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Quantifying self-quantification: A statistical study on individual characteristics and motivations for digital self-tracking in young- and middle-aged adults in Germany

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Abstract

This study presents a quantitative account of who uses or stops using digital self-tracking (ST). A representative sample of German adults aged 20–50 years ($N = 1022$) completed an online survey on their ST practices, personality traits and attitudes toward numbers, on sociodemographic characteristics, mental disorders (particularly bulimia, burnout syndrome, and depression) and somatic disorders. A descriptive statistical analysis was performed on differences between self-trackers and non-trackers. Among others,

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they differ regarding age, civil status, social class, presence of mental and/or somatic diagnoses, performance-pressure, and strive for competition. A consequent binary logistic regression analysis suggests perfectionism, a somatic diagnosis within the last 5 years, a diagnosis of bulimia in the past, as well as a present mental diagnosis to be significant predictors for ST, though the predictive value of the factors was relatively low.

Keywords
Digital lifestyle, mental disorder, optimization, quantified self, self-tracking

Introduction

In a macro-sociological perspective, a proliferation of quantifying technologies and practices in late modernity is observable, that is promoted by the sheer reason of technological possibilities (Fioramonti, 2014). This leads to the situation that virtually every aspect of the social world becomes numerically represented and comparable (Mennicken and Espeland, 2019; Muller, 2018). According to Heintz (2010), the use of numbers serves to improve communicative effectiveness and must be analyzed in respect to the need for social comparability and the process of globalization. More critical, the sociologist Mau (2019) claims that the digitalization and economic demands together support the quantification of social parameters, generating rankings and rating systems that are subsequently used for social evaluation and political decision making. To understand late modern dynamics, it is of high interest to deepen the understanding of quantification on every level. This article strives to provide empirical data on the individual level by analyzing motivations for self-tracking (ST).

Looking at quantification on the individual level ST can be seen as relevant to changes in individual lifestyle, self- and body images (Crawford et al., 2015; Rettberg, 2014). The use of technologies for ST has become a ubiquitous phenomenon in contemporary societies (Neff and Nafus, 2016). The availability through smartphones and the simplicity of wearable tools and mobile applications appear to be major reasons why a growing population makes use of them across the world (Fox and Duggan, 2013; GfK, 2016; Paré et al., 2018). However, personal motives for ST vary considerably (e.g. Lupton, 2016), ranging from physical to emotional-cognitive, either for medical or lifestyle reasons (Sharon, 2017), and social aspects (Kent, 2018).

Even though research on the use of ST is getting more attention, it is still in the pioneering stage (Maltseva and Lutz, 2018; Pettinico and Milne, 2017). Debates tend to be somewhat ambivalent, in the sense, that quantification is either viewed as a form of subjugation or a potential for emancipation (Sharon, 2017). On one hand, individuals may be seduced, pushed, or even forced into ST for commercial, disciplinary, or biopolitical reasons (Ajana, 2017; Charitsis et al., 2019; Lupton, 2017; Moore and Robinson, 2016; Morozov, 2013; Sanders, 2017). Some proponents suggest that the use of ST creates new or increases existing mental problems and proliferates individual optimization phantasies, typical to late modernity (Eikey and Reddy, 2017;

Gutierrez, 2016; King et al., 2019; Krüger, 2018). Kent (2018), for example, argues that ST in combination with social media intensifies the internalization of discursive demands for normative body images. Thus, ST can be of significance for the enhancement of ideals of self-optimization (King et al., 2018) and/or a form of self-scientificization (Zillien and Fröhlich, 2018). On the other hand, individual variations and forms of emancipation and resistance ought to be considered (Pols et al., 2019; Sharon and Zandbergen, 2017). Ultimately, both positions lack statistical data.

Sociological claims need empirically based data when they draw conclusions for individual behavior and therefore rely on psychological research (Sharon, 2017). However, most investigations on this matter are primarily qualitative. Additional to qualitative studies focusing on single cases and special areas, this study provides a broad account on ST for an entire population. Therefore, this study can show differences between trackers and non-trackers and which variables may serve as predictive factors for the use of ST.

Motivations and traits regarding self-tracking

Looking at research on ST in more general terms, the typology developed by Lupton (2016) is often-cited. It presents five different modes of ST: pushed, imposed, exploited, private, and communal; only the latter two are voluntarily. Furthermore, the individually oriented modes elaborated by Lupton show a great variety of motives: self-optimization (e.g. work-, body-, health-oriented), the wish for self-knowledge, curiosity, self-awareness, pleasure, and self-experimentation. With respect to psychological conditions, she mentions narcissism as a personality trait that is discussed in literature for being relevant due to self-trackers' self-focus (Morozov, 2013). Interestingly, an empirical study by Chatzigeorgakidis et al. (2016) using the NARQ-inventory did not find support for this hypothesis.

