3.68	0.61	.84
Negative Emotions (SPANE-n)	829	2.42	0.69	.92
Burnout (CBI)	830	2.15	0.70	.85
Pro-Environmental Behaviour (PEB)	834	3.19	0.79	.81

Table A.3
Study Measures

Variable	Description and Example Items	Measurement
Control Variables		
Gender	Binary variable of gender	1 = female, 0 = other; nmissing = 0
Age	Age as of 31 December 2018	nmissing = 28
Education	Binary variable of highest educational degree	1 = university, 0 = no university; nmissing = 27
Household Size	Number of persons living in own household	Values > 7 were treated as 7; nmissing = 0
Parenthood	Binary variable whether children in own household	1 = yes, 0 = no; nmissing = 0
Residence Area (urban)	Binary variable whether living in a municipality with 20,000 inhabitants or more	1 = yes, 0 = no; nmissing = 27

(*continued on next page*)

Table A.3 (*continued*)

Variable	Description and Example Items	Measurement
Environmental Self-Identity	German translation of a 3-item measure from Van der Werff et al. (2014), indicating whether one sees oneself as environmentally friendly. "I see myself as an environmentally friendly person."	5-point Likert scale; 1 = totally disagree to 5 = totally agree; mean of t0, t1 & t2 used; nmissing = 0
Materialistic Values	German 6-item version (Müller et al., 2013) of the Material Values Scale (Richins, 2004); indicating materialistic value orientation. "I admire people who own expensive homes, cars, and clothes."	5-point Likert scale; 1 = totally disagree to 5 = totally agree; mean of t0, t1 & t2 used; nmissing = 0
Household Income Contribution	Percentual contribution to household income for participants in an income partnership	Participants answered categorically, category means were used
Working Time and Income (Predictors)		
Baseline Working Hours	Number of average/usual paid weekly working hours of the first questionnaire answered. "What is your average weekly working time in hours, considering all your employment?"	Participants answered either numerical or categorial, category means were used; nmissing = 0
Baseline Income	Numerical annual gross income at time of first questionnaire. "What is your approximate annual gross income (in CHF), considering all your employment?"	Participants answered categorial, category means were used; nmissing = 20
WTR	Binary variable whether a working time reduction of at least 4 h/week was observed at t1 or t2 compared to t0	1 = reducer, 0 = non-reducer
Environmental Behaviour (Outcome Variables)		
Clothing Expenditure	Categorial amount of money spent monthly on clothing and shoes for oneself; categories treated as quasimetric; according to WWF Switzerland (2017), higher expenditure is linked to higher emissions. "How much do you spend monthly on clothing and shoes for yourself?"	5 categories; 1 = very little (less than CHF 20/month) to 5 = a lot (>CHF 250/month)
Living Space	Numerical living space in m2 per person living in the household. "How large is your apartment/ your house (heated living space) in m2?"	Values < 15 were treated as 15
Probability of Air Travel	Binary variable capturing whether any hours of travel by airplane for private purposes were indicated for the last 12 months (t0), 3 months (t1) or 6 months (t2)	1 = yes, 0 = no
Air Travel	Average monthly hours travelled by airplane for private purposes in the last 12 (t0), 3 (t1) or 6 (t2) months. "How many hours did you travel by airplane for private purposes in the last 12 months?"	Values of 0 were treated as missing; values > 11 were treated as 11
Car Travel	Average weekly km travelled by car in the last 12 (t0) or 3 (t1 & t2) months. "How many kilometres do you travel by car or motorbike per year (including work trips)?"	Participants answered categorial, category means were used
Probability of Car Commuting	Binary variable whether any hours were commuted by car in the last 4 weeks	1 = yes, 0 = no
Car Commuting	Average hours commuted by car per week in the last 4 weeks. "How many hours per week have you approximately spent on the following activity … Commuting to work by car or motorbike."	Values of 0 were treated as missing; values > 16 were treated as 16
PEB	5-item scale measuring pro-environmental behaviour adapted from Kaiser (2020). •"I buy fruit and vegetables according to the season." •"I am engaged in environmental protection. " •"I avoid shops and/or products that are proven to be environmentally harmful." •"I inform myself about different product alternatives and their production methods so that I can assess and compare their resource consumption. " •"I get books, information pamphlets or other materials that deal with environmental issues. "	5-point Likert scale; 1 = never to 5 = very often
Well-Being (Outcome Variables)		
SWLS	German version of the Satisfaction with Life Scale (Glaesmer et al., 2011; original scale by Diener et al., 1985); indicating cognitive subjective well-being. "I am satisfied with my life."	7-point Likert scale; 1 = totally disagree to 7 = totally agree
SPANE-p	Adapted German version of the Scale of Positive and Negative Experience (Rahm et al., 2017; original version by Diener et al., 2010); positive 6-item subscale indicating frequency of positive affect. "How often have you felt … ?" •"… positive" •"… good" •"… pleasant" •"… happy" •"… filled with joy" •"… contented"	5-point Likert scale; 1 = very rarely or never to 5 = always
SPANE-n	Negative 6-item subscale indicating frequency of negative, stress-related affect. "How often have you felt … ?" •"… bad" •"… unpleasant" •"… stressed" •"… overwhelmed" •"… concerned" •"… nervous"	5-point Likert scale; 1 = very rarely or never to 5 = always
CBI	German version of the work-related burnout subscale of the Copenhagen Burnout Inventory (Hanebuth et al., 2012; original scale by Kristensen et al., 2005). "Do you feel worn out at the end of the working day?"	5-point Likert scale; 1 = never/to a very low degree to 5 = very often/to a very high degree

Table A.4
LMER Results of a Working Time Reduction for Working Hours (hours per week) and Income (CHF per year)

Variable	Working Hours (n = 865, Observations = 2034)			Income (n = 865, Observations = 2036)		
	b	SE	b*	b	SE	b*
Intercept	40.21***	0.66	0.49	85,818***	2612	0.11
t1	−0.24	0.21	−0.03	−75	576	0.00

(*continued on next page*)

Table A.4 (*continued*)

Variable	Working Hours (n = 865, Observations = 2034)			Income (n = 865, Observations = 2036)		
	b	SE	b*	b	SE	b*
t2	−0.51*	0.21	−0.06	110	596	0.00
Gender: female	−5.95***	0.53	−0.65	−22717***	2131	−0.60
Age	0.82**	0.28	0.09	12,475***	1121	0.33
Parent: Yes	−3.36***	0.70	−0.37	−5527*	2785	−0.15
Household Size	−1.05**	0.34	−0.11	−341	1374	−0.01
Urban Residence Area	−0.28	0.54	−0.03	2870	2137	0.08
Education: University	1.63**	0.54	0.18	25,989***	2173	0.69
Environmental Self-Identity	−0.83**	0.28	−0.09	−4967***	1105	−0.13
Materialistic Values	0.86**	0.28	0.09	368	1101	0.01
WTR (non-reducers vs. reducers)	3.39***	0.82	0.37	−1192	3199	−0.03
WTR x t1	−8.85***	0.51	−0.97	−8313***	1412	−0.22
WTR x t2	−9.92***	0.53	−1.09	−10900***	1472	−0.29
R2	.25			.31		

* p < .05
**p < .01
*** p < .001

Note. Numeric predictors were z-standardized, binary predictors were coded as 0/1. Outcome variables were used in their original scale for b-values and were z-standardized using the mean and standard deviation at baseline for b*-values. LMER = Linear Mixed-Effects Regression; WTR = Working Time Reduction (non-reducers = 0, reducers = 1).

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jenvp.2022.101849.

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