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Self-tracking in effortful activities: Gender differences in consumers' task experience

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Abstract

Despite the increasing use of self-tracking technologies, surprisingly little empirical research has examined the effect of self-tracking in effortful activities on consumers' task experience. Accordingly, the present research examined the moderating role of gender in the effect of self-tracking in effortful activities on perceived competence and task experience (namely, enjoyment and subjective vitality). Across three experiments, results suggested that self-tracking in effortful activities increases the perceived competence, enjoyment, and subjective vitality of females more than males, and that perceived competence explains these interaction effects. Interestingly, an experimental manipulation designed to prompt overestimation of abilities attenuated these positive effects among females. As such, the present research contributes to the literatures on self-tracking and feedback instrumentality, and offers important practical implications for marketers.

1 | INTRODUCTION

Self-tracking—or the use of modern technologies to track and collect personal information in numerical form—has become a common practice for many consumers (Ajana, 2018) who embrace technologies such as activity trackers and apps in their daily life. Regardless of whether the activity is relatively effortless (e.g., walking) or more challenging (e.g., running), consumers are generating and obtaining more information about their behavior now than ever before (Etkin, 2016), which presents new opportunities for consumers (in the form of self-knowledge) and marketers (in the form of consumer data).

Although self-tracking seems to be appealing, recent research has suggested that there is a hidden cost to this practice. Specifically, with relatively effortless activities (e.g., coloring simple shapes) self-tracking can reduce consumers' task experience (such as enjoyment) by making such activities feel more like work (Etkin, 2016). As a positive experience is critical for consumers' task involvement (Kim, Fiore, & Lee, 2007), performance (Puca & Schmalt, 1999), and psychological wellness (Sanz-Vergel & Rodríguez-Muñoz, 2013), this hidden cost might raise an important concern among those who market self-tracking products.

However, it is unclear whether self-tracking has a uniformly negative impact on consumers' task experience in more challenging (i.e., effortful) activities. Moreover, it is unclear whether self-tracking has a consistent impact on different segments of the consumer population, such as females versus males. It is a well-established finding that external events that convey a sense of perceived competence can increase enjoyment (Deci, Koestner, & Ryan, 1999). In addition, a sense of perceived competence can be more salient while performing effortful, rather than effortless, activities (Jung, Schneider, & Valacich, 2010). Therefore, it is possible that as a form of feedback, self-tracking can have a positive impact on consumers' task experience in effortful activities when the feedback conveys a sense of perceived competence to the consumer.

Further, this positive impact might be stronger among females because they seem to be more likely than males to underestimate their competence and see feedback as an opportunity to gain information about their competence. Such moderation by gender can be

inferred from previous studies. For example, Buser, Geijtenbeek, and Plug (2018) found that males report higher confidence in a calculation-related task than females, which (although not measured directly) suggests that females have a tendency to underestimate themselves. On the other hand, Corpus and Lepper (2007) found that praise for a task outcome enhances the desire to continue the task among girls but not boys, which suggests that females have a tendency to perceive feedback as more informational than males. Although self-tracking can undermine consumers' enjoyment in effortless activities (Etkin, 2016), the present research examined whether consumers (especially females) will report more positive task experience (namely, enjoyment and subjective vitality) with self-tracking in effortful activities. The authors used self-determination theory (Ryan & Deci, 2017) and one of its mini-theories (specifically, cognitive evaluation theory) to guide their reasoning and hypotheses.

By identifying the effect of self-tracking on task experience while different segments of the consumer population are engaged in effortful activities, the present research will make several important contributions to the literature. First, although previous research on self-tracking has shown considerable interest in the consequences of self-tracking (e.g., activity output, health benefit, and anticipated motivation; Cadmus-Bertram, Marcus, Patterson, Parker, & Morey, 2015; Jakicic et al., 2016; Pettinico & Milne, 2017), little attention has been given to the experiential side of self-tracking. Also, the extant literature is limited to the impact of self-tracking in effortless activities (e.g., walking, eating; Etkin, 2016; Weathers, Siemens, & Kopp, 2017). Therefore, the present research will extend the self-tracking literature by investigating the effect of self-tracking on consumers' task experience in effortful activities.