Another repeatedly quoted set of motivations for ST based on a qualitative analysis was developed by Choe et al. (2014). This set substantiates the other following systemizations: improve health, improve other aspects of life, or find new life experiences. In their qualitative research on self-trackers, Sharon and Zandbergen (2017) were able to show that ST is seen as an additional and playful tool to further self-understanding in emancipatory terms. The authors draw a line from the wish for more self-knowledge to techniques of mindfulness and resistant practices against concepts of a reductionist datafication. This approach relates to observations by Zillien and Fröhlich (2018) showing that ST serves to gain self-control in everyday life and is not so much about forms of self-economization (Selke, 2016). A closer look at the variety of perspectives on motivations reveals a high variance and ambivalence regarding critical self-optimization tendencies on one hand and playful, emancipatory or self-exploring intentions on the other hand. These debates are embedded into larger discussions concerning processes in late modernity such as forms of economic pressure or individual abilities to make an emancipatory use of new technologies. More than so often, such discussions are biased by normative assumptions and can benefit from empirical statistical data.

In more descriptive terms and avoiding normative assumptions, Gimpel et al. (2013) developed a five-factor-framework of motivations based on an exploratory survey integrating various aspects of ST. By conducting interviews, five primary motivations for ST were

identified: (1) self-entertainment, that is motivated by pleasure-driven aspects; (2) self-association, a motivation aiming at affiliation and individualization through ST and sharing as well comparing personalized data with others; (3) self-design, indicating what is more commonly known as self-optimization; (4) self-discipline, meaning the rewarding and focusing aspect that ST provides; and finally, (5) self-healing, which connotes the motivation for the self-healing possibilities of ST. We believe this set of motivations, including the scales to be the most comprehensive one at present and used it for our inventory.

Maltseva and Lutz (2018) study is one of the few studies that investigates the correlation of personality traits and the use of ST applications. They argue that research typically concentrates on motivations and does not take long-lasting traits into account. The authors use the well-established five factor model by Costa and McCrae (1992) that differentiates five personality traits (openness to experience, conscientiousness, extraversion, agreeableness, and neuroticism) to elaborate on trait-based criteria for the openness for and compliance to ST. They found out that extraversion, agreeableness, and openness to experience showed no effect at all, conscientiousness had a positive and emotional stability a negative effect: "Thus, the more conscientious and the less emotionally stable individuals are, the more frequently they engage in ST" (Maltseva and Lutz, 2018). Moreover, the study mentioned earlier by Chatzigeorgakidis et al. (2016) showed a correlation between ST and conscientiousness. Most of the discussed studies are based on thorough, rather well-educated self-trackers, giving only limited insight into the general usage and lacking differing criteria between users and non-users.

Research emphasis and inventory focus

Even though our approach intends to shed light on the relevance of ST practices in late modernity, we do not base our study on specific hypotheses such as subjugation or self-empowerment. Instead, this non-experimental study focuses on basic descriptive data and subsequently to what extent demographic criteria correlate with selected factors. We concentrate on specific personality traits that are repeatedly discussed in the literature (narcissism and conscientiousness) as well as the motivational aspect of ST. Finally, we concentrate on three different mental disorders (bulimia, burnout syndrome, and depression) that are often discussed as being mental disorders sensitive to self-optimization and cultural background (e.g. Ehrenberg, 2009). The research interest in these to a relevant part mood- and work-related disorders (precisely, depression, burnout syndrome) is in line with current psychosocial debates on the impact of late capitalism on the subject. Bulimia, however, appears to be correlated with environmental factors that idealize specific body images (Gerisch et al., 2018; Keel and Forney, 2013; King et al., 2020). To our knowledge, there is no existing statistical data that investigate any mental disorder as a trigger or enhancement for ST at all.

Methods

Inventory

The questionnaire includes scales and variables that were chosen based on results and theories discussed in the literature on quantification practices and orientation on numbers in

today's society. The survey's first part focuses on individual patterns of social media usage (not relevant for this article's analysis that focuses only on ST), the second part of the questionnaire concentrates on internal beliefs regarding numbers and quantifying measures in everyday life as well as specific personality traits. To ascertain information on personality traits, scales from the standardized Persönlichkeits-Stil- und Störungsinventar PSSI (Kuhl and Kazén, 2009) were used. The PSSI scale "ambitious-narcissistic" consists of 10 items covering tendencies of self-aggrandizement and hypersensitivity for criticism; the second included PSSI scale "accurate-compulsive," also consisting of 10 items, describes manifestations of excessive and inflexible thoroughness in everyday activities. In addition, a "self-care" scale was compiled by the authors covering aspects of sleep hygiene, emotional self-reflection, engagement in positive social contacts, and self-efficacy. The third part of the questionnaire deals with digital ST practices, followed by the fourth section on socioeconomic details and data on participants' mental and somatic condition. In this study, ST is defined by a continuous period of at least 3 months of digital ST in the sense of collecting and protocoling both numerical and textual data regarding the self in various fields of life including bodily measures like blood pressure, steps, caloric intake, or other parameters such as finances, cognitions, and emotions.

