The Hidden Cost of Personal Quantification

JORDAN ETKIN

From sleep and energy use to exercise and health, consumers have access to more information about their behavior than ever before. The appeal of personal quantification seems clear. By better understanding our behavior, we can make the necessary changes to live happier, healthier lives. But might the new tools people are using—quantifying life— rob them of some of the benefits of engaging in those activities? Six experiments demonstrate that while measurement increases how much of an activity people do (e.g., walk or read more), it can simultaneously reduce how much people enjoy those activities. This occurs because measurement can undermine intrinsic motivation. By drawing attention to output, measurement can make enjoyable activities feel more like work, which reduces their enjoyment. As a result, measurement can decrease continued engagement in the activity and subjective well-being. Even in the absence of explicit external incentives, measurement itself can thus have similar effects. The findings have implications for measurement's use, as well as for the psychology of external incentives and intrinsic motivation.

Keywords: behavioral tracking, measurement, intrinsic motivation, enjoyment, performance, subjective well-being

The era of the quantified self is upon us. From sleep, reading, sex, and energy use to devices that track exercise and monitor health, people have access to more information about their behavior than ever before (Azar 2014; Lazer et al. 2009; Poole 2013; Topol 2013). Popular devices like Fitbit and Jawbone track how many steps people walk, how many calories they eat, and how many hours they sleep. More than one in five US adults use some form of personal health tracking device (Fox and Duggan 2013), and an estimated 485 million wearable computing devices will be in the market by 2018 (Flood 2013).

The appeal of personal quantification seems clear. By better understanding our behavior, we can make the necessary changes to live happier, healthier lives. People can walk more, eat healthier, and feel better rested. But are the new tools people are using—quantifying life—robbing them of some of the benefits of engaging in those activities?

This research examines unintended negative consequences of personal quantification. I propose that while measuring output can increase how much of an activity consumers do (e.g., the number of steps they take over a day), such measurement can simultaneously undermine intrinsic motivation, reducing how much the activity is enjoyed. As a result, measurement may decrease consumers' interest in continuing to do the activity in the future and even reduce how happy and satisfied people feel overall.

The findings make two main contributions. First, personal quantification is an increasingly prevalent phenomenon, yet little empirical work has explored how such measurement impacts consumers. This work demonstrates that while viewing measurement increases output, it can sometimes (although not always) have detrimental consequences for enjoyment, continued engagement, and subjective well-being. This has important implications for measurement's use.

Second, this research furthers understanding of how extrinsic factors impact intrinsic processes. External rewards can undermine intrinsic motivation (Deci 1971; Higgins et al. 1995; Kruglanski, Friedman, and Zeevi 1971; Lepper, Greene, and Nisbett 1973), and while measurement does not provide explicit external incentives for

Jordan Etkin is an assistant professor of marketing at The Fuqua School of Business, Duke University, 100 Fuqua Drive, Durham, NC 27708 (jordan.etkin@duke.edu). She thanks Jim Bettman, Jonah Berger, Tanya Chartrand, and Chris Hsee for their thoughtful comments on previous versions of this article, and the JCR review team for their help and guidance during the review process.

Vicki Morwitz served as editor, and Leonard Lee served as associate editor for this article.

Advance Access publication February 16, 2016

 • Vol. 42 • 2016
DOI: 10.1093/jcr/ucv095

engaging in an activity, the findings demonstrate that it nonetheless has similar effects. By drawing attention to output, measurement highlights a quantitative outcome (i.e., output; Kruglanski et al. 1971) of engaging in enjoyable activities, which can make them seem more like work. Simply measuring how much people do can thus decrease enjoyment and continued engagement. Like focusing on the external benefits of engaging in an activity (e.g., Fishbach and Choi 2012; Laran and Janiszewski 2010; Werle, Wansink, and Payne 2014; Wrzesniewski et al. 2014), attending to quantitative outcomes can undermine intrinsic motivation.

EXTERNAL INCENTIVES AND INTRINSIC MOTIVATION

External incentives are often used to motivate desired behaviors. Insurance companies offer discounts for regular gym attendance, parents promise kids dessert for eating their vegetables, and companies give performance bonuses to top employees.

Providing external incentives can improve performance and encourage people to do more (e.g., Cadsby, Song, and Tapon 2007; Farr 1976; Hamner and Foster 1975; Jenkins et al. 1998; Kruglanski et al. 1971; Lawler 1971, 1973; Lazear 1999, 2000; Locke et al. 1980; Wiersma 1992; Wimperis and Farr 1979). Offering an insurance discount for regular gym attendance may increase how often consumers go to the gym, for example, and offering a bonus for sales performance may increase how many sales employees make.

At the same time, however, external rewards can undermine intrinsic motivation (Deci 1971; Frey 1994; Higgins et al. 1995; Kruglanski et al. 1971). Intrinsically motivated activities are pursued simply because they are enjoyable (Ryan and Deci 2000; Kruglanski, Alon, and Lewis 1972). Activities like coloring, walking, or reading a book, for instance, are pleasurable in and of themselves, so people do them for their own sake. Research on overjustification (Higgins and Trope 1990; Kruglanski 1975; Lepper 1981; Morgan 1981) demonstrates that providing external rewards for engaging in such enjoyable activities can "crowd out" intrinsic motivation. People attribute their behavior to the reward rather than to personal interest and thus infer that they do the activity to receive the reward rather than because they like it.

This shift in attribution can reduce how much an activity is enjoyed (Deci, Koestner, and Ryan 1999; Kruglanski et al. 1972). Giving children a reward for coloring, for example, decreased their interest in coloring more in the future (Lepper et al. 1973). Similarly, making a reward (e.g., playing) dependent on consuming a certain food decreased how much children enjoyed the food (Birch, Marlin, and Kramer 1982). These external incentives presumably made children see the activities as instrumental to achieving the rewards, rather than as valuable in their own right, reducing their enjoyment.

THE IMPACT OF MEASUREMENT

I propose that even in the absence of explicit external incentives, measurement *itself* can have similar effects. By "measurement," I mean feedback about behavioral output, or how much of an activity a consumer has done—tracking the number of pages read in a book, for example, or the number of steps taken in a day.

Measurement should increase performance. Consumers value being productive (Hsee, Yang, and Wang 2010; Keinan and Kivetz 2011; Norton, Mochon, and Ariely 2012) and tend to maximize salient dimensions of behavior (Hsee et al. 2003; Hsee et al. 2013). By giving people feedback on how much of an activity they have done, measurement should make this aspect (i.e., output) of engaging in the activity salient. Measuring steps walked or pages read, for instance, should draw consumers' attention to how much they walk and read. Thus even without an explicit incentive to increase output (e.g., a reward per unit of output), measurement should lead people to do more. Showing consumers how many pages they have read in a book, for example, should make page count salient and lead them to read more. Likewise, tracking step count should lead people to walk more (e.g., Bratava et al. 2007; Spence et al. 2009).

At the same time, however, I propose that measurement can reduce how much people enjoy doing an activity. This prediction is based on the notion that measurement can undermine intrinsic motivation. Many enjoyable activities also offer external benefits (Choi and Fishbach 2011; DeCharms 1968; Fishbach and Choi 2012; Laran and Janiszewski 2010). Walking can be pleasant, for example but also offers health benefits, and reading can be enjoyable but also offers knowledge benefits. People may thus engage in such enjoyable activities for their own sake or for the external benefits they provide.

Like external rewards, engaging in fun activities for their external benefits can undermine intrinsic motivation (Kruglanski et al. 1975; Werle et al. 2014; Wrzesniewski et al. 2014). Activities performed for their external benefits often feel like work (Babin, Darden, and Griffin 1994; Higgins and Trope 1990; Laran and Janiszewski 2010; Lepper and Greene 1975). Focusing on the external benefits of engaging in enjoyable activities can thus make those activities seem more like work than fun, and less enjoyable in their own right. Preschoolers who were told that eating carrots would help them be good at counting, for example, rated the carrots as less tasty and consumed fewer of them (Maimaran and Fishbach 2014). Highlighting an external benefit of eating carrots made the carrots seem less delicious and enjoyable to eat. Likewise, encouraging consumers to consider what they would achieve from yoga (e.g., better balance) decreased their interest in doing yoga in the future (Fishbach and Choi 2012).

I suggest that measurement can make enjoyable activities seem more like work, albeit for a different reason. When activities are intrinsically motivated, people tend not to think about how much of them they do (Kruglanski et al. 1971). Children who color for fun, for example, do not usually track the number of shapes they color, and people who walk for fun do not usually monitor the number of steps they take. By drawing attention to output, however, measurement highlights a quantitative outcome (i.e., output) of engaging in enjoyable activities. Because people tend to think about output when activities are extrinsically motivated, but not when they are intrinsically motivated (Kruglanski et al. 1971), and such activities tend to feel like work (e.g., Laran and Janiszewski 2010; Lepper and Greene 1975), I argue that attending to quantitative outcomes can make fun activities seem more like work and less enjoyable in their own right. Rather than walking or reading for fun, for instance, tracking steps walked or pages read should make walking and reading seem more like work.

Consequently, like focusing on external benefits (Fishbach and Choi 2012; Laran and Janiszewski 2010; Werle et al. 2014; Wrzesniewski et al. 2014), I propose that attending to output can undermine intrinsic motivation. While measurement may lead consumers to walk further or read more (at least while the measurement is present), I predict it will simultaneously make those activities seem more like work, reducing how much they are enjoyed. Even in the absence of explicit external incentives, measurement itself can thus have similar effects.

OVERVIEW OF EXPERIMENTS

Six experiments tested these predictions. In each experiment, participants spent time engaging in an enjoyable activity. Experiment 1 (and a follow-up study) examined coloring, experiments 2 and 3 examined walking, and experiments 4, 5, and 6 examined reading. I manipulated whether output (e.g., shapes colored or pages read) was tracked and examined the impact of such measurement on how much of the activity participants did, as well as how much they enjoyed it. I predicted that measurement would lead participants to do more but would reduce their enjoyment.

The experiments also examined whether measurement decreases enjoyment because it makes fun activities seem more like work. Experiments 3, 4, and 5 measured how much the activity seemed like work and tested whether this mediated measurement's negative effect on enjoyment. Experiment 4 also examined the underlying process using moderation. If measurement reduces enjoyment by making fun activities seem more like work, as I suggest, then framing such activities as work-like to begin with should attenuate the effect (Fishbach and Choi 2012; Laran and Janiszewski 2010). In addition, the experiments cast doubt on a number of potential alternative explanations including goal activation (experiments 1, 5, and 6) and distraction or interruption (follow-up to experiment 1, experiments 4 and 5).

