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Do Health Shocks Modify Personality Traits?

Evidence from Locus Of Control*

Antoine Marsaudon[†]

January 8, 2019

Abstract

This paper analyzes whether a personality trait, that is, locus of control, is stable after the occurrence of a health shock, namely a hospital stay. To do so, we use the German Socio-Economics Panel dataset. To identify the causal effect of such a shock on locus of control, we rely on a fixed-effects model. Results suggest that individuals facing health shocks are more likely to decrease their locus of control. That is, they tend to believe that their future outcomes are more determined by external factors than their own will. This decrease is attributable to individuals that had, prior to the shock, lower values of locus of control. Further, individuals facing severe hospital stays (i.e., measured by the number overnights) and those with chronic diseases (i.e., measured by the number of hospital stays within a year), have a higher LOC decline than others. This provides evidence that perception of control is not constant over time and could change after experiencing a traumatic health event.

Keywords: health shocks; locus of control; hospital stays; panel data; fixed-effect model

JEL: C33; D91; I12

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1 INTRODUCTION

Personality traits, often referred to as non-cognitive skills, comprise a large variety of traits such as self-efficacy, self-esteem, openness to experience, emotional intelligence or perception of control (see [Almlund et al. \(2011\)](#) for an overview)¹. In this study, we focus on the latter, which is individuals' beliefs on the control they have on the occurrence of life events. Such perception is measured with the locus of control (LOC, hereafter). LOC is a psychological concept capturing how future outcomes are perceived to be under one's control (([Rotter, 1954, 1966](#))). A distinction is typically made between internal and external LOC. Individuals with an internal LOC see future outcomes as being contingent upon their own behaviors. Those with an external LOC believe that future outcomes are, to a large extent, beyond their control (e.g., due to fate or luck).

Individuals' beliefs on what causes life events have major impacts on educational attainment, on labor market and health outcomes. Individuals with internal LOCs are more likely to have higher educational attainment ([Feinstein \(2000\)](#); [Flouri \(2006\)](#)), higher wages ([Groves \(2005\)](#); [Cebi \(2007\)](#); [Semykina and Linz \(2007\)](#); [Heineck and Anger \(2010\)](#)), and save more ([Cobb-Clark et al. \(2016\)](#)). These individuals are also more prone to eat well and exercise regularly ([Cobb-Clark et al. \(2014\)](#)), and are less likely to drink excessive amounts of alcohol ([Chiteji \(2010\)](#))². Perception of control is, thus, predictive of various outcomes. Investigating whether LOC is stable has, therefore, important consequences on individuals' lives and more generally provides insights on the stability of non-cognitive skills.

The main objective of this paper is, therefore, to test the stability of LOC after a negative health shock (i.e., a hospital stay). This shock is likely to induce changes in the individual's perception of control. Individuals facing such a shock might reduce their perception of control (i.e., a LOC decrease) or increase their willingness to take control (i.e., a LOC increase).

¹Economists typically refer to these traits as « non-cognitive skills » to distinguish them from other productivity-related characteristics (e.g., ability, experience, or education), which are generally described as cognitive skills ([Kuhn and Weinberger \(2005\)](#); [Cobb-Clark and Schurer \(2013\)](#); [Elkins et al. \(2017\)](#)). Further, LOC captures beliefs that are distinct from – but complementary to – risk, time and social preferences ([Becker et al. \(2012\)](#)).

²Other papers relate the positive correlation between personality traits (measured by the Big-Five indicator), health and financial outcomes: [Heckman et al. \(2006\)](#); [Roberts et al. \(2007\)](#); [Hampson et al. \(2007\)](#) and [Hampson et al. \(2010\)](#). It seems that conscientiousness is the personality trait that best predict health outcomes. [Brown and Taylor \(2014\)](#) found that extraversion is significantly associated with higher household debt. For a global aspect of change in personality traits, one may refer to the Personality Psychology and Economic Handbook at section 8.

In the former case, health shocks may reduce the individual's motivation to prevent future shocks while the reverse would hold true for a LOC increase. Determining the direction and the magnitude of such effects is thus an empirical issue.

The second objective of this study is to provide evidence on the endogeneity of personality traits. Empirical studies often assume that these personality traits are fixed³. However, there is an emerging literature on the instability of personality traits (measured with the Big-Five indicator⁴ and the LOC). To investigate this question, four recent studies have analyzed the impact⁵ of life events on the two above-mentioned personality traits, using two large representative panel surveys: the Household Income and Labor Dynamics in Australia survey (HILDA, hereafter) and the German Socio-Economic Panel Study (G-SOEP, hereafter).