Second, the present research investigated the role of a consumer characteristic (namely, gender) in the effect of self-tracking on consumers' task experience. Gender has not been widely investigated in relation to consumers' task experience, and to the authors' knowledge the present research is the first to examine the moderating role of gender in the effect of self-tracking on task experience. Therefore, the present research will add to the literature on gender differences.

Third, the present research examined how external feedback influences consumers' psychological needs and experiences. Much of the previous research on feedback instrumentality has focused on verbal feedback (Deci et al., 1999), text-based feedback (Heslin & Latham, 2004), or end-task feedback (Zhou, 1998), and so the effect of non-verbal, numeric, in-task feedback (especially from a non-human source) on consumers is not known. Therefore, the present research will contribute to this line of inquiry by identifying self-tracking as an emerging feedback intervention that can affect consumers' perceived competence and task experience in effortful activities.

Fourth, the present research will provide important strategical insights that can help firms such as gyms and sports centers improve consumers' task experience while training or exercising through the introduction of self-tracking technologies (e.g., activity trackers) or through the addition of self-tracking features to their existing products (e.g., workout equipment). Findings from the present research might also aid marketers in identifying consumer segments for whom self-tracking technologies can have a positive impact on consumers' task experience.

2 | THEORETICAL FRAMEWORK AND HYPOTHESES

2.1 | Self-determination theory

As a macro-theory of human motivation, self-determination theory (SDT; Ryan & Deci, 2017) is concerned with how social-contextual factors can influence people's thriving through the satisfaction of their basic psychological needs for autonomy, competence, and relatedness. In SDT, autonomy refers to an experience of volition and perceiving oneself as the origin of one's actions, competence refers to an experience of effectance and mastery, and relatedness refers to an experience of meaningful connection with important others (Sørebø, Halvari, Gulli, & Kristiansen, 2009). According to SDT, the satisfaction (vs. frustration) of these three needs has an impact on people's psychological experience, including their motivation, vitality, and well-being (Baard, Deci, & Ryan, 2004; Deci & Ryan, 2000).

Cognitive evaluation theory (CET) is a mini-theory within SDT that examines the factors that facilitate or undermine intrinsic motivation via their impact on the basic psychological needs. In the present research, the authors focused on perceived competence, as self-tracking often offers a reasonably high level of user autonomy (e.g., allows the user to decide what to track and when to track it). According to CET, external feedback will affect people's enjoyment to the extent that the feedback influences their perceived competence at a given activity (Ryan & Deci, 2017), such that feedback that promotes perceived competence will enhance enjoyment. CET suggests that feedback that promotes perceived competence will enhance another important aspect of task experience as well, namely, subjective vitality (Mouratidis, Vansteenkiste, Lens, & Sideridis, 2008; Ryan & Deci, 2008). Therefore, self-tracking as a form of feedback can have a positive effect on consumers' task experience in effortful activities to the extent that self-tracking enhances their perceived competence.

2.2 | Self-tracking and perceived competence in effortful activities

Self-tracking refers to the monitoring of consumers' everyday lives in order to measure and quantify their activities (Whitson, 2013). In this way, self-tracking provides numerical feedback to consumers about their behavioral output (e.g., number of steps) (Etkin, 2016). Such feedback is immediate, cumulative, and manifested as an increasing value, which can give consumers a sense of competence and accomplishment (Earley, Northcraft, Lee, & Lituchy, 1990).

According to Shen and Hsee (2017), people respond positively to increasing values that are linked to their behaviors (e.g., word typing). Karapanos, Gouveia, Hassenzahl, and Forlizzi (2016) also argue that numerical feedback can be rewarding (e.g., increasing health-related

values can make people feel healthier) because people have a tendency to focus on the immediate outcome rather than the more remote, fundamental outcome. In this way, people are sensitive to the existence of a medium—a proxy representation of a more fundamental value (Hsee, Yu, Zhang, & Zhang, 2003). Similarly, self-tracking feedback can act as such a medium during a given task, which can facilitate positive outcomes. For instance, if one is running in order to become healthy (fundamental value), then the number of kilometers (medium) that one has run can be perceived as a proxy representation of their healthiness. As this number increases, consumers are likely to perceive that their behavior (running) is conducive to achieving their fundamental value of health, which can boost their perceived competence in running.