The experiments also explored downstream consequences of measurement. First, they examined how measurement affects continued engagement. In addition to reducing enjoyment, external rewards can make people less likely to keep doing an activity in the future (Deci et al. 1999; Kruglanski et al. 1972; Kruglanski et al. 1975; Maimaran and Fishbach 2014; Werle et al. 2014). Providing external rewards decreases "free choice" engagement in an activity, or engagement after the incentive is removed (e.g., Deci 1971; Deci et al. 1999; Frey 1994; Higgins et al. 1995; Kruglanski et al. 1971). After being offered an external reward for coloring, for example, children who were given the chance to color again (this time, without a reward) colored less (Lepper et al. 1973). Similarly, after focusing on the external benefits of practicing yoga (e.g., improved balance), people were less interested in doing yoga in the future (Fishbach and Choi 2012). Thus once intrinsic motivation has been undermined (e.g., after an external reward has been offered or external benefits emphasized), people tend to do less of the activity.

Consequently, measurement may also reduce continued engagement for similar reasons. If measurement undermines intrinsic motivation, as I suggest, then having viewed measurement previously should lead people to do less of the activity. But importantly, this decrease in output should only occur *after* the measurement is removed (i.e., when people can no longer see how much they do). Lepper et al. (1973), for instance, found no decrease in engagement when the reward for coloring remained available; it was only after the reward had been removed that the children's interest in coloring declined. Thus whereas viewing measurement should lead consumers to do more of an activity (e.g., tracking the number of pages read should lead people to read more); after the measurement is removed, they should do less. Experiments 5 and 6 tested this reasoning, examining how much of an activity people do (experiment 5) and whether people choose to keep doing an activity (experiment 6) after measurement is removed.

Second, the experiments explored whether measurement impacts subjective well-being. Work activities often feel like chores (Higgins and Trope 1990) and can be depleting (Laran and Janiszewski 2010; Muraven, Gagné, and Rosman 2008). People also tend to be less happy after spending time on work activities versus fun ones (Kahneman et al. 2004; Mogilner 2010). If measurement makes enjoyable activities feel more like work, as I suggest, then it may also reduce how happy and satisfied people feel after engaging in those activities. Experiments 3 and 4 tested this reasoning.

Notably, the experiments test measurement's effects on enjoyable activities that people pursue for their own sake (i.e., ones they are intrinsically motivated to do). Such activities are ends in and of themselves, rather than means to achieving higher-order goals (Fishbach and Choi 2012). Thus rather than informing consumers where they stand relative to a higher-order goal (e.g., how much progress they have made; Amir and Ariely 2008; Cheema and Bagchi 2011; Kivetz, Urminsky, and Zheng 2006; Koo and Fishbach 2010, 2012; Soman and Shi 2003), the measurement feedback examined here merely reflects output, or the amount of an activity people have done. I explore how measurement's effects may differ when an activity is pursued as means to a goal in the General Discussion section.

Taken together, these experiments demonstrate that personal quantification can have unintended harmful effects. I discuss implications for measurement's use, as well as for the psychology of external incentives and intrinsic motivation in the General Discussion.

EXPERIMENT 1

The first experiment examined how measurement impacts enjoyment. Coloring is a simple activity that is enjoyable to do (Lepper et al. 1973). I had people spend a few minutes coloring and tested measurement's effects on the amount they colored (i.e., output) and how much they enjoyed coloring. While measurement should increase how much participants colored, I predicted it would reduce their enjoyment.

Design and Method

105 students (average age = 22.2 years, 63% female) at a private eastern university participated in exchange for payment. In this and subsequent lab experiments, sample size was determined by available lab space, and all instructions and dependent measures were administered through a computer-based survey. Participants were randomly assigned to either the control or measurement condition.

Participants read that the experimenter was pretesting stimuli for a later study, and that they would spend 10 minutes coloring simple shapes (e.g., a fish; online appendix A). They were told that payment was not based on the speed or quality of their coloring, and that regardless of how fast or slow they colored, the activity would last for 10 minutes. Participant were given a stack of figures, each on a separate sheet of paper (18 in total), and a standard box of 16 crayons. They read that after coloring the first shape, they should flip to the next shape and continue coloring.

The only difference between conditions was measurement feedback. In the measurement condition, participants were given information about how many shapes they had colored. The screen displayed a counter ("You have colored [X] shapes") which started at zero. Every time participants finished coloring a shape, they clicked the mouse and the counter increased by one (i.e., after coloring the first shape, it read, "You have colored 1 shape"). In the control condition, participants were given no further information until the end of the allotted time period. See online appendix B for sample experimental stimuli.

After 10 minutes had elapsed, I measured how much participants enjoyed coloring using five items: "To what extent do you find coloring: enjoyable, boring (reverse scored), interesting, a waste of time (reverse scored), and fun" (1 = not at all to 7 = very much; $\alpha = .89$, averaged to an enjoyment index).

Then, I collected additional measures to test potential alternative explanations. One might wonder whether measurement makes activities feel more difficult, which drives its negative effects. To test this possibility, I asked participants, "How difficult was the coloring activity?" (1 = Very easy, 7 = Very difficult). One might also wonder whether measurement undermines intrinsic motivation by activating a goal to achieve (i.e., to do as much of an activity as possible). To test this possibility, participants completed the need for achievement scale (sample items include "I enjoy difficult work," and "I often set goals that are very difficult to reach," 1 = Strongly disagree to 5 = Strongly agree; $\alpha = .82$; Jackson 1974). If goal activation was playing a role, measurement's effects might be influenced by individual differences in need for achievement. Finally, in this and subsequent experiments, participants answered some demographic questions.

Results

Output. As expected, measurement increased output. Compared to the control ($M = 6.91$ shapes, SD = 3.46), participants in the measurement condition colored more shapes ($M = 8.68$ shapes, SD = 3.38; $F(1, 103) = 6.87$, $p = .010$).

Enjoyment. However, as predicted, measurement decreased enjoyment. Compared to the control ($M = 5.13$, SD = 1.37), participants in the measurement condition enjoyed coloring less ($M = 4.63$, SD = 1.30; $F(1, 103) = 3.55$, $p = .062$).

Creativity. To further explore the consequences of measurement, I also examined the drawings themselves (Kruglanski et al. 1971; Lepper et al. 1973). Independent coders rated the creativity of each participant's drawings (1 = Low creativity, 5 = High creativity; interrater reliability = .94, $p < .01$) and counted the number of colors used for each shape. Measurement led participants to draw less creatively ($M_{measurement} = 2.58$, SD = .87 vs. $M_{control} = 3.02$, SD = .95; $F(1, 103) = 6.19$, $p = .014$) and reduced the average number of colors they used ($M_{measurement} = 2.54$, SD = .63 vs. $M_{control}$ = 2.83, SD = .79; $F(1, 103) = 4.58$, $p = .035$).

Alternative Explanations. There was no difference in perceived task difficulty across conditions ($M_{measurement}$ = 1.54, SD = .91 vs. $M_{control}$ = 1.65, SD = .95; $F < 1$), casting doubt on the notion that task difficulty is what drives the reduced enjoyment. In addition, there was no difference in participants' need for achievement across conditions ($M_{measurement}$ = 3.42, SD = .50 vs. $M_{control}$ = 3.41, SD = .58; $F < 1$), and regressing enjoyment on measurement condition, need for achievement (mean centered), and their interaction only revealed the predicted main effect of measurement ($\beta = -.50$; $t(102) = -1.88$, $p = .062$). Need for achievement did not impact enjoyment ($\beta = -.13$; $t < 1$); nor did it moderate measurement's effect ($\beta = .23$; $t < 1$), which provides preliminary evidence that the findings cannot be explained by measurement activating a goal to achieve.

Discussion

Experiment 1 demonstrates that measurement can sometimes have harmful effects. While measurement increased the number of shapes participants colored, it decreased how much they enjoyed coloring (and made them color less creatively).

A follow-up study ($N = 160$) also casts doubt on alternative explanations based on distraction or interruption. Given that distracting consumers from pleasurable experiences can reduce their enjoyment (e.g., Lee and Tsai 2014; Wilson and Gilbert 2008), one might wonder whether measurement could decrease enjoyment simply by reducing attention to an enjoyable activity (e.g., coloring). To test this possibility, I ran a version of experiment 1, except that in the control condition, the screen displayed a random letter. Every time control participants finished coloring a shape, they clicked the mouse and the letter changed. Both conditions thus required the exact same actions on the part of the participant, and all participants received a potential interruption or distraction between each shape (a number in the measurement condition and a letter in the control condition).

Results were the same as in experiment 1. Measurement increased the number of shapes colored ($F(1, 158) = 6.06$, $p = .015$) but reduced how much participants enjoyed coloring ($F(1, 158) = 6.19$, $p = .014$). That measurement decreased enjoyment even when control participants also received an interruption or distraction suggests that this is not what drives the effect. I further test this alternative explanation in experiments 4 and 5.

The follow-up study also casts doubt on an alternative explanation based on performance feedback. While measurement feedback can sometimes inform consumers how well or poorly they are performing at an activity, in all of the experiments, the activities are pursued for their own sake, and the measurement simply reflects output, or how much of an activity someone has done. There is no reference to whether that amount is a lot or a little, and participants do not have other reference points to tell them how well they are doing. That said, to further test whether measurement's effects could be driven by its providing positive (or negative) performance feedback, the follow-up study also asked participants how well they thought they performed at coloring (1 = Not very well to 7 = Very well).

As expected, measurement had no impact on how well participants thought they performed ($M_{measurement}$ = 5.04 vs. $M_{control}$ = 5.02; $F < 1$). Thus while some types of measurement may provide positive or negative performance feedback (i.e., that one is doing well or poorly), in the present research, this is not what drives measurement's effects.

EXPERIMENT 2

Experiment 2 tested my predictions in the field. Walking is an enjoyable activity that is frequently tracked, and it is also a popular target of public health interventions. I gave college students pedometers and examined how measurement impacted the amount they walked and how much they enjoyed walking. Consistent with prior research (e.g., Bratava et al. 2007; Spence et al. 2009), tracking step count should increase how much participants walked, but I predicted it would reduce their enjoyment.