Using HILDA, [Cobb-Clark and Schurer \(2013\)](#) find that medium-run (i.e., four years) changes in LOC are, on average, modest and concentrated among the youngest and oldest individuals. They find that individuals who experience the birth of a child, a serious illness of a family member, or a worsening in their finances become more external, while those who change jobs, get promoted, or experience an improvement in their finances become more internal. Three other important life events (i.e., death of a spouse, being retired, or being a crime victim) have no significant impacts on LOC. Using the same dataset and the same time span (i.e., four years), but using another personality trait, namely the Big-Five, [Cobb-Clark and Schurer \(2012\)](#) find that health related events (i.e., serious illness or injury due to physical violence, or a new health condition), and labor market related events (i.e., worsening of finances, being retiring, being fired, or becoming unemployed) are significantly and negatively associated with conscientiousness and emotional stability. Family related events (i.e., death of a spouse, a child, a relative, or a friend, or being a victim of property crime), however, have no impact on personality traits. Further, using a sample of Australian adolescents and young adults, [Elkins et al. \(2017\)](#) find that long-term experience of pain is associated with an increase in external tendencies and with a decline in openness to

³In contrast, in the psychological literature, it is argued that personal experiences, especially recent ones, exert a greater influence on personal decisions than statistical summary information in books or via education ([Nisbett and Ross \(1980\)](#); [Weber et al. \(1993\)](#); [Hertwig et al. \(2004\)](#)).

⁴Such indicator summarizes five core personality traits: openness to experience, neuroticism, agreeableness, extraversion, and conscientiousness as a taxonomy for personality traits.

⁵Two other studies have investigated the reverse relationship, that is, the impact of personality traits on the probability to face a life event. Those studies find that individuals with internal LOC are less likely to face negative life events.

experience, conscientiousness and agreeableness. Using three waves (i.e., 2005; 2009; and 2013) of the G-SOEP, [Anger and Schnitzlein \(2017\)](#) find that involuntary job loss following a plan closure leads to an increase in openness to experience⁶ for the average displaced worker and, to some extent, to a change in emotional stability, whereas the other dimensions of the Big-five personality traits remain unchanged.

To estimate the stability of LOC after the occurrence of a health shock, we also use the G-SOEP. We combine two sets of sub-samples. First, we extract information as to whether individuals had a hospital stay along with covariates (i.e., age, educational attainment, income, gender, place of residence, employment status, marital status, number of hospitalization, number of nights in hospital, nationality, self-reported health, and insurance status) for all available waves (from 1984 to 2015). Second, we extract LOC measures for the three available waves (2005, 2010, 2015)⁷. We combine these two sub-samples to obtain a three-years panel dataset with full information. Using such panel data highlights both inter-individuals' differences and intra-individuals' dynamics that are both important to capture possible variations in personality traits.

To take into account the non-randomness of the health shock, we rely on a fixed-effects model. Individuals that had one or more hospital stays in 2010 or in the following years constitute the treatment group. Those who never went to hospital over the period constitute the control group. Thus, in 2005 none of the groups are exposed, and in 2010 and after, only the treated group is exposed. We compare the difference in outcome (i.e., LOC level) after and before the shock for the treated and the control groups, controlling for the full range of individual covariates.

The results show that individuals facing a health shock decrease their perception of control. More precisely, when using a LOC normalized index⁸, individuals facing a health shock decrease LOC by 0.007. This decrease is attributable to individuals that had, prior to the shock, lower values of LOC. Further, individuals facing severe hospital stays (measured with the number of overnights per hospital stay) or chronic illnesses (measured by the frequency

⁶The increase in openness following a job loss is driven by displaced workers who have a high level of education and who quickly find another job.

⁷Locus of control is also available in 1999 but since the scale is different (i.e., a 4 items-scale rather than a 7 items-scale), it is not used in the present study.

⁸This means that the minimum value of LOC is mapped to 0, and the maximum value of LOC is mapped to 1. Thus, the entire ranges of value of LOC from minimum to maximum are mapped to the range 0 to 1. The histogram of this measure is shown in Figure 1 in the appendix.

of hospital stays per year) have a greater decline in LOC than others. These findings are robust to several specification checks: to a balanced panel dataset; to maternity hospital stays (a particular type of hospital stays); to past non-health shocks (i.e., death of partner, death of mother, death of father, and being divorced), and show heterogeneous effect: older individuals are more likely to reduce their perception of control than younger ones. Our results corroborate the above-mentioned findings in the literature ([Cobb-Clark and Schurer \(2012\)](#); [Boyce et al. \(2013\)](#); [Cobb-Clark and Schurer \(2013\)](#); [Anger and Schnitzlein \(2017\)](#); [Elkins et al. \(2017\)](#)) on the instability of personality traits.

Our paper improves upon the existing literature in at least five ways. First, it provides the long-run (i.e., 10 years) impact of negative life events on personality traits. Second, it provides an estimate of the change in LOC depending on the severity and the chronicity nature of the shock. To do so, we document whether longer (respectively, shorter) hospital stays lead to greater (respectively, smaller) LOC changes and whether repeated (respectively, unique) hospital stays impact such change. Third, it provides some indications of the direction and magnitude of the LOC change for German individuals (whereas previous studies mostly relied on Australian data). This is of importance as cultural dimensions may determine perception of control. Fourth, it provides additional support for the idea that fixed effect models or first-difference methods are not sufficient to control for personality traits. Fifth, this study contributes to the empirical debate on whether shocks can be considered as a new and credible source of information that individuals use to update their personal beliefs.

The first section describes the dataset. Section 2 presents the empirical strategy. Results and robustness checks are presented respectively in sections 3 and 4. Section 5 discusses the findings and reports limitations. The last section concludes.