Data collection

Before the actual survey, a pretest was conducted through the online platform SoSci Survey from 5 June to 9 July 2018. Recruiting followed the snowball effect by distributing the web link in social media and student groups across Germany. Based on the pretest sample ($N = 125$), reliabilities of the scales could be analyzed and insufficient items were removed. Nearly all scales included in the final survey reached sufficient internal reliability of $>.7$ or higher (Cronbach's alpha).

The study's data were finally gathered through BACES, a commercial polling agency at the University of Bamberg, Germany. Participants were chosen from an access-panel sample and received a gratification of €1 that could either be disbursed or donated. The survey was conducted from 20 to 30 November 2018. Raw data included a sample of an additional 10% of required participants in order to guarantee a full data set after fine filtering for possible outliers.

Sample

Inclusion criteria. Participants from the German general population aged 20–50 years were chosen by distributional quoting for gender, age, and level of education ($N\_initial = 1125$).

Exclusion criteria. After viewing the raw data, participants were excluded who took less than 10 minutes to fill out the whole questionnaire (average completion time was 20–30 minutes), who showed an implausible answering scheme (e.g. always crossing the same answer category), or who continually filled in random letter combinations in free text fields ($n\_exclusion = 103$).

According to the inclusion and exclusion criteria, data from a representative sample of $N\_total = 1022$ participants was included in the final data analysis.

Statistical analysis

All statistical analyses were performed in SPSS. The significance level (α) was set to .05. Correlation coefficients between scales and variables were calculated with Bravais–Pearson correlation (r); group differences were tested with the Mann–Whitney U test if the normal distribution was not given. Categorical variables were analyzed for significant group differences by using Pearson's χ^2-test. The statistical effect was specified by Cramer's V. Binary logistic regression was performed in order to identify statistically significant predictors of digital ST practices.

Results

Distribution of self-tracking in the general population

More than one-third (35.5%) of the whole sample has ever engaged in digital self-quantification practices ($n = 363$). Almost half of them (43.5%) utilized tracking devices in the past, 56.5% are current users.

Reasons for quitting self-tracking

Former users most frequently reported reasons like too much time investment (32.1%), too much pressure (25.8%), and unfulfilled expectations of success (22.6%) for quitting their digital self-quantification habits. Further but less frequently named reasons are neglect of other important areas of life (14.5%), loss of interest (13.2%), too complex application (10.1%), financial reasons (8.2%), and technical deficits of the device (4.4%).

Sociodemographic characteristics

The gender ratio between female and male self-trackers is approximately equally distributed (Table 1). There is a statistically significant relation between age and ST-pp (includes past and present self-trackers; $r = -.110$, $p < .01$) with a higher tendency to track at a younger age. Proportional rates of digital self-quantifiers decrease with age in comparison to the general population as represented by the whole sample (42.2% of all 20- to 29-year-old participants have tracked themselves compared to only 37.1% of all 30- to 39-year-old and 29.6% of all 40- to 50-year-old persons). The majority of self-trackers (>60%) live in urban surroundings such as cities or metropolises and report being in a relationship or married (>70%). Almost half of all self-trackers have one child or more, though this correlation is small and not statistically significant ($r = -.041$, $p = .195$). Consistent with most self-trackers having an A-level school diploma or advanced technical school certificate, the majority also has completed a professional qualification such as an apprenticeship (53.2%) or Bachelor/Master's degree at university (28.4%). The correlation between social class

Table 1. Sociodemographic characteristics of self-trackers.

	%
Gender	
Female	51.0
Male	49.0
Age**	
20–29 years	33.6
30–39 years	32.8
40–50 years	33.6
Place of residence	
Village < 5000 inhabitants	16.0
Small town 5000–20,000 inhabitants	23.7
City 20,000–100,000 inhabitants	23.7
Big city > 100,000 inhabitants	36.6
Civil status	
Single	24.2
In relationship	31.3
Married/registered partnership	39.3
Divorced	4.4
Widowed	0.3
Parental status	
⩾one child	46.6
No child	53.4
Highest level of school education	
No school diploma	0.8
Secondary modern school qualification (“Hauptschulabschluss” 9 years)	18.5
Secondary school certificate (“Realschulabschluss” 10 years)	33.9
Advanced technical certificate (“Fachhochschulreife”)	32.4
High school diploma (“Abitur” 12 years)	40.2
Highest professional qualification	
No professional qualification	13.8
Apprenticeship	53.2
Bachelor’s degree	13.8
Master’s degree	14.6
PhD	2.5
Other	2.5
Monthly net household income	
No income	0.0
⩽€450	2.8
€451–1000	6.9
€1001–1500	11.3
€1501–2000	13.5
€2001–2500	10.5
€2501–3000	15.2
€3001–4000	19.0