Experiment 2 also explored whether measurement reduces enjoyment even among people who choose to be measured. Experiment 1 demonstrated that measurement decreased enjoyment on average, but one could argue that participants did not voluntarily seek such feedback. Alternatively, one could argue that people differ in their preference for measurement (some want it and some do not), and among those who self-select into measurement, the effect may not hold.

To test these possibilities, I examined whether people choose measurement for an enjoyable activity, and if so, whether it has the same effects. One group of participants were given the option to wear a pedometer for the day (i.e., to opt in to measurement), and I compared their output and enjoyment to a control group who were not given this option. Even among participants who choose to be measured, I predicted that measurement would reduce how much they enjoy walking.

Design and Method

95 students (average age = 21.1 years, 67% female) at a private eastern university participated in exchange for payment. Participants came to the lab in the morning (9–10 AM) and were randomly assigned to either the control or measurement condition.

Participants were told that the study was about walking and that the experimenter was interested in “what people think about as they walk around on a typical day.” Remaining instructions differed across conditions. In the measurement condition, participants were told: “You have the option to wear a pedometer for the day. This is not a required part of the study, but if you wear a pedometer it will give you an idea about how much you have walked. Would you like to wear a pedometer?” All but four participants chose to wear a pedometer. The individuals who chose measurement were given a basic pedometer (online appendix A) and instructed to wear it for the rest of the day and to look at the number of steps they had taken several times. In the control condition, all participants received a pedometer that had been sealed shut. They were told, “We have taped the lid shut because we are just interested in whether the step counter feels comfortable to wear.” Because the lid was opaque, this prevented participants from knowing the pedometer was tracking their steps, but it allowed me to measure how much they walked. All participants then left the lab.

Later that day (5–6 PM), participants returned to the lab. Upon entering, they handed the pedometers to the lab administrator, who discreetly recorded the number displayed. Step count was log-transformed (natural log base) to stabilize for nonnormality in its distribution (Kolmogorov-Smirnov test = 168, $p < .001$).

Participants then rated how much they enjoy walking: “How much do you enjoy walking?” and “How much do you like walking?” (1 = Not at all to 7 = Very much; $r = .84$, averaged to an enjoyment index). Finally, participants confirmed whether they wore the pedometer all day (98% indicated that they did, and this did not differ across conditions; $\chi^2 = 1.68$, $p = .195$).

Results

For all analyses, I compared participants in the measurement condition who self-selected into wearing a pedometer ($N = 50$) with control participants ($N = 41$).

Output. As in experiment 1, measurement increased output. Compared to the control ($M = 7.01$, SD = 1.84), participants in the measurement condition walked more steps ($M = 7.97$, SD = 1.11; $F(1, 89) = 9.43$, $p = .003$).

Enjoyment. However, as predicted, measurement reduced enjoyment. Compared to the control ($M = 5.33$, SD = .89), participants in the measurement condition enjoyed walking less ($M = 4.82$, SD = 1.24; $F(1, 89) = 4.87$, $p = .030$).

Discussion

Experiment 2 provides further evidence that measurement can decrease enjoyment. Tracking step count led participants to walk more but decreased how much they enjoyed walking.

The findings also highlight the external validity of measurement’s effects. Measurement reduced enjoyment even among people who chose (i.e., opted in) to be measured. This shows that even for enjoyable activities, making measurement available may encourage consumers to opt in, and the very people who self-select into measurement are the ones who are hurt by it. That the effects persisted in the field, and without requiring participants to engage in the activity for a certain amount of time, further underscores their importance.

Note that people did not enjoy walking less because they did more of it. Enjoyment was not correlated with output ($r = -.098$, $p = .339$) and output did not mediate the effect of measurement on enjoyment ($ab = -.02$, 95% CI, $-.19$ to .11]). Doing more of an activity thus is not what causes measurement to reduce enjoyment. I test the hypothesized underlying process in the next three experiments.

EXPERIMENT 3

Experiment 3 had three objectives. First, it tested the proposed underlying mechanism. I examined whether, by drawing attention to output, measurement makes an enjoyable activity (walking) seem more like work, and whether this perception decreases how much participants enjoy the activity.

Second, experiment 3 explored measurement’s consequences for subjective well-being. Given that spending time on work activities reduces subjective well-being (Kahneman et al. 2004; Mogilner 2010), if measurement makes enjoyable activities seem more like work, as I suggest, then it may make consumers feel less happy and satisfied overall.

Third, this experiment further explored whether measurement’s effects persist when attending to measurement is optional. One group of participants received pedometers but were told that viewing the measurement feedback was entirely up to them. This allowed me to examine whether people choose to attend to measurement when available, and if so, whether it reduces how much they enjoy the activity (and subjective well-being).

Design and Method

100 students (average age = 20.7 years, 67% female) at a private eastern university participated in exchange for payment. Participants came to the lab in the morning (9–10 AM) and were randomly assigned to a measurement condition: control, measurement, or optional measurement.

Participants were told that the study was about pedometers. They were given a basic pedometer and instructed to wear it for the rest of the day. Remaining instructions differed across conditions. In the measurement condition, participants were asked to look at the number of steps they had taken several times throughout the day. In the control condition, as in experiment 2, participants were told that the experimenter was just interested in whether the pedometer was comfortable to wear and so the lid had been taped shut. In the optional measurement condition, participants were given the step counter without any request to look at their step count. They were told, "If you are interested in how many steps you have taken, feel free to look at the counter, but it is not a required part of the study" (71.4% indicated that they looked). All participants then left the lab.

Later that day (5–6 PM), participants returned to the lab. Upon entering, they handed the pedometers to the lab administrator, who discreetly recorded the number displayed. Step count was log-transformed (natural log base) to stabilize for nonnormality in its distribution (Kolmogorov-Smirnov test = .128, $p < .001$).

Participants then completed the dependent measures. First, I measured subjective well-being: "How happy do you feel right now?" and "How satisfied do you feel right now?" (1 = Not at all to 7 = Very much; $r = .78$, averaged to a subjective well-being index). Second, participants answered the enjoyment measures from experiment 1 ($\alpha = .81$, averaged to an enjoyment index). Enjoyment was only modestly correlated with subjective well-being ($r = .28$), and a factor analysis on all seven items revealed a two factor solution (with eigenvalues > 1): happiness and satisfaction loaded on one factor (principle loadings > .90, cross loadings < .20), whereas the five enjoyment items loaded on the other (principle loadings > .80, cross factor loadings < .25), confirming that they are distinct constructs.

Third, participants indicated to what extent walking seemed like work: "Would you consider walking to be work or fun?" (1 = Definitely work to 7 = Definitely fun). Finally, they confirmed whether they wore their pedometer all day (93% indicated that they did, and this did not differ across conditions; $\chi^2 < 1$).

Results

Output. Consistent with experiments 1 and 2, measurement increased output ($F(2, 97) = 7.08$, $p = .001$; figure 1A). Compared to the control ($M = 7.28$, SD = 1.23), measurement increased how much participants walked ($M = 8.06$, SD = .76; $F(1, 97) = 11.74$, $p = .001$), even when attending to measurement was optional ($M = 8.04$, SD = .95; $F(1, 97) = 7.89$, $p = .006$). How much participants walked did not differ between the measurement and optional measurement conditions ($F < 1$).

Enjoyment. However, as predicted, measurement decreased enjoyment ($F(2, 97) = 7.06$, $p = .001$; figure 1B). Compared to the control ($M = 5.21$, SD = .98),

FIGURE 1A

MEASUREMENT INCREASES HOW MUCH PEOPLE WALK

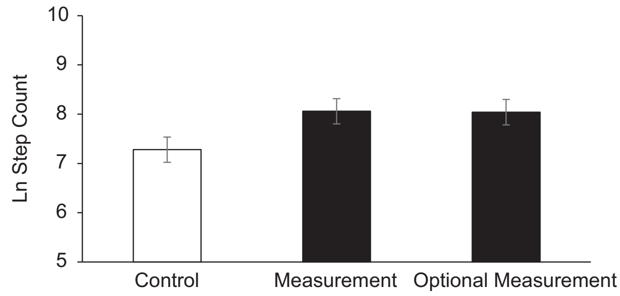
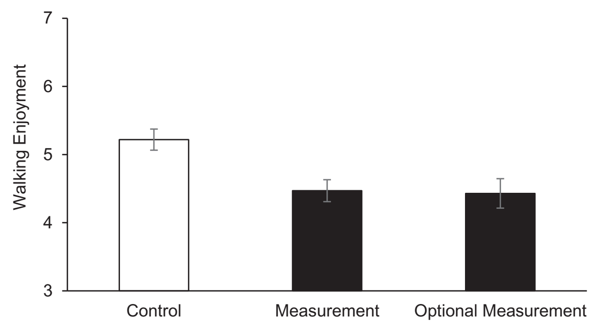


FIGURE 1B

MEASUREMENT REDUCES HOW MUCH PEOPLE ENJOY WALKING



measurement reduced enjoyment ($M = 4.47$, SD = .92; $F(1, 97) = 11.01$, $p = .001$), even when attending to measurement was optional ($M = 4.43$, SD = 1.15; $F(1, 97) = 8.73$, $p = .004$). There was no difference between the measurement and optional measurement conditions ($F < 1$).

Underlying Process. As predicted, attending to measurement feedback made walking seem more like work ($F(2, 97) = 4.82$, $p = .010$). Compared to the control ($M = 4.85$, SD = 1.32), measurement made walking seem more like work ($M = 4.00$, SD = 1.09; $F(1, 97) = 8.45$, $p = .005$), even when attending to measurement was optional ($M = 4.10$, SD = 1.61; $F(1, 97) = 4.70$, $p = .033$). There was no difference between the measurement and optional measurement conditions ($F < 1$).

To test whether perceiving walking as work drove measurement's negative effect on enjoyment, I ran a bias-corrected mediation analysis (Hayes 2013). Because I expected (and found) no difference between the measurement and optional measurement conditions, they were combined for this analysis (effects are the same if each is separately compared to the control). As predicted, seeing the activity as more like work drove the negative effect of measurement on enjoyment ($ab = -.43$, 95% CI, $-.77$ to $-.16$]). Measurement reduced enjoyment by making walking seem like work rather than fun.