2 DATA

The G-SOEP is a longitudinal dataset of approximately 11,000 private households in the Federal Republic of Germany survey from 1984 to 2016, and Eastern German länder from 1990 to 2016⁹. All household members aged 16 or older are eligible for inclusion in the regular

⁹See more on [Wagner et al. \(2007\)](#). This dataset is funding with public sources [Krupp \(2008\)](#).

panel survey. Variables include household composition, employment, occupation, earnings, health, and personality traits measures. G-SOEP’s rich dataset enables us to control for a large number of covariates to remove confounding factors.

2.1 Variables of interest

To measure the shock, we rely on the following question that is present over the whole span of the panel: “did you have to stay in hospital for one or more nights during the previous year?” We define a dummy variable set to one if individuals face such a shock, and zero otherwise. We collect information on hospital stays for all individuals. We therefore reconstruct each individual’s health shock history since 1984. Further, as LOC is only recorded in three waves (2005, 2010, and 2015), we aggregate hospital stays information to coincide within these three waves. More precisely, in 2005 we aggregate for each person, hospital stays information, from 1984 to 2005; in 2010 we aggregate hospital stays information from 2006 to 2010, and in 2015 we aggregate hospital stays information from 2011 to 2015. We have, thus, for all individuals a three time period analysis. To implement a fixed-effects model, we consider individuals that have had health shocks after 2005. We select out those who had health shocks before 2005¹⁰.

LOC is measured using the Rotter scale. It contains 10 questions on individuals’ perception of control over their life outcomes. The different components of the LOC scale are summarized in Table 1. Individuals have to indicate whether or not they agree with 10 statements on a 7 points-scale¹¹. We aim to group these questions into 2 groups, where the first would aggregate information on internal questions, and the second on external ones. To do so, we adopt the same approach as [Caliendo et al. \(2010\)](#) and [Cobb-Clark and Schurer \(2013\)](#) and run a multi-component analysis. Our results corroborate theirs and indicate that questions 1, 6 and 9 load onto an internal factor, and 2, 3, 5, 7, 8, and 10 loads onto an external factor¹². Item 4 does not load onto either factor and is therefore dropped from the analysis. We then construct an internal index (the average of the internal questions); an

¹⁰Individuals in the treatment, therefore have a health shock only after 2005, and not before. Individuals in the control group never had any health shock (but we are not able to provide with certainty that they had no health shock before entering in the dataset).

¹¹The scale ranks from 1 (I do not agree at all) to 7 (I agree fully).

¹²This analysis could be seen in Figure 2 in annex.

external index (the average of the external questions); and a full index (the average of both internal and external questions with the external questions reversed)¹³. To better interpret variations in LOC, we use a normalized LOC index¹⁴. It simplifies the interpretation of the full index as it ranges from 0 to 1. For this indicator, the higher (lower, respectively) the value, the more internal (external, respectively) is the individual.

Table 1: Components of locus of control

	2005				2010				2015			
	N	Mean	SD	Median	N	Mean	SD	Median	N	Mean	SD	Median
Components of locus of control (1: I do not agree at all, 7: I agree fully)												
Q1. My lifes course depends on me	17,466	5.459	(1.363)	[6.000]	14,064	5.431	(1.291)	[6.000]	19,888	5.599	(1.266)	[6.000]
Q2. Haven't achieved what I deserve	17,466	3.272	(1.802)	[3.000]	14,064	3.259	(1.768)	[3.000]	19,888	3.196	(1.753)	[3.000]
Q3. What you achieve depends on luck	17,466	3.632	(1.698)	[4.000]	14,064	3.504	(1.638)	[3.000]	19,888	3.629	(1.670)	[4.000]
Q4. Influence on social conditions through involvement	17,466	3.510	(1.659)	[4.000]	14,064	3.773	(1.580)	[4.000]	19,888	3.891	(1.632)	[4.000]
Q5. Others make crucial decisions in my life	17,466	3.118	(1.720)	[3.000]	14,064	3.099	(1.670)	[3.000]	19,888	3.023	(1.679)	[3.000]
Q6. Success takes hard work	17,466	6.065	(1.084)	[6.000]	14,064	5.948	(1.113)	[6.000]	19,888	5.910	(1.141)	[6.000]
Q7. Doubt my abilities when problems arise	17,466	3.334	(1.684)	[3.000]	14,064	3.159	(1.624)	[3.000]	19,888	3.250	(1.647)	[3.000]
Q8. Possibility are defined by social conditions	17,466	4.534	(1.514)	[5.000]	14,064	4.492	(1.450)	[5.000]	19,888	4.453	(1.478)	[5.000]
Q9. Abilities are more important than effort	17,466	4.956	(1.333)	[5.000]	14,064	4.794	(1.333)	[5.000]	19,888	4.898	(1.334)	[5.000]
Q10. Little control over my life	17,466	2.721	(1.551)	[2.000]	14,064	2.674	(1.477)	[2.000]	19,888	2.697	(1.487)	[2.000]
Aggregated LOC indices												
Internal index ((Q1 + Q6 + Q9)/3)	17,466	5.494	(0.861)	[5.667]	14,064	5.391	(0.837)	[5.333]	19,888	5.469	(0.847)	[5.333]
External index ((Q2 + Q3 + Q5 + Q7 + Q8 + Q10)/6)	17,466	3.435	(1.037)	[3.333]	14,064	3.364	(1.015)	[3.333]	19,888	3.375	(1.002)	[3.333]
Full index ((Q1 + Q6 + Q9 + R(Q2 + Q3 + Q5 + Q7 + Q8 + Q10))/9)	17,466	4.874	(0.774)	[4.889]	14,064	4.887	(0.754)	[4.889]	19,888	4.906	(0.734)	[4.889]