(Continued)

Table 1. (Continued)

	%
€4001–5000	11.8
€5001–6000	5.5
€6001–7000	1.1
>€7000	2.5
Social class (according to OECD index)**	
Underclass	5.8
Lower middle class	9.5
Middle class	19.0
Upper middle class	32.1
Upper class	33.6

OECD: Organisation for Economic Co-operation and Development.
Included are present and past self-trackers ($n = 363$); significant correlation with "self-tracking-pp."
**$p < .01$.

(as defined by OECD) and ST is statistically significant ($r = .132$, $p < .01$) with higher proportions of ST behavior in participants belonging to the upper-middle and upper class.

Type and frequency of self-tracking usage

As shown in Table 2, self-trackers most frequently quantify movement-related measures such as steps (61.4%) and general exercise (50.7%). More than one-third track their physical activities, sleep, and/or caloric intake. Other frequently measured parameters are pulse rate (29.8%), body weight (29.2%), nutrition (26.7%), time (19.3%), and blood pressure (16.5%). Less than 10% log their hormone cycle, finances, blood sugar, mood, emotional state, and/or cognitions.

The majority uses one (71.9%) or two (24.2%) digital devices such as a smartphone, smart watch or wristband, a computer or tablet, a digital scale, or a blood pressure/blood glucose meter. With regard to ST applications, most self-trackers utilize one (58.7%) or two (27.5%) apps on their device, 13.8% expand their tracking procedures to three or more apps. Almost a third of self-quantifiers (29.2%) look at their data once or twice a day, about a fifth (19.8%) check it more frequently. Another fifth checks their digital results every 2 or 3 days or once a week (21.2%). Less frequent data checks are pursued by 12.1%. Among all the self-trackers, 18.5% share their data with others online.

Reasons and motivations for self-tracking usage

When asked why they commence with digital self-quantification practices (Table 3), the majority of self-trackers (63.6%) reported "out of curiosity." One fifth started to actively track their data since their device, for example, their smartphone, captures the information automatically. Orientation by ST friends has been reported by 12.4%. Some persons took up ST upon the recommendation of their doctor or health insurance (9.4%) or because they receive bonuses if they track from the health insurance company (5.8%).

Table 2. Type and frequency of self-tracking usage.

	%
Steps	61.4
Exercise in general	50.7
Sportive activities	36.6
Sleep	36.6
Caloric intake	36.1
Pulse rate	29.8
Body weight	29.2
Nutrition	26.7
Time	19.3
Blood pressure	16.5
Hormonal cycle	8.5
Finances/money	8.3
Blood sugar	6.6
Mood	6.6
Emotional state	6.6
Thoughts/cognitions	4.4

Multiple-choice item. Included are present and past self-trackers ($n = 363$).

Table 3. Reasons and motivations for self-tracking usage.

		%
Why did you start to track yourself?[a]		
Out of curiosity		63.6
Because my device captures relevant data automatically		20.9
Because many of my friends do so		12.4
Because my health insurance or doctor recommends it		9.4
Because I therefore receive bonuses by my health insurance		5.8
Because my employer requests it		5.2
Motivational scales by Gimpel et al. (2013)[b]		
Self-design	Present	80.1
	Past	63.5
Self-discipline	Present	77.0
	Past	65.5
Self-association	Present	55.6
	Past	45.0
Self-entertainment	Present	53.6
	Past	41.7
Self-healing	Present	33.5
	Past	16.2

[a]Multiple-choice items. Included are present and past self-trackers ($n = 363$).
[b]The scales "self-design" and "self-entertainment" consist of five items each, "self-association" of four items, "self-discipline" of three items, and "self-healing" of two items. Relative frequencies are given separately for present and past self-trackers.

A similar percentage of self-trackers started at the request of their employers (5.2%). Other occasionally reported reasons for applying digital self-quantification were "the device was a gift," to further a more conscious food intake, for women to self-monitor as a substitute for the birth control pill, and keeping control of one's body data in order to be independent of doctors' diagnoses.