However, this positive impact of self-tracking on perceived competence is likely to be more prominent in effortful (vs. effortless) activities, which are associated with subjective tiredness and task difficulty, and are more mentally and/or physically demanding (Critchley, Corfield, Chandler, Mathias, & Dolan, 2000). For example, holding a pressure bulb with a consistently high amount of pressure is effortful, whereas holding it with a low amount of pressure is effortless and, thus, is not associated with subjective tiredness or task difficulty. In other words, effortful activities require focused attention and conscious control or effort (e.g., solving 23×12), whereas effortless activities can be performed without awareness of complex information processing (e.g., counting from 1 to 5) (Dehaene, Kerszberg, & Changeux, 1998). Indeed, the challenges represented in effortful activities provide an environmental condition for affecting one's perceived competence (Jung et al., 2010), and self-tracking feedback can have an impact on this need. For instance, self-tracking feedback (e.g., number of solved math problems) is likely to be more relevant to a college student's perceived competence when solving college-level math (effortful activity) relative to elementary math (effortless activity).

Additionally, the completion of an activity that requires a high (vs. low) level of effort is likely to serve as a stronger indication of one's competence (Bandura, 1982; Jagacinski & Nicholls, 1987), as such accomplishments require more complete skill development. Hsee et al. (2003) also argued that the accumulation of a medium (e.g., points), especially when doing so requires effort, is likely to yield a sense of accomplishment, competence, and enjoyment. Continuing with the previous example, for most college students self-tracking feedback can better serve to indicate competence while solving college-level math relative to elementary math. Therefore, by signaling one's level of accomplishment through numerical feedback, self-tracking can positively influence perceived competence in effortful activities.

2.3 | The moderating role of gender

The authors theorized, further, that the positive impact of self-tracking on perceived competence in effortful activities is likely to be stronger among females than males, as females are more likely than males to underestimate their competence (i.e., to be more modest or less confident), whereas males are more likely than females to overestimate their competence (Buser et al., 2018; Dasgupta, Mani, Sharma, & Singhal, 2019; Herbert & Stipek, 2005; Pajares, 2002). Thus, the provision of feedback (e.g., in the form of self-tracking) is expected to affect females and males in different ways (Roberts & Nolen-Hoeksema, 1989).

Previous research has shown that females and males differ in their perceptions of the informational value of feedback. For example, females are more likely than males to perceive feedback as informative about their competence (Roberts, 1991), whereas males are more likely than females to rely on their own internal standards and discount the value of feedback (Corpus & Lepper, 2007). Therefore, self-tracking in effortful activities might have a more positive impact on females' perceived competence, relative to males. Without clear feedback, females' perceived competence in effortful activities might suffer because of their tendency to underestimate themselves. In other words, self-tracking feedback might help females to more accurately assess their abilities and to realize their true capabilities, as sufficiently clear and verifiable information can eliminate self-evaluation bias (Jussim, Coleman, & Nassau, 1987).

In contrast, males might perceive self-tracking feedback as less informational, as they tend not to use external feedback when assessing their abilities (Dweck, Davidson, Nelson, & Enna, 1978). Additionally, self-tracking feedback might even prompt males to realize that they are not as capable as initially thought and be at odds with their tendency to overestimate their abilities, thereby leaving males with a sense of less—albeit more accurate—perceived competence in effortful activities. Hence, self-tracking feedback is expected to have a weaker positive impact, if any at all, on males' perceived competence in effortful activities.

Hypothesis 1 *Gender will moderate the effect of self-tracking in effortful activities on perceived competence, such that self-tracking in effortful activities will increase the perceived competence of females more than males.*

2.4 | Task experience: Enjoyment

As positive experiences are important for consumers' psychological wellness (Sanz-Vergel & Rodríguez-Muñoz, 2013), the present research examined the downstream effects of self-tracking in effortful activities on consumers' task experience. Although Etkin (2016) found a negative effect of self-tracking on enjoyment, it is possible that this effect differs across various types of tasks. Herein, the authors argued that self-tracking in effortful activities can have a positive impact on enjoyment by promoting perceived competence, which facilitates the enjoyment of tasks (Deci et al., 1999). Indeed, Ryan, Mims, and Koestner (1983) asserted that external events such as feedback can differ in their functional significance. Whereas controlling events tend to be perceived as pressuring or coercive toward a particular outcome, informational events affirm an individual's self-determined competence (Promberger & Marteau, 2013; Ryan & Deci, 2000a). Importantly, external events that are perceived as informational are

conducive to enjoyment. Therefore, it stands to reason that self-tracking in effortful (relative to effortless) activities can have a positive impact on enjoyment because its associated feedback is likely to be perceived as informational.