Note: this table shows the components of locus of control for waves 2005, 2010, and 2015. Source: G-SOEP data.

Furthermore, we also exploit the richness of the panel by using a broad set of covariates in our analysis. In particular, age, educational attainment¹⁵, income (in log)¹⁶, gender¹⁷, place of residence¹⁸, marital status¹⁹, number of hospital stays²⁰, number of nights in hospital²¹, self-reported health²², and insurance status²³.

¹³This allows interpreting the full indicator as follow: the higher (lower, respectively) its value, the more internal (external, respectively) an individual is.

¹⁴It sets to 0 the lower value taken by the LOC full index and to 1 its higher value. This makes the LOC variation easier to interpret. The lower (higher, respectively) the value of the normalized index, the more external (internal, respectively) is the individual.

¹⁵Individuals' level of education is a dummy variable equal to one if he or she reports having a secondary or a upper secondary school degree, 0 otherwise.

¹⁶Income is the log of the yearly individual income.

¹⁷Gender is a dummy with value one for women and zero for men.

¹⁸Place of residence is equal to 1 if individuals live in Eastern regions, and 0 if they live in Western regions.

¹⁹Individuals' marital status is equal to 1 if they are in couple, and 0 otherwise.

²⁰Number of hospital stays is a continuous variable.

²¹Number of nights in hospital is a continuous variable.

²²Self-reported health is a categorical variable coded from 0 to 10 (0 for being in poor health, 10 in excellent health).

²³Insurance status is equal to 1 if individuals have a private health insurance and 0 if they had a compulsory health insurance.

2.2 Descriptive statistics

We observe 29,962 individuals in our unbalanced panel dataset. In this sample, 22,45% of the individuals face a health shock. Individuals in the treatment group (i.e., those who face health shock) have particular characteristics that are not shared by those in the control group (i.e., those who never faced a health shock). For instance, the treated group is significantly older (46,7 years old, on average, compared to 40,3 for the control group), are more likely to have a lower income, to live in Eastern region, to have no private insurance plan, to be more educated and to be a woman, than individuals in the control group. Individuals have, on average, 2.3 hospital-stays and stay 22 nights in hospital. Individuals facing a health shock are also more likely to have lower LOC than those in the control group. This provides first evidence that LOC may change after facing such event. This calls for a quasi-experimental empirical strategy to take into account the non-randomness of the shock. Importantly, looking at the within variation of treated individuals reveals that before the shock, they reported higher health than after. Furthermore, they also reduce their perception of control, as LOC is lower after than before the occurrence of the shock. This suggests that treated individuals have more external LOCs after the occurrence of health shocks. Additional descriptive statistics between groups can be found in Table 2.

Table 2: Characteristics of sample by groups

	Treated and control groups			Treated group		
	Treatment group	Control group	Difference	After	Before	Difference
	(1)	(2)	(3)	(4)	(5)	(6)
Locus of Control	0.631 (0.001)	0.637 (0.001)	-0.006*** (0.001)	0.629 (0.002)	0.636 (0.001)	-0.007*** (0.002)
Age	46.687 (0.137)	40.370 (0.098)	6.316*** (0.165)	47.800 (0.162)	46.267 (0.259)	1.533*** (0.308)
Being in couple	0.124 (0.001)	0.122 (0.001)	0.002 (0.001)	0.134 (0.001)	0.097 (0.001)	0.036*** (0.002)
Income (log)	9.789 (0.008)	9.843 (0.010)	-0.054*** (0.013)	9.725 (0.018)	9.947 (0.013)	-0.222*** (0.023)
Living in Eastern region	0.242 (0.002)	0.202 (0.003)	0.039*** (0.004)	0.234 (0.006)	0.262 (0.004)	0.029*** (0.007)
Private insurance plan	0.137 (0.002)	0.143 (0.003)	0.006* (0.003)	0.126 (0.005)	0.168 (0.003)	0.042*** (0.006)
Self-reported health	4.623 (0.015)	4.631 (0.016)	0.007 (0.024)	3.486 (0.015)	5.056 (0.020)	1.570*** (0.035)
Educated	0.527 (0.003)	0.484 (0.004)	0.044*** (0.005)			
Female	0.557 (0.003)	0.463 (0.004)	0.095*** (0.005)			
Nb. of hospital stays	2.295 (2.917)					
Nb. of overnights	22.474 (36.852)					
Observation	15,586	26,099		4,266	11,320	

Note: this table shows the difference in mean of all covariates between the treated and the control group (column 3) and within the treatment group (column 6). Individuals in the treatment group have characteristics not shared with those of the control group (e.g., lower LOC and are older). After the shock, treated individuals are in worse health and have lower LOC.