According to the five motivational reasons for ST postulated by Gimpel et al. (2013), in this sample, two areas turned out to be very relevant. First, the majority of the present (80.1%) and past self-trackers (63.5%) state to practice ST for reasons of "self-design." The scale self-design covers means of self-control with the aim of self-optimization in various areas of life such as health, fitness, and mood. Examples for corresponding items are "I'm self-tracking because I try to manipulate certain aspects in my life" and ". . . it helps me to optimize the way I'm living." The "self-discipline" scale turned out to be the second most common motivational factor, as affirmed by 77% of present and 65.5% of past self-trackers. "Self-discipline" refers to the motivation of purposefully working toward a specific goal and consequently receiving a reward for it. The scale includes items such as "I'm self-tracking because it facilitates my self-discipline" and ". . . it allows me to reward myself." About half of the present (55.6%) and of the past (45%) self-quantifiers explain their uptake of ST practices with the desire to create a comparative norm within their social environment ("self-association"). Respective statements are, for instance, "I'm self-tracking because I want to present myself to others" and ". . . I want to compare my results to others." Likewise, the scale "self-entertainment" as a dimension for the pleasure of playing with numbers, statistics, and technical devices has been affirmed by about half of the present (53.6%) and past self-trackers (41.7%). The least stated motivational factor was the scale "self-healing," which explored the want to be independent of traditional medical treatments as well as having doubts about the classic health system. These factors were reported by one third of the present (33.5%) and only 16.2% of the past self-trackers.

Personality traits and usage of self-quantification

According to the standard values of PSSI, 14% of all self-trackers-pp show an above-average manifestation of "ambitious-narcissistic" personality traits. The correlation between self-quantification and the personality scale, "ambitious-narcissistic" is statistically significant ($r = .129^{**}$) in the way that self-trackers ($M = 12.06$; $SD = 4.83$) score significantly higher in "ambitious-narcissistic" traits than non-trackers ($M = 10.67$; $SD = 4.85$; $Z = -4.01$; $p = .000$). When looking at the whole sample, among all participants with an above average "narcissistic-ambitious" score half of them (49%) have tracked in the past or present.

About one quarter (24.3%) of all self-trackers-pp score an over-average degree of personality traits on the scale "accurate-compulsive." However, the correlation is statistically not significant ($r = .042$) meaning that self-trackers did not significantly differ from non-trackers in their level of "accurate-compulsive" traits ($Z = -0.89$; $p = .373$).

Personal attitudes and actions

Self-care. Self-trackers show significantly higher levels of self-care ($M=14.18$, $SD=2.56$) than non-trackers ($M=13.65$, $SD=2.72$; $Z=-2.81$; $p=.005$). When compared to the distribution of self-care related traits and behaviors within the whole sample, 10.7% of self-trackers display an above-average manifestation (with a value differing more than one standard deviation from the sample's mean), 81.7% normal, and 7.7% below-average degrees.

Perfectionism. Self-trackers reached significantly higher scores of perfectionism ($M=12.91$, $SD=3.61$) than non-trackers ($M=11.76$, $SD=3.69$, $Z=-4.80$, $p=.000$). They also approved the following statements more often than non-trackers: "I always feel the need to perform things I start in a perfect and precise way" ($Z=-2.39$, $p=.017$), "It is important to me to always belong to the best" ($Z=-3.97$; $p=.000$), "I always expect top performances from myself" ($Z=-4.24$, $p=.000$), and "I set myself higher goals than most other people" ($Z=-5.32$, $p=.000$).

Striving for competition. We used the German version of the "Competitiveness Index" (by Dirk Köster, research team neurocognition and movement at the University of Bielefeld, based on Houston et al., 2002). Self-trackers obtained significantly higher scores in "striving for competition" than non-trackers did ($Z=-1.99$, $p=.046$). The following items showed the strongest correlations with the ST group: "I often try to outperform others" ($r=.120$**), "I am a competitive individual" ($r=.114$**), and "I get satisfaction when competing with others" ($r=.102$**).

Belief in numbers. ST highly correlates with a general belief in numbers ($r=.82$**). The general belief of self-trackers ($M=12.72$, $SD=3.30$) is significantly higher than of non-trackers ($M=12.14$, $SD=3.23$, $Z=-2.85$, $p=.004$). For instance, self-trackers agree significantly more often to the statement that "Numbers show how things really are" ($Z=-2.32$, $p=.020$) and that they "generally trust in numbers" ($Z=-3.50$, $p=.000$). They affirm significantly more often than non-trackers that "Orientation based on numbers has increased" ($Z=-3.66$, $p=.000$), that "Numbers gained more significance through the Internet" ($Z=-3.85$, $p=.000$), and that "A comparison through numbers is generally fair" ($Z=-2.19$, $p=.028$).

Pressure to perform. Self-trackers ($M=6.73$, $SD=2.25$) reported sensing a higher pressure to perform at work or in their studies than non-trackers ($M=6.38$, $SD=2.35$, $Z=-2.21$, $p=.027$). At the same time, they significantly differ in their scores of presenting their achievements. Self-quantifiers compared to non-trackers more often agreed to statements like "When I am proud of an achievement, I like to show it to others" ($Z=-3.63$, $p=.000$) and "I tend to exaggerate when presenting my achievements" ($Z=-2.94$, $p=.003$).