Consequences for Subjective Well-Being. Finally, measurement also reduced subjective well-being ($F(2, 97) = 3.04$, $p = .053$). Compared to the control ($M = 5.18$, $SD = 1.07$), participants in the measurement condition reported less happiness and satisfaction overall ($M = 4.59$, $SD = 1.08$; $F(1, 97) = 5.11$, $p = .026$), even when attending to measurement was optional ($M = 4.62$, $SD = 1.45$; $F(1, 97) = 3.28$, $p = .073$). There was no difference between the measurement and optional measurement conditions ($F < 1$).

Discussion

Experiment 3 demonstrates the proposed underlying process driving measurement's negative effect on enjoyment. As predicted, measurement reduced enjoyment by making an enjoyable activity (walking) seem more like work. While tracking step count increased how much participants walked, it also made walking seem more like work, which led participants to enjoy walking less. By drawing attention to output, measurement can thus make enjoyable activities seem more like work, reducing their enjoyment.

Furthermore, consistent with experiment 2, this negative effect emerged even when attending to measurement was optional. While participants did not have to look at their pedometer in the optional measurement condition, 71.4% indicated that they looked at how much they walked. This suggests that people access measurement information when it is available, even though doing so can have negative consequences.

Finally, the results also illustrate a negative downstream consequence of measurement. In addition to enjoyment, tracking step count reduced subjective well-being. Participants who could view the number of steps that they walked felt less happy and satisfied at the end of the day than their control counterparts. Measurement's unintended harmful effects can thus extend beyond decreasing an activity's enjoyment to reducing subjective well-being.

EXPERIMENT 4

Experiment 4 had two main objectives. First, it further tested the underlying process using both mediation and moderation. If measurement reduces enjoyment by making enjoyable activities seem more like work, as I suggest, then framing such activities as work-like to begin with should attenuate the effect (Fishbach and Choi 2012; Laran and Janiszewski 2010).

To test this possibility, I had people spend time reading a book, and manipulated how the reading activity was framed. For some participants, reading was framed as fun, whereas for others, reading was framed as work (i.e., useful for learning). I expected that when framed as fun (as should naturally be the case), measurement would make reading seem more like work, reducing its enjoyment. When framed as work to begin with, however, measurement should have less of an effect on how reading is perceived, which should attenuate this effect.

Notably, I did not expect that manipulating how reading is framed would attenuate measurement's effect on output. Because measurement should highlight output regardless of how the activity is framed, it should lead people to do more.

Second, experiment 4 further explored consequences of measurement for subjective well-being. Consistent with experiment 3, when framed as fun (and in the control), I expected that tracking how much participants read would reduce subjective well-being. Framing reading as work to begin with, however, should attenuate this effect.

Design and Method

310 students (average age = 24.6 years, 58.5% female) from two private eastern universities participated in exchange for payment. Participants were randomly assigned to condition in a 2 (measurement: control vs. measurement) $\times$ 3 (activity frame: control, fun, work) between-subjects design.

Participants read that the experimenter was interested in the effects that reading has on people. They were told that they would be reading an excerpt from a book, and that regardless of how fast or slow they read, they would read for eight minutes. Remaining instructions differed across activity frame conditions. In the work-frame and fun-frame conditions, participants read additional text that explicitly framed reading as either useful or enjoyable. In the work-frame condition, participants read that "Reading is a useful and educational activity, and people often read to learn things they need to know." In the fun-frame condition, participants read that "Reading is a fun and relaxing activity, and people often read for its enjoyment." In the control-frame condition, participants received no additional information.

Then, I manipulated measurement feedback. Similar to a regular book, the excerpt was divided into pages and participants clicked to advance to the next page after reading a given page of text. Both conditions thus required the exact same actions on the part of the participant; the only difference was whether a page number was displayed. In the measurement condition, in addition to the text itself, each page displayed the number of pages completed (e.g., "You have read 4 pages") in the top left corner. In the control condition, no such number was displayed.

After eight minutes had elapsed, participants completed the dependent measures. First, they answered the subjective well-being measures from experiment 3 ($r = .79$), and second, the enjoyment measures from experiment 2 ($r = .89$). Third, similar to experiment 3, participants indicated to what extent they perceived reading to be work (1 = Definitely work to 7 = Definitely fun).

Results

Output. A 2 (measurement) × 3 (frame) analysis of variance (ANOVA) on output only revealed the expected main effect of the measurement condition ($F(1, 304) = 32.02$, $p < .001$; figure 2A). Consistent with the prior experiments, measurement increased how much participants read ($M_{measurement} = 16.14$ pages, SD = 4.15 vs. $M_{control} = 13.44$ pages, SD = 4.14).

The main effect of frame condition was not significant ($F < 1$); nor was the interaction ($F(1, 304) = 1.41$, $p = .247$). Thus regardless of how activities are framed, by drawing attention to output, measurement increases how much people do.

Enjoyment. A 2 (measurement) × 3 (frame) ANOVA on enjoyment revealed a main effect of measurement condition ($F(1, 304) = 4.70$, $p = .031$), qualified by the predicted interaction ($F(2, 304) = 4.83$, $p = .009$; figure 2B). There was no main effect of frame condition ($F < 1$).

Consistent with the prior experiments, in the control-frame condition, measurement made participants enjoy reading less ($M_{measurement} = 5.19$, SD = 1.62 vs. $M_{control} = 5.97$, SD = 1.17; $F(1, 304) = 8.89$, $p = .003$). As expected, this same effect emerged in the fun-frame condition ($M_{measurement} = 4.98$, SD = 1.71 vs. $M_{control} = 5.70$, SD = 1.26; $F(1, 304) = 5.33$, $p = .022$).

In the work-frame condition, however, this effect was attenuated ($M_{measurement} = 5.57$, SD = 1.57 vs. $M_{control} = 5.18$, SD = 1.47; $F(1, 304) = 1.59$, $p = .208$). Supporting my theory this pattern was driven by the control (i.e., no measurement) condition, such that framing reading as work to begin with reduced enjoyment at baseline (compared to the control-frame and fun-frame conditions; $M_{work} = 5.18$, SD = 1.47, $M_{control} = 5.97$, SD = 1.17, $M_{fun} = 5.70$, SD = 1.26; $t(159) = -3.06$, $p = .003$).

Underlying Process. A bias-corrected moderated mediation analysis (Hayes 2013) further demonstrated that measurement's negative effect on enjoyment was driven by reading seeming more like work. Because I expected (and found) no difference in how measurement affected enjoyment in the control-frame and fun-frame conditions, these conditions were combined for this analysis (effects are the same if each is separately compared to the work-frame condition).

Results revealed the predicted moderated mediation (*Index* = .40, 95% CI, .04–.84]). Consistent with experiment 3, in the control- (and fun-) frame conditions, measurement made reading seem more like work, which drove its negative effect on enjoyment ($ab = -.24$, 95% CI, −.47 to −.05]). This indirect effect disappeared, however, in the work-frame condition ($ab = .16$, 95% CI, −.16 to .51]). When reading seemed like work to begin with, measurement had less of an effect on how the activity was perceived, attenuating its negative impact on enjoyment.

Consequences for Subjective Well-Being. Furthermore, as expected, manipulating activity frame moderated measurement's effect on subjective well-being. A 2 (measurement) × 3 (frame) ANOVA on subjective well-being revealed a main effect of measurement condition ($F(1, 304) = 3.34$, $p = .069$), qualified by the predicted

FIGURE 2A

MEASUREMENT INCREASES HOW MUCH PEOPLE READ

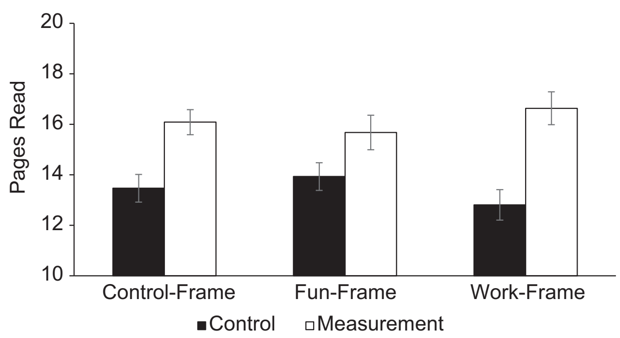
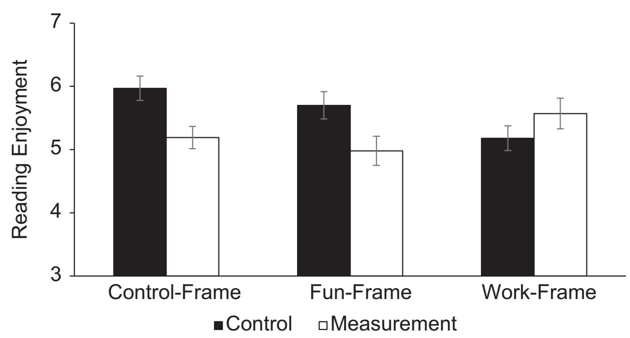


FIGURE 2B

ACTIVITY FRAME MODERATES MEASUREMENT'S EFFECT ON ENJOYMENT



interaction (although it was marginal, $F(2, 304) = 2.27$, $p = .105$). There was no main effect of frame condition ($F < 1$).

Consistent with experiment 3, in the control-frame condition, measurement reduced participants' subjective sense of well-being (albeit marginally, $M_{\text{measurement}} = 4.39$, $SD = 1.18$ vs. $M_{\text{control}} = 4.74$, $SD = 1.10$; $F(1, 304) = 2.81$, $p = .095$). This same effect emerged in the fun-frame condition ($M_{\text{measurement}} = 4.27$, $SD = 1.46$ vs. $M_{\text{control}} = 4.84$, $SD = 1.05$; $F(1, 304) = 5.02$, $p = .026$). As expected, however, in the work-frame condition, this effect was attenuated ($M_{\text{measurement}} = 4.63$, $SD = 1.23$ vs. $M_{\text{control}} = 4.80$, $SD = 1.17$; $F < 1$).

Discussion

Experiment 4 further demonstrates measurement's harmful effects and underscores the proposed underlying process in two ways. First, while measurement led people to read more pages, it simultaneously made reading seem more like work, which, in turn, reduced how much reading was enjoyed (and subjective well-being). Second, framing reading as work to begin with attenuated the reduced enjoyment. When participants focused on what they could achieve from reading (i.e., improved learning), rather than the fun of it, measurement no longer reduced enjoyment. Thus by drawing attention to output, measurement can make enjoyable activities seem more like work, which decreases their enjoyment (and subjective well-being).