3 EMPIRICAL STRATEGY

3.1 Empirical model

To estimate the causal effect of hospital stays on LOC, we use the following econometric fixed-effects model, which removes unobservable individual specific effects that are constant over time (e.g., genetic factors).

$$LOC_{i,t} = \beta.(HealthShock_{it}) + \phi.\mathbf{X}_{i,t}' + \gamma_i + \epsilon_{i,t} \quad (1)$$

In equation (1), $LOC_{i,t}$ refers to the normalized LOC index of an individual i at time t . $HealthShock_{i,t}$ is a dummy variable equals to 1 for years after the shock for individuals in the treatment group, 0 otherwise. $\mathbf{X}_{i,t}'$ is the covariate matrix (detailed in the previous Section), γ_i are individual fixed-effects, and $\epsilon_{i,t}$ is an error term that is assumed to be orthogonal to all characteristics.

While facing a health shock may have an average impact on LOC, significant disparities may exist in the population and need to be further documented. To study these heterogeneous effects, we provide information on particular subgroups. We specifically analyze the impact of health shocks on LOC by the severity of shocks (measured with the number of overnights in hospital), and by the frequency of hospital stays within a year. Further, we provide heterogeneous effects depending on the initial level of LOC. To do so, we create an indicator based on the LOC indicator, which takes the value of 1 if an individual has a higher than median LOC, and 0 otherwise. We also perform a quartile regression to assess where in the LOC distribution the change is most significant.

3.2 Identification

Our identification approach exploits the probability that an individual may face one or more hospital stays. The focus on this specific type of health event is motivated by their severity because they are in most cases unanticipated. Even in the case individuals might envisage experiencing a similar health shock (e.g., due to unfavorable genetic factors or due to family past health history), uncertainty remains, if not on occurrence, on the time of potential occurrence. Previous works on the relationship between health and labor market behaviors

have adopted similar measures (e.g., [Lindeboom et al. \(2007\)](#); [García-Gómez et al. \(2013\)](#)).

For β to measure the causal impact of health shocks on individuals' LOC, there should be no endogeneity issues. We are not able, however, to ensure that this is not the case. Health shocks and LOC may be either correlated with unobservable variables, or subject to reverse causality, or both. Regarding reverse causality, individuals with an internal LOC are more likely to be resilient after health shocks than those with external LOC ([Schurer \(2014\)](#); [Buddelmeyer and Powdthavee \(2016\)](#))²⁴. Regarding unobservable variables, risk tolerance and personality traits (e.g., optimism)²⁵ could be good candidates: they may influence both LOC and the probability to face a shock. Their omission, therefore, may bias our results. This concern may be alleviated if risk tolerance or optimism are constant over time as the fixed-effects model purges time invariant unobservable variables.

4 RESULTS

In this section, we first present OLS estimates of equation (1) using pooled and fixed-effect analyses. We then provide results for sub-group analyses. We conclude by performing robustness checks.

4.1 Main results

Table 3 shows the effect of the health shock on the LOC's normalized index using the approach described in Section 2. We report results as follow. Columns 1 and 2 give the findings of the pooled analysis (without and with control variables). Columns 3, 4 and 5 indicate the results of the fixed-effect model. Column 3 provides results without control variables and individual fixed-effects. Column 4 adds control variables. Column 5 adds individual fixed-effects. When using a pooled analysis, results are not significant. Indeed, significant disparities within individuals need to be taken into account, which is done using

²⁴An instrumental variable method, using health care services at the individual level, would be a promising strategy to purge such endogeneity. However, do date, finding such a variable is challenging because the catchment area in Germany is not well defined or documented ([Bauer and Groneberg \(2016\)](#); [Greiner et al. \(2018\)](#)).

²⁵Religion has been shown to insure against some adverse life events (e.g., unemployment). Further, Catholic and Protestants suffer less from unemployment than do the non-religious ([Clark and Lelkes \(2005\)](#)). The reader can also refer to [Smith et al. \(2003\)](#)' meta-analysis on religiousness and its influence on stressful life events.

the fixed-effect analysis. By doing so, compared to those who do not face a health shock, treated individuals reduce their LOC by 0,007.

Table 3: Pooled and fixed-effects analysis

	Pooled analysis		Fixed-effects analysis		
	LOC	LOC	LOC	LOC	LOC
	(1)	(2)	(3)	(4)	(5)
Health Shock	-0.007*** (0.001)	0.001 (0.002)	-0.010*** (0.001)	-0.008*** (0.002)	-0.007*** (0.002)
Individual covariates	No	Yes	No	Yes	Yes
Individual Fixed-effects	No	No	No	No	Yes
Observations	41685	41685	41685	41685	41685
R^2	0.001	0.031			0.002

Note: this table provides the effect of health shock on locus of control using a pooled analysis (columns 1 and 2) and a fixed effects model (column 3, 4, and 5). Facing such a shock reduce LOC of control by 0.007. Individuals, therefore, become more internal after the shock.