Mental and somatic diagnoses

According to self-rated items, self-trackers reported significantly more often to non-trackers that they have been diagnosed with a mental disorder such as depression,

Table 4. Included variables for logistic regression analysis "self-tracking-pp" ($N = 678$).

Variable	χ^2	*df*	*p*
Step 0			
Perfectionism total score	12.70	1	.000**
Belief in numbers total score	5.21	1	.022*
PSSI "ambitious-narcissistic" total score	6.43	1	.011*
Pressure to perform at work/in studies	5.42	1	.020*
Striving for competition total score	1.43	1	.230
Age	9.23	5	.100
Highest level of school education	12.11	4	.017*
Highest professional qualification	18.63	4	.001**
Monthly net household income	18.40	8	.018*
Social class according to OECD index	13.24	4	.010*
Civil status	9.41	4	.052
Place of residence	6.85	3	.077
Presence of at least one somatic diagnosis[a] past[b]	6.07	1	.014*
Current presence of at least one somatic diagnosis[a]	3.31	1	.069
Presence of at least one mental diagnosis[c] past[b]	16.76	1	.000**
Current presence of at least one mental diagnosis[c]	18.44	1	.000**
Diagnosis depression past[b]	8.94	1	.003**
Diagnosis burnout past[b]	6.61	1	.010*
Diagnosis bulimia past[b]	10.10	1	.001**
Diagnosis burnout present	16.70	1	.000**
Diagnosis bulimia present	8.27	1	.004**
Diagnosis adiposity past[b]	0.68	1	.410
Diagnosis asthma/COPD past[b]	4.11	1	.043*
Diagnosis adiposity present	0.01	1	.935
Overall statistic	107.52	49	.000**

COPD: chronic obstructive pulmonary disease; OECD: Organisation for Economic Co-operation and Development; PSSI: Persönlichkeits-Stil- und Störungsinventar.
[a]Somatic diagnoses: diabetes, adiposity, asthma/COPD, cardiovascular disease.
[b]Within the last 5 years.
[c]Mental diagnoses: depression, burnout syndrome, bulimia.
*$p < .05$; **$p < .01$.

burnout syndrome, or bulimia, either currently or within the last 5 years ($\chi^2 = 23.87$, $p = .000$, $V = .153$). In the entire sample, 28.9% of the self-trackers-pp have had a mental diagnosis, compared to 16.1% of the non-trackers. A similar effect could be found between "self-tracking-pp" and having a somatic diagnosis such as diabetes, adiposity, cardiovascular disease, or asthma/ Chronic obstructive pulmonary disease (COPD) either presently or within the last 5 years. Self-trackers (27.5%) report significantly more often a somatic diagnosis than non-trackers (17.5%, $\chi^2 = 14.73$, $p = .001$, $V = .120$). A more detailed look at time-related effects reveals the following: Present self-trackers (defined by tracking themselves for at least the past 3 months) report significantly more often than non-trackers to have a mental diagnosis, respectively persons with a current

mental diagnosis digitally track themselves more often than persons without a current mental diagnosis ($\chi^2 = 9.29$, $p = .002$, $r = -.095$**). Likewise, the correlation between having a current somatic diagnosis and presently ST is highly significant ($\chi^2 = 8.35$, $p = .004$, $r = -.090$**). Participants who used to digitally quantify themselves in the past but have stopped, do not significantly differ from participants who have never tracked themselves in terms of any present mental ($\chi^2 = 3.83$, $p = .05$) or somatic diagnosis ($\chi^2 = 1.87$, $p = .17$). However, participants who have been diagnosed with at least one mental or somatic disorder within the last 5 years presently track themselves more often than participants who did not get a diagnosis (thus, "healthy" participants). Both the relations between mental diagnosis within the last 5 years and present ST ($\chi^2 = 12.17$, $p = .000$, $r = -.109$**) as well as between somatic diagnosis within the last 5 years and present ST ($\chi^2 = 11.95$, $p = .001$, $r = -.108$**) are statistically highly significant.

Self-tracking and body mass index (BMI)

The entire sample's mean BMI of 26.36 ($SD = 6.43$) is slightly higher than the equivalent reference value of 25.11 among the German population aged 20–50 years according to results of micro-census 2017 (Statistisches Bundesamt, 2019). Self-trackers-pp in this sample show no significant difference in their mean BMI to non-trackers ($Z = -.220$, $p = .826$). This changes however, if the self-quantifiers are subtracted who track themselves for disease-related reasons (i.e. diabetes, adiposity, cardiovascular diseases, asthma/COPD). Self-trackers without somatic medical condition have a significantly lower mean BMI ($M = 24.82$, $SD = 4.45$) than non-trackers without somatic medical condition ($M = 25.39$, $SD = 5.35$, $Z = -9.55$, $p = .000$).