While not significant, the directional reversal of enjoyment in the work-frame condition suggests that measurement may increase how much consumers enjoy work (e.g., goal-directed) activities. Although subjective well-being does not show the same pattern, the possibility that measurement might sometimes increase enjoyment merits further consideration. I return to this point in the General Discussion.

The moderation also addresses potential alternative explanations. First, the findings cast further doubt on the possibility that distraction alone might explain measurement's harmful effects. If measurement decreases enjoyment simply by reducing attention to an enjoyable activity, then this effect should persist regardless of how the activity is framed. But it did not. That framing reading as work attenuated its negative effects suggests that measurement does more than simply reduce attention.

Second, while one could argue that evaluation apprehension (i.e., concerns about being observed by an experimenter) somehow played a role, this alternative also has difficulty explaining the moderation. Participants' awareness of being tracked should be the same regardless of how reading was framed, yet measurement only decreased enjoyment (and subjective well-being) when reading seemed fun to do.

EXPERIMENT 5

Experiment 5 had two main objectives. First, it examined measurement's downstream consequences for continued engagement. In addition to decreasing enjoyment, undermining intrinsic motivation reduces how much of an activity people do in the future (Deci et al. 1999; Fishbach and Choi 2012; Kruglanski et al. 1972; Lepper et al. 1973). Thus if measurement undermines intrinsic motivation, as I suggest, then measurement should lead people to do less of the activity after measurement is removed.

To test this possibility, I had people spend time reading with or without measurement, as in the prior experiment. Then, after reporting their enjoyment, all participants continued to read for a few minutes, this time with the measurement feedback removed. I examined how having viewed measurement previously (i.e., seeing the number of pages read) impacted the amount participants read after measurement was removed. While currently viewing measurement should lead people to read more, after it is removed, I expected that people who viewed measurement previously would read less.

Second, experiment 5 further addressed whether mere distraction can explain the results by directly manipulating attentional resources. Half of participants were randomly assigned to read while under cognitive load. If measurement decreases enjoyment simply by reducing attention to an enjoyable experience, then cognitive load should generate similar effects. If it does not, this would further suggest that measurement does more than simply reduce attention.

Design and Method

240 US adults recruited from Amazon's Mechanical Turk participated in exchange for payment. Sample size was determined by a target rule of 60 participants per cell. Four individuals failed to complete the experiment, leaving a sample of 236 (average age = 32.76 years, 40.3% female). Participants were randomly assigned to condition in a 2 (measurement: control vs. measurement) × 2 (cognitive load: no load vs. load) between-subjects design.

Similar to experiment 4, participants read that the experimenters were interested in the effects that reading has on people and that they would read a book excerpt for 10 minutes. In the cognitive load condition, I asked participants to remember an eight-digit number while they read (Gilbert, Giesler, and Morris 1995; Shiv and Huber 2000). In the control condition, participants received no additional information.

Next, I manipulated measurement feedback. As in experiment 4, the book excerpt was divided into pages. In the measurement condition, each page displayed the number of pages read in the top left corner. In the control condition, no such number was displayed.

After eight of the ten minutes had elapsed, I paused the reading activity. To remove the cognitive load, participants in the load condition typed the eight-digit number in a space provided (81.9% entered the correct number, with an additional 9.4% off by only one digit).

Participants then completed the dependent measures. First, they answered the enjoyment measures from experiments 2 and 4 ($r = .95$). Second, to check the cognitive load manipulation, I asked participants how absorbed they felt in the reading material (1 = Strongly disagree to 7 = Strongly agree). Results confirmed that cognitive load had the intended effect. A 2 (measurement) × 2 (cognitive load) ANOVA revealed the expected main effect of load condition ($F(1, 232) = 4.96$, $p = .027$), such that participants under cognitive load felt less absorbed in the reading material ($M = 5.03$, SD = 1.54) than their no-load counterparts ($M = 5.45$, SD = 1.44).

Third, as in experiment 4, participants indicated to what extent they perceived reading to be work (1 = Definitely work to 7 = Definitely fun). Fourth, I measured continued engagement. All participants read for the remaining two minutes, this time, without any measurement feedback (i.e., page count was no longer displayed in the measurement condition), and I summed the number of pages read.

Results

Output. A 2 (measurement) × 2 (cognitive load) ANOVA on output revealed a main effect of load condition ($F(1, 232) = 3.57$, $p = .060$), qualified by an interaction ($F(1, 232) = 4.98$, $p = .027$; figure 3A). There was no main effect of measurement condition ($F(1, 232) = 1.50$, $p = .222$).

As in the prior experiments, in the no-load (i.e., control) condition, measurement increased how much participants read ($M_{measurement} = 12.58$ pages, SD = 4.51 vs. $M_{control} = 10.56$ pages, SD = 4.81; $F(1, 232) = 5.55$, $p = .019$). In the load condition, however, this effect was eliminated ($M_{measurement} = 10.17$ pages, SD = 3.36 vs. $M_{control} = 10.76$ pages, SD = 5.13; $F < 1$), driven by participants in the measurement condition reading fewer pages ($M_{load} = 10.17$ pages, SD = 3.36 vs. $M_{no\ load} = 12.58$ pages, SD = 4.51; $F(1, 232) = 8.80$, $p = .003$). This moderation is consistent with the notion that measurement's effects are driven by increased attention to output. When attentional resources are limited (i.e., under cognitive load), measurement is less able to draw attention to output, and thus its effect on how much people do is reduced.

Enjoyment. A 2 (measurement) × 2 (cognitive load) ANOVA on enjoyment revealed only the predicted main effect of the measurement condition ($F(1, 232) = 3.67$, $p = .057$; figure 3B). Consistent with the prior experiments, measurement reduced enjoyment ($M_{measurement} = 5.27$, SD = 1.67 vs. $M_{control} = 5.64$, SD = 1.39).

FIGURE 3A

COGNITIVE LOAD MODERATES MEASUREMENT'S EFFECT ON OUTPUT

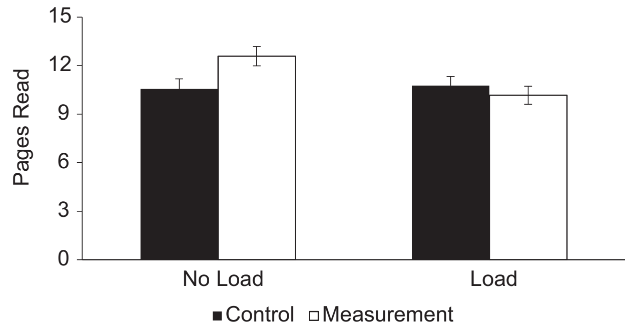


FIGURE 3B

MEASUREMENT REDUCES HOW MUCH PEOPLE ENJOY READING (EXPERIMENT 5)

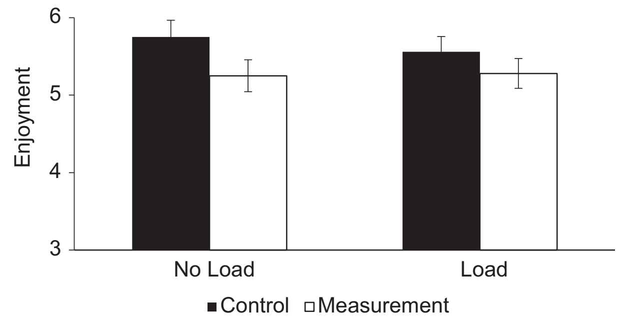
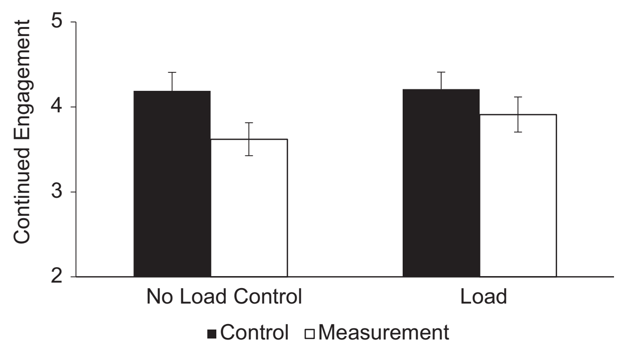


FIGURE 3C

MEASUREMENT REDUCES HOW MUCH PEOPLE CONTINUE TO READ



Notably, the main effect of cognitive load condition was not significant ($F < 1$); nor was the interaction ($F < 1$). Thus whereas measurement reduced how much reading was enjoyed, merely reducing attention to the activity did not have the same effect.

Underlying Process. A bias-corrected mediation analysis (Hayes 2013) further demonstrated that measurement's negative effect on enjoyment was driven by seeing reading more as work. Because I expected (and found) no difference in how measurement affected enjoyment in the load and no-load conditions, these were combined for the analysis (effects are the same if each condition is considered separately).

Results revealed the predicted indirect effect ($ab = .40$, 95% CI, .04–.84]). As in experiments 3 and 4, measurement reduced enjoyment by making reading seem more like work.

Consequences for Continued Engagement. A 2 (measurement) × 2 (cognitive load) ANOVA on how much participants read after measurement was removed revealed only the predicted main effect of measurement condition ($F(1, 232) = 4.57$, $p = .034$; figure 3C). As expected, and in opposition to the effect when measurement was present, after such feedback was removed, having viewed measurement previously reduced the number of pages participants read ($M_{\text{measurement}} = 3.75$ pages, SD = 1.31 vs. $M_{\text{control}} = 4.20$ pages, SD = 1.79).

Importantly, the main effect of load condition was not significant ($F < 1$); nor was the interaction ($F < 1$). Thus whereas viewing measurement reduced continued engagement after the feedback was removed, merely reducing attention to the activity did not have the same effect after participants' attentional resources were restored.

Discussion

Experiment 5 underscores the prior results and demonstrates measurement's downstream consequences for continued engagement. While viewing measurement increased how much participants read, it simultaneously made reading seem more like work, which reduced how much reading was enjoyed. Furthermore, after the measurement was removed (i.e., the number of pages read was no longer displayed), having viewed measurement previously led participants to read less. By undermining intrinsic motivation, measurement can thus reduce continued engagement in an enjoyable activity.

The findings also cast further doubt on alternative explanations. First, they underscore that measurement does more than simply reduce attention to an enjoyable activity. Measurement increased output and decreased enjoyment (as well as continued engagement), but putting people under cognitive load (i.e., reducing attention to the enjoyable activity directly) did not generate the same effects.