The impact of a health shock might be different depending on how long an individual stays in hospital, and if he or she has many hospital stays in a given year. To document this potential source of heterogeneity, Table 4 exhibits sub-group analysis results, with columns 1 to 5 providing the effect of the shock depending on the number of hospital stays per year: 1 hospital stay (column 1); 0-2 (column 2); 0-3 (column 3); 0-4 (column 4); and 5 and more (column 5). Results indicate that individuals facing 2 to 4 hospital stays are more likely to reduce their perception of control than others. Those with one and more than 5 hospital stays do not significantly change their perception of control. This result might suggest that frequency matters up to a certain threshold, beyond which there are no more changes in LOC. Columns 6 to 9 provide an assessment of the role played by severity, as measured by the number of overnights. Results show that only those who stay more than 15 days (column 9) reduce their LOC. Results indicate that the higher the severity, the more important the LOC decrease. Overall, our findings point to the fact that LOC change is dependent of both the severity and the frequency of the shock.

Table 4: Sub-group analysis:
Comparing subgroups with different lens of overnights

	Nb. Hospital stays					Nb. overnights			
	LOC	LOC	LOC	LOC	LOC	LOC	LOC	LOC	LOC
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	(0-1)	(0-2)	(0-3)	(0-4)	(5 and more)	(0-2)	(0-7)	(0-14)	(15 and more)
Health shock	-0.005 (0.003)	-0.005* (0.003)	-0.006** (0.003)	-0.006** (0.003)	-0.011 (0.007)	0.007 (0.006)	-0.005 (0.003)	-0.004 (0.003)	-0.015*** (0.005)
Individual covariates	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Individual Fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	31311	34933	36685	37631	25487	26138	31372	34592	4428
R^2	0.002	0.002	0.002	0.002	0.002	0.001	0.002	0.002	0.007

Note: individuals facing intermediate number of hospital stays are more likely to reduce their perception of control. Those facing 15 or more overnights are also more likely to reduce thier LOC.

Table 5 provides more detailed information on those who reduced their LOC²⁶. To be considered as having a high versus low LOC, we consider that individuals have to be below (column 1) or above the median (column 2). Results show that individuals who have a LOC below the median decrease more their perception of control. Therefore, facing a health shock reduces the perception of control for those who previously believed they had less control over their life outcomes. Individuals who already had a high perception of control do not change their perception. Column 3 provides the results of the quartile regression. It shows that individuals belonging to the first two quartiles are more likely to reduce their perception of control by comparison with those of the last quartile. Furthermore, those who belong to the first quartile reduce even more their perception of control than those in any of the other quartiles. This provides additional evidence that perception of control is reduced amongst those who previously have a lower LOC.

²⁶Other heterogeneous effects, among which gender or educational attainment, are available on request. In our results on LOC change following a health shock, we do not find a statistical relationship with being a female and or being more educated (reaching at least an upper degree).

Table 5: Sub-group analysis:

Comparing subgroups with high versus low LOCs before the shock

	High versus low LOC		Quartile of LOC
	LOC	LOC	LOC
	Below the median	Above the median	
	(1)	(2)	(3)
Health shock	-0.009*** (0.003)	-0.002 (0.003)	0.005** (0.002)
Health shock \times 1 st quartile			-0.012*** (0.003)
Health shock \times 2 nd quartile			-0.005* (0.003)
Health shock \times 3 rd quartile			0.001 (0.003)
1 st quartile			-0.294*** (0.002)
2 nd quartile			-0.185*** (0.002)
3 rd quartile			-0.104*** (0.001)
Individual covariates	Yes	Yes	Yes
Individual Fixed-effects	Yes	Yes	Yes
Observations	18584	23101	41685
R^2	0.005	0.002	0.780

Note: individuals that have a LOC below the median and those who belong to the first quartile are more likely to reduce their perception of control.

4.2 Robustness checks

To test the sensitivity of our results, we provide four robustness checks in Table 6. First, to assess the attrition problem that occurs when working on panel data, we provide the baseline

equation using a balanced panel (column 2). Second, results in column 3 control for past non-health shocks (column 3) that individuals may have faced, such as death of partner, of a parent, or of a friends, as well as divorce. Controlling for such non-health shocks matters as individuals’ ability to cope with current health shocks is influenced by past events (e.g., [Powdthavee \(2014\)](#)). Third, we control for childbirth (column 4) as this type of hospital stay cannot be considered as a health shock, but may have an impact on LOC. Fourth, we document the effect of LOC change on individuals aged 60 or more (column 5). Results show that older individuals facing a health shock are more likely to reduce their perception of control than younger ones. This is in line with other studies on the stability of personality traits over the life cycle: change in such traits is modest and concentrated among the younger and the older individuals ([Cobb-Clark and Schurer \(2013\)](#); [Elkins et al. \(2017\)](#)).