Regression analysis: predictors for digital self-tracking

Binary logistic regression was used to identify statistically significant predictors of digital ST. In total, 24 variables were included in the analysis based on significant group differences between self-trackers-pp and non-trackers with $p < .05$, as well as a statistically significant correlation with the variable "self-tracking-pp" (Table 4).

A stepwise forward procedure was applied to gradually analyze which of the 24 included variables serve as significant predictors of the dichotomous outcome "self-tracking-pp." The analysis revealed nine possible predictive models of which the model of step 5 shows the highest explanatory power. Adding more variables in steps 6, 7, 8, and 9 does not add more statistically significant predictive value, therefore they were neglected. The variables listed in Table 5 altogether have the strongest predictive power for digital ST.

The four variables presented in Table 5 allow a correct group allocation to either "self-tracker-pp" or "non-tracker" in 66.3% of all cases, though the higher proportion of the correct allocations to non-trackers with 90.3% largely overweighs the proportion to 26.8% of correct allocation to self-trackers. The predictive power of the model is between 8 and 11% according to R^2 by Cox and Snell and Nagelkerke. Hence, by implication, 89–92% of the factors responsible for "self-tracking-pp" cannot be explained by factors in the model.

Table 5. Logistic regression model for the prediction of the outcome "self-tracking-pp."

	B	*SE*	*p*	95% CI of odds ratio		
				Lower	Odds ratio	Upper
Perfectionism total score	0.09	0.02	.000	1.04	1.09	1.14
Diagnosis bulimia within last 5 years	–2.41	1.10	.028	0.01	0.08	0.77
Presence of at least one somatic diagnosis within last 5 years (diabetes, adiposity, asthma/COPD, cardiovascular disease)	–0.54	0.23	.019	0.36	0.58	0.91
Current presence of at least one mental diagnosis (depression, burnout, bulimia)	–1.01	0.27	.000	0.21	0.36	0.62
Constant	3.91	1.58	.014		50.05	

CI: confidence interval; SE: standard error.
$R^2 = .08$ (Cox & Snell); $R^2 = .11$ (Nagelkerke); Model χ^2 (8, $N = 679$) = 61.16, $p = .000$; the fifth model variable "Highest professional qualification" has been left out in this table due to its insufficient statistical significance.

Discussion

This study presents empirical data for a deeper understanding of ST phenomena in contemporary society and the individual reasons for use or non-use. Compared to the study by GfK (2016), the German population shows a similar percentage of people using ST. Roughly one-third of the general population aged 20–50 years in Germany has engaged in digital self-quantification practices ever in their life. Interestingly, contrarily to our observation that almost half of the self-quantifying persons have stopped their practices at some point in their life, a German marketing survey by Splendid Research GmbH (2019) reports a much lower percentage of former users of only 6%. This discrepancy may be due to differences in defining ST. In this study, using a broad definition, the participants had to actively track any kind of parameter including physical features for at least 3 months.

The most frequently named reasons for quitting ST in this study are consistent with findings by Epstein et al. (2016) who found the cost of collecting and integrating data on a regular basis as well as perceived pressure to share data and discomfort with the information revealed leading to frustration about unfulfilled expectations of success to be the most prominent factors for abandonment. Less frequently named reasons in our study like losing interest in the device, for example, after having reached a personally set goal, technical deficits of the device, or overextension due to the complexity of tracking features have also been reported in recent studies analyzing advertisement contents of tracking tools on the secondhand market (Clawson et al., 2015; Lyall, 2019).

In descriptive terms, socioeconomic variables revealed no gender bias among self-trackers. They tend to be somewhat younger, living settled in close relationships in bigger cities and having relatively high school and job qualifications when compared to the general population in Germany according to micro-census 2011 (Statistisches Bundesamt, 2013). Higher social classes go hand in hand with digital self-quantification. This accords to findings by Paré et al. (2018) on the diffusion of ST in Canada. However, among the

Canadian population, the number of people using ST applications is twice as large in comparison to the German population. Again, this may be biased by different definitions of ST. Results from a study from France (Régnier and Chauvel, 2018) suggest that individuals from affluent or intermediate social milieus are more likely to engage in ST. Particularly for sociological research, these repeatedly observed socioeconomic differences seem relevant to lifestyle, empowerment, and disciplinary oriented discussions of ST as refereed to the introductory parts (e.g. Ajana, 2017; Rettberg, 2014, 2018; Sharon, 2017; Zillien and Fröhlich, 2018). They point to its social specificity, thus, quantifying phenomena may reproduce existing social gaps following arguments by Mau (2019).

The high rate of married self-trackers or those living in a long-term relationship may be biased by the generally high rate of participants who are married and/or living in a long-term relationship throughout the whole sample. The corresponding proportion in this sample is about 10% higher than in the German general population when compared with the results of micro-census 2011 (Statistisches Bundesamt, 2013). This effect might be due to the narrow age range in this investigation that leaves out singles below 20 years old or widows above 50 years old.