Note that measurement and cognitive load produced different effects on enjoyment and continued engagement despite both reducing attention to the enjoyable reading activity. In addition to the expected main effect of cognitive load, the previous 2 (measurement) × 2 (cognitive load) ANOVA on how absorbed participants felt in the reading also revealed a main effect of measurement condition ($F(1, 232) = 3.68$, $p = .056$), such that measured participants felt less absorbed in the reading ($M = 5.06$, SD = 1.56) than those in the control ($M = 5.40$, SD = 1.44; no interaction: $F(1, 232) = 2.03$, $p = .156$). However, a bias-corrected mediation analysis (Hayes 2013) confirmed that reduced absorption is not what drives measurement's negative effect on enjoyment ($ab = -.14$, 95% CI, $-.32$ to .005). Thus while measurement and cognitive load may both reduce attention to enjoyable activities, only measurement shifts attention to a quantitative task outcome (i.e., output), which is what undermines intrinsic motivation and reduces enjoyment. Together with the follow-up to experiment 1 and experiment 4, these results rule out alternative explanations based on distraction or interruption.

Second, the results cast further doubt on the possibility that measurement undermines intrinsic motivation by activating an achievement goal. If measurement activates a goal to achieve, then when given the option to do more of the activity, measurement should increase the amount people do. But it did not. That having viewed measurement previously decreased how much participants subsequently read thus supports my claim that measurement undermines intrinsic motivation and casts further doubt on this alternative explanation.

Third, measured participants did not read less after measurement because they read more during and therefore felt they did not have to read any more. In fact, the amount read during and after measurement was positively correlated ($r = .58$), casting doubt on this potential alternative explanation.

EXPERIMENT 6

The final study had two main objectives. First, I tested measurement's effect on continued engagement in a different way. Rather than examining how much of an activity consumers do after measurement is removed, I tested whether viewing measurement previously impacts consumers' choice to continue engaging in the activity.

To test this possibility, I had people spend time reading with or without measurement, as in the prior experiments. Then, after reporting their enjoyment, I gave participants the opportunity to continue reading, and examined how having access to measurement previously impacted their decision to do so. While viewing measurement should increase how much people read, I expected it would make them less likely to choose to keep reading.

Second, experiment 6 further explored whether measurement's effects persist when attending to measurement is optional. Half of participants received the option to view the number of pages they had read, but they were not required to do so. This allowed me to examine whether people choose to attend to measurement when available, and if so, whether it reduces enjoyment and continued engagement.

Design and Method

66 students (average age = 21.2 years, 56.1% female) at a private eastern university participated in exchange for payment. Participants were randomly assigned to either the control or (optional) measurement condition.

Similar to experiments 4 and 5, participants were told that they would read a book excerpt and regardless of how fast or slow they read, they would read for eight minutes. The only difference between conditions was whether participants had the option to view the number of pages read. In the optional measurement condition, participants were told that at any point they could see how many pages they had read by scrolling their mouse over a small box in the top left corner of the page. Thus similar to the optional measurement condition in experiment 3, participants could attend to the measurement feedback if they wished but were not required to do so (93.9% of participants in this condition chose to look, on average, 2.68 times). In the control condition, no such number was displayed.

After eight minutes had elapsed, participants completed the dependent measures. First, they answered the enjoyment measures from experiments 1 and 3 ($\alpha = .88$, averaged to an enjoyment index). Second, I asked whether they wanted to continue reading. Participants were told that they had a few more minutes remaining in the experiment and could choose to continue reading or do something else. I recorded whether people chose to keep reading (1 = yes, 0 = no). After indicating their choice, participants learned that, due to time constraints, they would not complete the activity.

Third, I collected additional measures to test potential alternative explanations. One could argue that tracking people's behavior leads to more stress and anxiety, and these negative feelings are what drives measurement's harmful effects. To test this possibility, I asked participants how much stress ("How stressed did you feel in the past eight minutes?" 1 = Not very stressed to 7 = Very stressed) and anxiety ("How anxious did you feel in the past eight minutes?" 1 = Not very anxious to 7 = Very anxious) they felt while reading ($r = .86$, averaged to a stress index). There was no difference in stress and anxiety across conditions ($M_{\text{measurement}} = 2.59$, SD = 1.68 vs. $M_{\text{control}} = 2.38$, SD = 1.57; $F < 1$), casting doubt on the notion that increased stress and anxiety is what drives the reduced enjoyment. As in experiment 1, I also asked participants how difficult they found the reading activity to be (1 = Very easy to 7 = Very difficult). There was no difference in perceived task difficulty across conditions ($M_{\text{measurement}} = 2.21$, SD = 1.32 vs. $M_{\text{control}} = 2.30$, SD = 1.31; $F < 1$), casting further doubt on the possibility that task difficulty underlies the reduced enjoyment.

Results

Output. Consistent with the prior experiments, measurement increased output. Compared to the control ($M = 14.36$ pages, SD = 4.48), measurement made participants read more pages, even though attending to it was optional ($M = 16.70$ pages, SD = 5.10; $F(1, 64) = 4.06$, $p = .048$).

Enjoyment. However, as predicted, measurement reduced enjoyment. Compared to the control ($M = 5.37$, SD = 1.06), measurement made participants enjoy reading less, even though attending to it was optional ($M = 4.68$, SD = 1.27; $F(1, 64) = 5.72$, $p = .020$).

Consequences for Continued Engagement. Importantly, measurement decreased interest in continuing to read. Compared to the control ($P = 48.5\%$), measured participants were less likely to choose to keep reading, even though attending to the measurement was optional ($P = 27.3\%$; $\chi^2 = 4.19$, $p = .041$).

Discussion

Experiment 6 further illustrates measurement's detrimental consequences for continued engagement. While having access to measurement led participants to read more, it reduced their enjoyment and made them less likely to choose to keep reading. Thus while viewing measurement can increase output, having viewed measurement previously makes consumers less interested in continuing to engage in the activity.

Notably, measurement reduced enjoyment and continued engagement even though attending to the feedback was completely optional. As in experiments 2 and 3, when given the option to access measurement information, people chose to do so—at an unintended cost.

As in experiment 5, the findings cast further doubt on an alternative explanation based on goals. If measurement activates a goal to achieve, then when given the option to do more of the activity, measurement should increase continued engagement. That having viewed measurement previously decreased participants' choice to continue reading thus supports my claim that measurement undermines intrinsic motivation and casts further doubt on this alternative account.

GENERAL DISCUSSION

Technological advances have allowed people to track a growing range of behaviors. The allure of personal quantification is simple. Knowing more about how much one is doing should encourage people to change their behavior and make them better off overall. But while these propositions seem intuitive, little empirical work has examined how measurement impacts consumers. Might personal quantification sometimes have unintended harmful effects?

Six experiments demonstrate that while measurement can increase how much of an activity people do, it can simultaneously reduce how much people enjoy the activity. Measurement led participants to color more shapes (experiment 1), walk more steps (experiment 2 and 3), and read more pages (experiment 4, 5, and 6). At the same time, however, it led people to enjoy coloring, walking, and reading less.

The experiments also show the process underlying this effect. By highlighting a quantitative outcome of enjoyable activities, measurement makes such activities seem more like work, which undermines intrinsic motivation. Tracking output made walking (experiment 3) and reading (experiment 5) seem more like work, which reduced their enjoyment. Experiment 4 found similar effects using both mediation and moderation. When framed as fun, measurement made reading seem more like work, which reduced how much participants enjoyed reading. When reading was framed as work-like to begin with, however, measurement had less of an effect on how reading was perceived, which attenuated its negative effect on enjoyment.

Furthermore, the experiments demonstrate two important downstream consequences of measurement. First, measurement can reduce continued engagement. After measurement was removed, having viewed it previously reduced how much participants subsequently read (experiment 5) and made them less likely to choose to keep reading (experiment 6). Second, measurement can reduce subjective well-being. Tracking steps walked (experiment 3) and pages read (experiment 4) made participants feel less happy and satisfied overall. Measurement's harmful effects can thus extend beyond decreasing immediate enjoyment to reducing continued engagement in (formerly) enjoyable activities, as well as how happy and satisfied people feel overall.

Finally, the experiments cast doubt on several potential alternative explanations. While one might wonder whether measurement undermines intrinsic motivation by activating a goal to achieve (i.e., to do as much of an activity as possible), such an explanation has trouble explaining why need for achievement did not moderate the effects (experiment 1) and why measurement reduced (rather than increased) continued engagement (experiments 5 and 6). Furthermore, while one might wonder whether measurement decreased enjoyment by reducing attention to an enjoyable experience (e.g., Lee and Tsai 2014; Wilson and Gilbert 2008), that measurement decreased enjoyment compared to a similar interruption (follow-up to experiment 1), that manipulating how an enjoyable activity was framed moderated this effect (experiment 4), and that directly reducing attention (via cognitive load) did not generate the same results (experiment 5) cast doubt on this notion. Rather than merely drawing attention away from an enjoyable activity, measurement also draws attention toward output, which is what undermines intrinsic motivation.

In addition, differences in perceived task difficulty (experiments 1 and 6), perceived performance (follow-up to experiment 1), output (experiment 2), evaluation apprehension (experiment 4), and stress and anxiety (experiment 6) cannot explain measurement's effects.

Practical Implications

This research has important implications for measurement's use. Personal quantification devices are increasingly used as tools to support behavior change (Patel, Asch, and Volpp 2015). Insurance companies, for example, give fitness tracking devices to members to encourage them to stay active. If they undermine intrinsic motivation, however, these devices may have the exact opposite effect, reducing consumers' interest in continuing to engage in the activity. In experiment 5, for instance, having viewed measurement previously reduced how much people read after the measurement was removed, and in experiment 6, it led participants to avoid reading altogether. Thus while tracking output may lead people to do more in the short term (e.g., walk more steps; Bratava et al. 2007; Spence et al. 2009), by reducing continued engagement, measurement may sometimes actually undermine sustainable behavior change. Future research could explore how long lasting this effect is.

This work also demonstrates the seductive aspect of measurement. Measurement's harmful effects persisted even when consumers self-selected into measurement. In experiment 2, for example, participants could choose whether to wear a pedometer (i.e., whether to opt in to measurement), and those who did walked more but enjoyed walking less. In experiments 3 and 6, participants could view measurement feedback if they wished, yet merely making measurement available reduced how much the activities were enjoyed. Thus if measurement is available, people attend to it, and if given the option to be measured, people opt in to it.