Table 6: Robustness checks

	LOC (1) (Baseline)	LOC (2) (Balanced panel)	LOC (3) (Past-non health shocks)	LOC (4) (Child birth)	LOC (5) (Older cohort)
Health Shock	-0.007*** (0.002)	-0.009*** (0.003)	-0.007*** (0.002)	-0.007*** (0.002)	-0.003 (0.254)
Older cohort					0.013*** (0.002)
Health Shock × Older cohort					-0.010 (0.391)
Individual covariates	Yes	Yes	Yes	Yes	Yes
Individual Fixed-effects	Yes	Yes	Yes	Yes	Yes
Past non-health shocks	No	No	Yes	No	No
Child birth	No	No	No	Yes	No
Observations	41685	10764	41685	41685	18304
R^2	0.002	0.003	0.002	0.002	0.002

Note: this table provides the robustness checks of the effect of health shock on locus of control. All these specifications confirm the sign, the magnitude and significant level effect of such shock.

5 DISCUSSION AND LIMITATIONS

Results show a significant and negative relationship between health shocks and perception of control. These results are, however, small in magnitude. Further, it seems that individuals

facing severe and chronic shocks, as well as individual with more external LOC, are more likely to reduce their perception of control.

Several mechanisms can be offered for our results. Individuals with an internal LOC tend to invest earlier and more intensively in education, health and social capital than individuals with an external LOC (e.g., [Coleman and DeLeire \(2003\)](#); [Cobb-Clark et al. \(2014\)](#)). This investment may act as an indirect psychological insurance to prevent future shocks. Moreover, individuals with internal LOC may have accumulated more hedonic capital (i.e., have a larger stock of psychological resources) and are therefore more resilient ([Graham and Oswald \(2010\)](#))²⁷. It is possible that the non-significance of LOC change among internal individuals is caused by this long-run accumulation of human and hedonic capitals in earlier ages. Individuals with an external LOC may also be more likely to have a self-serving bias (e.g., [Heider \(2013\)](#); [Campbell and Sedikides \(1999\)](#)). That is, they are less prone to take credit for personal success and blame external factors for personal failure. These individuals may refuse to accept that the shock can be preventable and blame it to fate. This self-serving bias may explain why our results are stronger for individuals with an external LOC.

Further, individuals with internal LOC may also have better coping strategy to counter-balance episode of ill health²⁸. Conscientiousness may also play a role in the coping strategy because conscientious individuals are more effective at following protocols and treatment advice from their physicians (e.g., [Christensen and Johnson \(2002\)](#)). Many studies found that conscientiousness is also associated with control beliefs (e.g., [Marshall and Ferenczi \(2015\)](#)) and with active problem-focused coping behavior (e.g., [Watson and Hubbard \(1996\)](#)).

Results face limitations due the fact these findings are derived for German individuals, so that it may not be generalizable for other countries. Indeed, cultural dimensions may determine control perception, influencing individual answers to LOC questions. Values and norms are forces that can induce behavioral changes. Since culture reinforces certain personal characteristics at the expense of others, one could expect that some cultures be more aligned with internal orientation than others ([Parsons and Schneider \(1974\)](#); [Reltz \(1974\)](#);

²⁷More precisely, [Graham and Oswald \(2010\)](#) define hedonic capital as « social relationships whit partners, friends, and colleagues; health; self-esteem; status; and meaningful work [...]. These are stock in that they rely on past inputs and are carried across time period.»

²⁸Evidence of individual coping responses to negative life events is well established in the psychological literature defined as post-traumatic growth by [Tedeschi and Calhoun \(2004\)](#)). For more evidence, see [Galatzer-Levy and Bonanno \(2013\)](#); [Lotterman et al. \(2014\)](#); [Orcutt et al. \(2014\)](#); [Jayawickreme and Blackie \(2014\)](#)

Mueller (2001); Spector and Miller (2002)). Research comparing countries has shown in more individualistic cultures, individuals have higher internal LOC (Mueller (2001))²⁹. As Germany is more likely to be an individualistic country, respondents may over-estimate their internal control. Plus, we do not observe religious status of individuals. Such a variable can influence the way one recovers from the shock and his or her perception of control.

6 CONCLUSION

This paper offers new evidence on how German individuals have changed their locus of control after experiencing a hospital stay. Although the empirical results do not necessarily establish a strict causality (due to a number of potential unobservable determinants), the findings nevertheless suggest that there are significant effects running from the shock to the perception of control. Individuals facing a hospital stay decrease their perception of control by comparison with those who do not face such a shock.

A direction to pursue could be to examine variance in personality traits (e.g., optimistic individuals, high self-esteem person) among individuals facing health shocks to analyze if they develop better coping strategies. Further, individuals with an external LOC may not enter the health system, as they believe their health is beyond their control. It may be worth designing individualized care pathways that take into account patients' behavioral characteristics.

Other studies will need to be carried out in different settings and countries, in order to give more support to our findings. And an open question remains, as to which personality traits public policy should target.

²⁹"Individualistic society" refers to places where social ties and commitments are loose. "Collectivism society" refers to places in which people are integrated in strong, cohesive groups throughout a lifetime (Hofstede (1991)).