The fact that less than 10% of all self-trackers track their hormone cycle, mood, or emotional state may be explained statistically by a higher proportion of women interested in parameters such as birth control. Discussing women's attitudes toward menstrual-tracking apps, Lutz and Sivakumar (2020) refer to physical and mood control as well as curiosity as important motivations in female tracking-behavior.

Concerning the motivations developed by Gimpel et al. (2013), our study indicates self-design and self-discipline to be the most relevant motivations for ST, whereas self-healing and self-entertainment were of less importance. This questions studies that emphasize the entertainment and health aspect of ST as primary motivations (e.g. Splendid Research GmbH, 2019) and serves as evidence for the significance of ST for self-optimizing intentions as described by Lupton (2016). Regarding personality traits, our investigation yields results suggesting that there is a correlation between ST and narcissistic tendencies. These results support the notion that there is a link between ST and a narcissistic self-reference (Krüger, 2018; Lupton, 2016; Morozov, 2013). Perhaps, this is the case because our study investigated ST in general and did not draw on data from one single application as the ones by Chatzigeorgakidis et al. (2016) and Maltseva and Lutz (2018) for instance. Specific applications may be used by a certain part of the population that is characterized by specific traits. Thus, it appears to be essential to note the difference between specific applications and their usage with respect to the personality traits which are being examined.

Compared to the prevalence rates of mental and somatic diagnoses in the general population in Germany, our results portray a picture of self-trackers with rather high proportions of both psychopathologies and/or somatic pathologies. The differences may be explained by the nature of the survey as a subjective self-questionnaire. Participants were not professionally screened for potential diagnoses; hence, a tendency of overstating their own condition may have biased their answers. For instance, whereas the 12-months prevalence of burnout syndrome is 1.5%, the respective rate of major depression 6.8%, and of bulimia nervosa 0.2% in the general population in Germany (Jacobi et al., 2015; Maske et al., 2015), a total of 28.9% of the self-trackers in our study reported

being diagnosed with at least one of these mental diagnoses. Likewise, 27.5% of the self-trackers stated having been diagnosed with at least one somatic disorder like diabetes, adiposity, cardiovascular disease, or asthma/COPD, though the normal prevalence rates of these conditions among adults in Germany are much lower with diabetes 7.2–9.9% (Heidemann and Scheidt-Nave, 2017), adiposity 18.1% (Schienkiewitz et al., 2017), cardiovascular disease 10–15.8% (Dornquast et al., 2016), asthma 6.2% (Steppuhn et al., 2017b), and COPD 5.8% (Steppuhn et al., 2017a).

The results of the regression analysis support the hypothesis that one of the mentioned somatic diagnoses and/or bulimia within the last 5 years paired with a high level of perfectionism indicate a later uptake of digital ST practices. Moreover, the usage of ST also seems to be determined by a present mental diagnosis, for example, bulimia, depression, or burnout syndrome. The relation between somatic diagnoses and ST behavior seems reasonable as a medically recommended self-monitoring. However, the link between mental diagnoses, especially the relation between bulimic psychopathology and accordant openness to digital ST is of interest for further investigations. A qualitative study on women with eating disorders using weight loss apps by Eikey and Reddy (2017) found out that the usage of such apps may lead to rather negative outcomes on well-being. They emphasize that eating-related digital ST may worsen accordant symptomatology. Since the interviewed patients with bulimia, all have had the diagnosis yet before the use of the app, future studies should not only focus on the direct outcome of ST on the mental well-being but instead raise the general question of cause-and-effect mechanisms of bulimia (and/or other mental disorders) in relation to self-quantification. In this matter, the measured gap between the low usage of mood-tracking and the likeliness of a mental disorder for the uptake of ST must be mentioned. One can speculate that self-trackers suffering from depression, burnout syndrome, or bulimia might track other parameters than mood as an attempt to compensate for low self-esteem for example. Furthermore, mood-tracking entails personal initiative and effort. Individuals suffering from psychic problems may perceive this as a burden and also fear reliving their experiences of pain by going through their logs.

This study only included the two personality scales that are mentioned as being important for ST attitudes and self-optimizing practices in earlier studies (Chatzigeorgakidis et al., 2016; Maltseva and Lutz, 2018). Moreover, we solely examined the mental diagnoses depression, burnout syndrome, and bulimia. This focus might have left out other relevant personality traits and/or mental disorders that might also show an effect on the individual openness to ST. Since the predictive power of 8–11% of the factors included is humble, our results should be regarded as a primary indication for factors leading to ST. Future research should consider other personality traits and mental disorders when analyzing interdependencies with ST. Given that mental disorders may lead to the use of ST devices, it appears important to further study the interplay of psychic dynamics with ST.

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