Ancillary data further indicate that if given the option, most people prefer to be measured. When I gave participants ($N = 104$) the chance to have their steps counted, most people (88%) wanted this information. This same preference emerged for the number of pages read ($N = 93$, 74%) and shapes colored ($N = 95$, 70%). One reason might be that people do not anticipate that measurement can have harmful effects. These same participants predicted that measurement would make walking more enjoyable ($t(103) = 6.06$, $p < .001$) and have no impact on enjoyment from reading ($t(92) = .50$, $p > .25$) or coloring ($t(94) = .38$, $p > .25$). Consumers seem to think that measurement will increase, or at least not change, enjoyment, which may lead them to access measurement information when it is available.

The findings suggest that measurement decisions should be made with care. Standardized testing and common core requirements, for example, have all but universalized the practice of tracking students' academic performance. While tracking may lead students to do better on the measured dimensions (e.g., test scores), this may come at the expense of how much they enjoy academic activities. Likewise, personal trainers are increasingly using personal quantification devices to track clients' calorie consumption and energy expenditures. If doing so reduces how much healthy behaviors are enjoyed, this practice may hamper long-term clientele.

Note this is not to say that measurement will always decrease enjoyment. Take, for example, when measurement is an expected or integral part of engaging in an activity (e.g., playing video games). External incentives tend not to undermine intrinsic motivation when the incentives are integral to the activity (e.g., gambling with money; Kruglanski et al. 1971). Thus when measurement is integral to an activity, it should be less likely to undermine intrinsic motivation and, as a result, may not reduce (and may even increase) enjoyment.

Measurement may also not reduce enjoyment when activities are performed in the service of a goal (e.g., reading in order to learn or running on a treadmill to get in shape). In such cases, measurement may even enhance enjoyment. Ancillary data support this view. Participants ($N = 300$) spent time reading, and in addition to manipulating whether their page count was displayed, I gave half of them a goal to "read as many pages as possible." Consistent with the prior experiments, measurement made participants read more pages ($F(1, 296) = 10.20$, $p = .002$), and there was no interaction with goal condition ($F(1, 296) = 1.31$, $p = .253$). But while measurement reduced enjoyment when people read without a goal (consistent with the other experiments) ($F(1, 296) = 4.73$, $p = .030$), this effect reversed when people read with a goal to read as much as possible ($F(1, 296) = 3.10$, $p = .079$). In this case, measurement increased how much people enjoyed reading, albeit marginally. Future research could explore why measurement enhances the enjoyment of goal-directed activities (e.g., by helping consumers visualize progress; Amir and Ariely 2008; Cheema and Bagchi 2011).

Importantly, whether measurement has a negative impact overall will likely depend on the combination of output, enjoyment, and subjective well-being. When an activity is performed for fun, measurement's overall impact may be negative because it hurts enjoyment, continued engagement, and subjective well-being. When an activity is performed for its external benefits (e.g., walking to get in shape), or when doing more outweighs the cost of enjoying the activity less, measurement may be beneficial because it increases output. Notably, providing measurement feedback and then removing it may have the most detrimental effect. So long as measurement is available, it should lead consumers to do more (e.g., walk more steps), but after it is removed, having viewed measurement previously should make people do less (e.g., walk fewer steps). Once people begin tracking a behavior, they may be better off continuing to do so.

Theoretical Contributions

The present research furthers understanding of how external factors impact intrinsic processes. It is well known that external rewards undermine intrinsic motivation (Deci 1971; Higgins et al. 1995; Kruglanski et al. 1971). Giving children rewards for coloring, for instance, reduces their interest in continuing to color (Lepper et al. 1973), and paying students for grades reduces their intrinsic motivation to do well in school (Condry and Chambers 1978; Kohn 1993). Even though measurement itself does not provide explicit external incentives, the findings show it can have similar effects. Simply measuring how much of an activity people do can undermine intrinsic motivation, reducing how much the activity is enjoyed, continued engagement, and subjective well-being.

The findings also extend prior work on instrumentality. Many enjoyable activities also offer external (i.e., goal-related) benefits. Eating healthy foods can be useful for achieving better fitness (Etkin and Ratner 2012; Maimaran and Fishbach 2014), for example, and practicing yoga can be instrumental to achieving better balance (Fishbach and Choi 2012). While focusing on the external benefits of engaging in enjoyable activities has been shown to undermine intrinsic motivation (Fishbach and Choi 2012; Kruglanski et al. 1975; Werle et al. 2014; Wrzesniewski et al. 2014), this work shows that attending to quantitative outcomes can have similar effects. Because people tend to think about output when activities are extrinsically motivated but not when they are intrinsically motivated (Kruglanski et al. 1971), paying attention to output makes enjoyable activities seem more like work. Tracking behavioral output is one factor that highlights output, which makes enjoyable activities seem like work rather than fun.

Finally, this work relates to the literature on mere measurement effects. Asking questions changes behavior (Weber and Johnson 2006). Measuring purchase intentions, for example, increases the accessibility of product-specific attitudes (Morwitz and Fitzsimons 2004; Morwitz, Johnson, and Schmittlein 1993) that influence consumer behavior. Whereas these prior articles primarily examined effects of measuring attitudes, the current research demonstrates consequences of quantifying behavior (see also Redden 2008; Shalev and Morwitz 2013). Merely measuring how much of an activity consumers do can influence enjoyment, subjective well-being, and continued engagement. Future research could explore whether other types of measurement (e.g., time spent on an activity, or counting downward instead of upward, e.g., Shalev and Morwitz 2013) would generate similar effects. I speculate other forms of measurement that draw attention to quantitative outcomes would lead to similar results.

Conclusion

Measurement is a powerful tool. But in addition to influencing output, it also impacts how people see and experience various activities. Does this mean we should stop quantifying our behavior? No. But it does underscore the importance of considering why consumers engage in an activity when deciding whether to measure it. For activities people do for their own sake, it may be better not to know.

DATA COLLECTION INFORMATION

The author supervised data collection by lab managers in two locations: the Wharton Behavioral Lab (experiments 1, 4, and 6) and the Cornell Behavioral Lab (experiments 2, 3, and 4). The author collected the data for experiment 5 on Amazon's Mechanical Turk. Experiments 1, 3, 4, and 6 were run in fall and winter 2014, experiment 2 was run in spring 2015, and experiment 5 was run in summer 2015. The author analyzed the data, with input and advice from colleagues.

REFERENCES

Amir, On and Dan Ariely (2008), "Resting on Laurels: The Effects of Discrete Progress Markers as Subgoals on Task Performance and Preferences," *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 34 (5), 1158–71.

Azar, Beth (2014), "QnAs with Davis Masten and Peter Zandan," *Proceedings of the National Academy of Science,* 111 (5), 1662–3.

Babin, Barry J., William R. Darden, and Mitch Griffin (1994), "Work and/or Fun: Measuring Hedonic and Utilitarian Shopping Value," *Journal of Consumer Research*, 20 (March), 644–56.

Birch, Leann L., Diane W. Marlin, and Laurie Kramer (1982), "Effects of Instrumental Eating on Children's Food Preferences," *Appetite*, 3 (2), 125–34.

Bratava, Dena M., Crystal Smith-Spangler, Vandana Sundaram, Allison L. Gienger, Nancy Lin, Robyn Lewis, Christopher D. Stave, Ingram Olkin, and John R. Sirard (2007), "Using Pedometers to Increase Physical Activity and Improve Health," *JAMA*, 298 (19), 2296–2304.

Cadsby, C. Bram, Fei Song, and Francis Tapon (2007), "Sorting and Incentive Effects of Pay for Performance: An Experimental Investigation," *Academy of Management Journal*, 50 (2), 387–405.

Cheema, Amar and Rajesh Bagchi (2011), "Goal Visualization and Goal Pursuit: Implications for Consumers and Managers," *Journal of Marketing*, 75 (2), 109–23.

Choi, Jinhee and Ayelet Fishbach (2011), "Choice as an End versus a Means," *Journal of Marketing Research*, 48 (3), 544–54.

Condry, John D. and James Chambers (1978), "Intrinsic Motivation and the Process of Learning," in *The Hidden Costs of Reward: New Perspectives on the Psychology of Human Motivation*, ed. Mark R. Lepper and David Greene, Hillsdale, NJ: Erlbaum.

DeCharms, Richard (1968), *Personal Causation: The Internal Affective Determinants of Behavior*, New York: Academic Press.

Deci, Edward L. (1971), "Effects of Externally Mediated Rewards on Intrinsic Motivation," *Journal of Personality and Social Psychology,* 18 (1), 105–15.

Deci, Edward L., Richard Koestner, and Richard M. Ryan (1999), "A Meta-Analytic Review of Experiments Examining the Effects of Extrinsi Rewards in Intrinsic Motivation," *Psychological Bulletin*, 125 (November), 627–68.

Etkin, Jordan and Rebecca K. Ratner (2012), "The Dynamic Impact of Variety Among Means on Motivation," *Journal of Consumer Research*, 39 (6), 1076–92.

Farr, James L. (1976), "Incentive Schedules, Productivity, and Satisfaction in Work Groups: A Laboratory Study," *Organizational Behavior and Human Performance*, 17 (1), 159–70.

Fishbach, Ayelet and Jinhee Choi (2012), "When Thinking About Goals Undermines Goal Pursuit," *Organizational Behavior and Human Decision Processes,* 118, 99–107.

Flood, Josh (2013), "Wearable Computing Devices," ABI Research, https://www.abiresearch.com/press/wearable-computing-devices-like-apples-iwatch-will/.

Fox, Susannah and Maeve Duggan (2013), "Tracking for Health: Main Report," *Pew Research Center*, http://www.pewinternet.org/2013/01/28/main-report-8/.

Frey, Bruno S. (1994), "How Intrinsic Motivation is Crowded Out and In," *Rationality and Society*, 6 (7), 334–52.

Gilbert, Daniel T., Brian R. Giesler, and Kathryn A. Morris (1995), "When Compromises Arise," *Journal of Personality and Social Psychology*, 69 (2), 227–36.

Hamner, W. Clay and Lawrence W. Foster (1975), "Are Intrinsic and Extrinsic Rewards Additive: A Test of Deci's Cognitive Evaluation Theory of Task Motivation," *Organizational Behavior and Human Performance*, 14 (3), 398–415.