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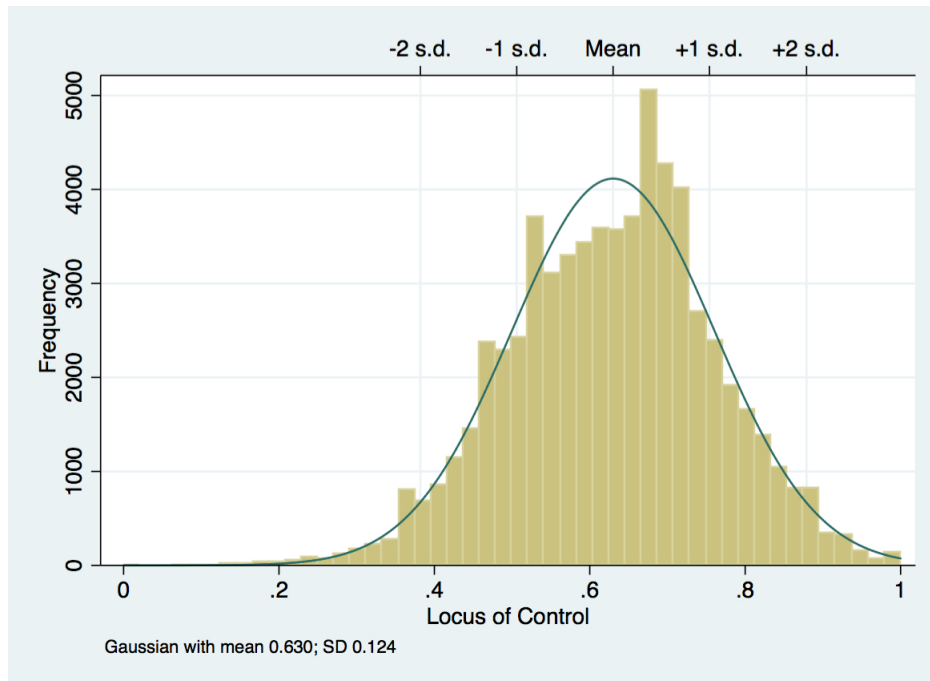
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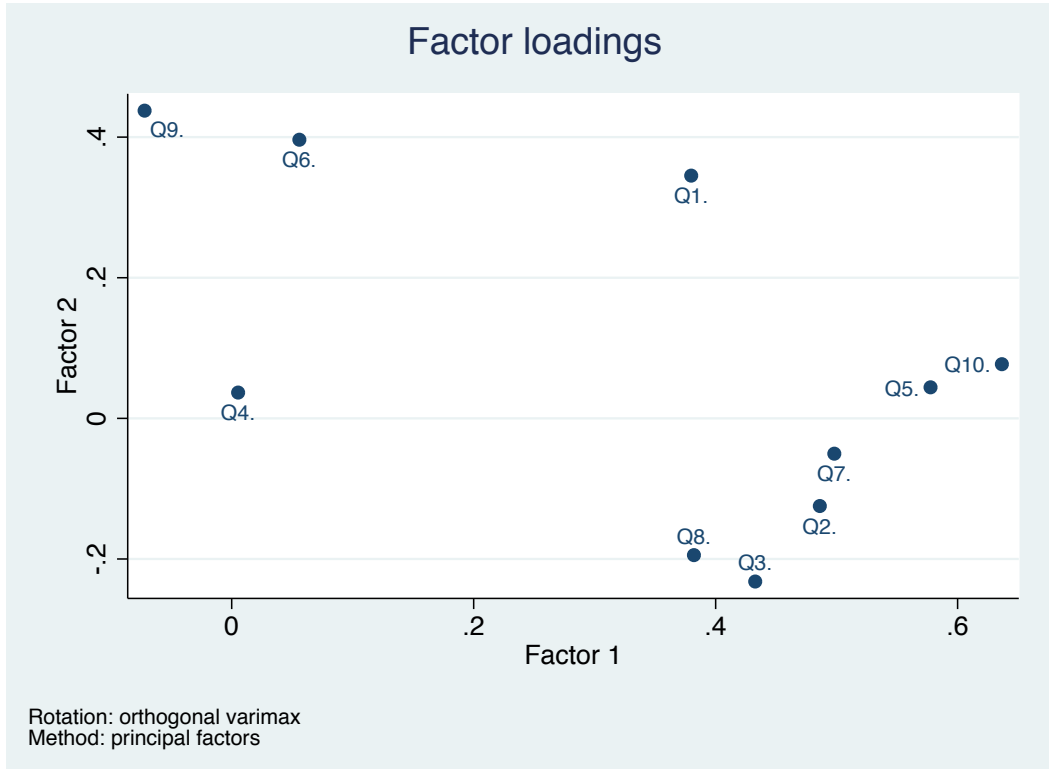
7 APPENDIX

Figure 1: Distribution of the Locus of Control index



Note: The distribution of the LOC index ranks from 0 to 1, with an average of 0.63 and a standard deviation of 0.124.

Figure 2: Principal factor analysis



Note: factor 1 and factor 2 represent respectively external and internal locus of control. External locus of control aggregates questions in the following way: $([Q2 + Q3 + Q5 + Q7 + Q8 + Q10]/6)$, and internal locus of control aggregates questions in the following way: $([Q1 + Q6 + Q9]/3)$. Question 4 seems not to be neither external nor internal.