Hayes, Andrew F. (2013), *Introduction to Mediation, Moderation, and Conditional Process Analysis*, New York: Guilford.

Higgins, E. Tory, Jessica Lee, Joonmo Kwon, and Yaacov Trope (1995), "When Combining Intrinsic Motivations Undermines Interest: A Test of Activity Engagement Theory," *Journal of Personality and Social Psychology,* 68 (5), 749–67.

Higgins, E. Tory and Yaacov Trope (1990), "Activity Engagement Theory: Implications of Multiply Identifiable Input for Intrinsic Motivation," in *Handbook of Motivation and Cognition: Foundations of Social Behavior*, Vol. 2, ed. Higgins E. Tory and Richard M. Sorrentino, New York: Guilford, 229–64.

Hsee, Cristopher K., Adelle X. Yang, and Liangyan Wang (2010), "Idleness Aversion and the Need for Justifiable Busyness," *Psychological Science,* 21 (7), 926–30.

Hsee, Christopher K., Fang Yu, Jiao Zhang, and Yan Zhang (2003), "Medium Maximization," *Journal of Consumer Research,* 30 (1)*,* 1–14.

Hsee, Christopher K., Jiao Zhang, Cindy F. Cai, and Shirley Zhang (2013), "Overearning," *Psychological Science,* 24, 852–59.

Jackson, Douglas N. (1974), *Personality Research Form Manual,* Port Huron, MI: Research Psychologists Press.

Jenkins, G. Douglas Jr., Atul Mitra, Nina Gupta, and Jason D. Shaw (1998), "Are Financial Incentives Related to Performance? A Meta-Analytic Review of Empirical Research," *Journal of Applied Psychology*, 83 (5), 777–87.

Kahneman, Daniel, Alan B. Krueger, David A. Schkade, Norbert Schwarz, and Arthur A. Stone (2004), "A Survey Method for Characterizing Daily Life Experience: The Day Reconstruction Method," *Science,* 306 (December), 1776–80.

Keinan, Anat and Ran Kivetz (2011), "Consumption of Collectable Experiences," *Journal of Consumer Research,* 37 (6), 935–50.

Kivetz, Ran, Oleg Urminsky, and Yuhuang Zheng (2006), "The Goal-Gradient Hypothesis Resurrected: Purchase Acceleration, Illusionary Goal Progress, and Customer Retention," *Journal of Marketing Research*, 42 (1), 39–58.

Kohn, Alfie (1993), *Punished by Rewards*, New York: Houghton Mifflin.

Koo, Minjung and Ayelet Fishbach (2010), "A Silver Lining of Standing in Line: Queuing Increases Value of Products," *Journal of Marketing Research*, 47 (4), 713–24.

—— (2012), "The Small-Area Hypothesis: Effects of Progress Monitoring on Goal Adherence," *Journal of Consumer Research*, 39 (3), 493–509.

Kruglanski, Arie W. (1975), "The Endogenous-Exogenous Partition in Attribution Theory," *Psychological Review,* 82, 387–406.

Kruglanski, Arie W., Sarah Alon, and Tirtzah Lewis (1972), "Retrospective Misattribution and Task Enjoyment," *Journal of Experimental Social Psychology,* 8 (6), 493–501.

Kruglanski, Arie W., Irith Friedman, and Gabriella Zeevi (1971), "The Effects of Extrinsic Incentive on Some Qualitative Aspects of Task Performance," *Journal of Personality,* 39 (4), 606–17.

Kruglanski, Arie W., Aviah Riter, Asher Amitai, Bath-Shevah Margolin, Leorah Shabtai, and Daliah Zaksh (1975), "Can Money Enhance Intrinsic Motivation? A Test of the Content Consequences Hypothesis," *Journal of Personality and Social Psychology,* 31 (4), 744–50.

Laran, Juliano and Chris Janiszewski (2010), "Work or Fun? How Task Construal and Completion Influence Regulatory Behavior," *Journal of Consumer Research*, 37 (April), 967–83.

Lawler, Edward E. (1971), *Pay and Organizational Effectiveness*, New York: McGraw-Hill.

—— (1973), *Motivation in the Work Place*, Monterey, CA: Brooks/Cole.

Lazer, David, Alex Pentland, Lada Adamic, Sinan Aral, Albert L. Barabasi, Devon Brewer, Nicholas Christakis, Noshir Contractor, James Fowler, Myron Gutmann, Tony Jebara, Gary King, Michael Macy, Deb Roy, and Marshall Van Alstyne (2009), "Life in the Network: The Coming Age of Computational Social Science," *Science,* 323, 721–73.

Lazear, Edward P. (1999), "Output-Based Pay: Incentives or Sorting?" *National Bureau of Economic Research,* 7419, working paper.

—— (2000), "The Power of Incentives," *The American Economic Review,* 90 (2), 410–14.

Lee, Leonard and Clare Tsai (2014), "The Immediate and Delayed Effects of Price Promotions on Post-Purchase Consumption Experience," *Journal of Consumer Research*, 40 (February), 943–59.

Lepper, Mark R. (1981), "Intrinsic and Extrinsic Motivation in Children: Detrimental Effects of Superfluous Social Controls," in *Aspects of the Development of Competence: The Minnesota Symposium on Child Psychology*, Vol. 14, ed. Andrew W. Collins, Hillsdale, NJ: Erlbaum, 155–213.

Lepper, Mark R. and David Greene (1975), "Turning Play into Work: Effects of Adult Surveillance and Extrinsic Rewards on Children's Intrinsic Motivation," *Journal of Personality and Social Psychology*, 31 (3), 479–86.

Lepper, Mark R., David Greene, and Richard E. Nisbett (1973), "Undermining Children's Intrinsic Interest with Extrinsic Rewards: A Test of the "Overjustification" Hypothesis," *Journal of Personality and Social Psychology,* 28 (1)*,* 129–37.

Locke, Edwin A., Dena B. Feren, Vicki M. McCaleb, Karyll N. Shaw, and Anne T. Denny (1980), "The Relative Effectiveness of Four Methods of Motivating Employee Performance," *Changes in Working Life*, 363 (1), 363–88.

Maimaran, Michal and Ayelet Fishbach (2014), "If It's Useful and You Know It, Do You Eat It? Preschoolers Refrain from Instrumental Food," *Journal of Consumer Research*, 41 (October), 642–54.

Mogilner, Cassie (2010), "The Pursuit of Happiness: Time, Money, and Social Connection," *Psychological Science,* 21 (September), 1348–54.

Morgan, Mark (1981), "The Overjustification Effect: A Developmental Test of Self-Perception Interpretations," *Journal of Personality and Social Psychology,* 40 (5), 809–21.

Morwitz, Vicki G. and Gavan J. Fitzsimons (2004), "The Mere-Measurement Effect: Why Does Measuring Intentions Change Actual Behavior?" *Journal of Consumer Psychology*, 14 (1&2), 64–73.

Morwitz, Vicki G., Eric Johnson, and David Schmittlein (1993), "Does Measuring Intent Change Behavior?" *Journal of Consumer Research*, 20 (1), 46–61.

Muraven, Mark, Marylène Gagné, and Heather Rosman (2008), "Helpful Self-Control: Autonomy Support, Vitality, and Depletion," *Journal of Experimental Social Psychology*, 44 (May), 573–85.

Norton, Michael I., Daniel Mochon, and Dan Ariely (2012), "The IKEA Effect: When Labor Leads to Love," *Journal of Consumer Psychology*, 22, 453–60.

Patel, Mitesh S., David A. Asch, and Kevin G. Volpp (2015), "Wearable Devices as Facilitators, Not Drivers, of Health Behavior Change," *JAMA*, 313 (5), 459–60.

Poole, Erika S. (2013), "HCI and Mobile Health Interventions," *Translational Behavioral Medicine,* 3 (4), 402–5.

Redden, Joseph P. (2008), "Reducing Satiation: The Role of Categorization Level," *Journal of Consumer Research*, 34 (February), 624–34.

Ryan, Richard M. and Edward L. Deci (2000), "Intrinsic and Extrinsic Motivations: Classic Definitions and New Directions," *Contemporary Educational Psychology*, 25 (1), 54–67.

Shalev, Edith and Vicki G. Morwitz (2013), "Does Time Fly When You're Counting Down? The Effect of Counting Direction on Subjective Time Judgement," *Journal of Consumer Psychology*, 23 (2), 220–27.

Shiv, Baba and Joel Huber (2000), "The Impact of Anticipating Satisfaction on Consumer Choice," *Journal of Consumer Research*, 27 (2), 202–16.

Soman, Dilip and Mengze Shi (2003), "Virtual Progress: The Effect of Path Characteristics on Perceptions of Progress and Choice," *Management Science*, 49 (9), 1129–51.

Spence, John C., Jenny Burgess, Wendy Rodgers, and Terra Murray (2009), "Effect of Pretesting on Intentions and Behaviour: A Pedometer and Walking Intervention," *Psychology & Health*, 24 (7), 777–89.

Topol, Eric J. (2013), *The Creative Destruction of Medicine*, New York: Basic Books.

Weber, Elke U. and Eric J. Johnson (2006), "Constructing Preferences from Memories," in *The Construction of Value*, ed. Lichtenstein Sarah and Paul Slovic, New York: Cambridge University Press, 37–410.

Werle, Carolina O. C., Brian Wansink, and Collin R. Payne (2014), "Is It Fun or Exercise? The Framing of Physical Activity Biases Subsequent Snacking," *Marketing Letters*, 1–12.

Wiersma, Uco J. (1992), "The Effects of Extrinsic Rewards in Intrinsic Motivation: A Meta-Analysis," *Journal of Occupational and Organizational Psychology*, 65 (2), 101–14.

Wilson, Timothy D. and Daniel T. Gilbert (2008), "Explaining Away: A Model of Affective Adaptation," *Perspectives on Psychological Science*, 3 (5), 370–86.

Wimperis, Bruce R. and James L. Farr (1979), "The Effects of Task Content and Reward Contingency upon Task Completion and Satisfaction," *Journal of Applied Social Psychology*, 9 (3), 229–49.

Wrzesniewski, Amy, Barry Schwartz, Xiangyu Cong, Michael Kane, Audrey Omar, and Thomas Kolditz (2014), "Multiple Types of Motives Don't Multiply the Motivation of West Point Cadets," *Proceedings of the National Academy of Sciences*, 111 (30), 10990–95.