In Etkin's (2016) research, it is likely that self-tracking in effortless activities was not perceived as informational, as feedback on the completion of easy activities does not indicate a sense of perceived competence. In contrast, feedback on the completion of more difficult activities can be used to indicate a sense of perceived competence. If true, then self-tracking feedback in effortful activities might be perceived as more informational than self-tracking feedback in effortless activities. Therefore, as perceived competence is associated with enjoyment (Ryan & Deci, 2000b), the authors proposed that self-tracking feedback can have a positive effect on enjoyment in effortful activities via perceived competence, and that this indirect effect will be stronger for females than males.

Hypothesis 2a *Gender will moderate the effect of self-tracking in effortful activities on enjoyment, such that self-tracking in effortful activities will increase the enjoyment of females more than males.*

Hypothesis 2b *Perceived competence will mediate the moderating role of gender in the effect of self-tracking in effortful activities on enjoyment.*

2.5 | Task experience: Subjective vitality

A positive experience is more than just enjoyment (Kwan & Bryan, 2010). Accordingly, it is important to examine how self-tracking feedback affects another aspect of task experience, namely, subjective vitality. Subjective vitality refers to an experience of positive energy that is available to the self (Chen & Sengupta, 2014). In general, engagement in effortful activities can deplete energy, as exerting effort on a cognitively/physically demanding task consumes cognitive/physical resources (Dragone, 2009). Accordingly, engagement in effortful activities can reduce subjective vitality, and indeed people are likely to experience less subjective vitality when they are cognitively or physically fatigued (Johnson, 2008; Ryan & Deci, 2017).

Yet it is possible that the depleting effect of engagement in effortful activities can be mitigated by support for perceived competence (Singh et al., 2005; Solberg, Hopkins, Ommundsen, & Halvari, 2012), and subjective vitality can be enhanced by engagement in activities that support the need for competence (Ryan & Deci, 2008). For example, previous research has revealed a positive association between perceived competence and subjective vitality even in activities that are highly effortful (e.g., soccer, physical activity; Adie, Duda, & Ntoumanis, 2012; Taylor & Lonsdale, 2010). In a similar way, it stands to reason that self-tracking in effortful activities can have a positive impact on subjective vitality because its associated feedback is likely to be perceived as informational, and thus affirming of perceived competence. Therefore, the authors proposed that self-tracking feedback can have a positive effect on subjective vitality in effortful activities via perceived competence, and that this indirect effect will be stronger for females than males.

Hypothesis 3a *Gender will moderate the effect of self-tracking in effortful activities on subjective vitality, such that self-tracking in effortful activities will increase the subjective vitality of females more than males.*

Hypothesis 3b *Perceived competence will mediate the moderating role of gender in the effect of self-tracking in effortful activities on subjective vitality.*

If, as suggested above, self-tracking feedback has a more positive effect on females than males because of their tendency to underestimate themselves, then exposing females to an experimental manipulation that is designed to prompt overestimation would be expected to attenuate this effect. Therefore, the authors proposed that overestimation can reduce the positive effect of self-tracking feedback on perceived competence and task experience in effortful activities among females but not males.

Hypothesis 4 *Overestimation will moderate the interaction of gender and self-tracking in effortful activities on perceived competence, enjoyment, and subjective vitality, such that the positive effects of self-tracking among females will be reduced among those who are prompted to overestimate themselves.*

Figure 1 presents the conceptual model for the present research.

3 | METHODOLOGICAL APPROACH

3.1 | Experiment 1

Experiment 1 examined the moderating role of gender in the effect of self-tracking in effortful activities on perceived competence (Hypothesis 1).

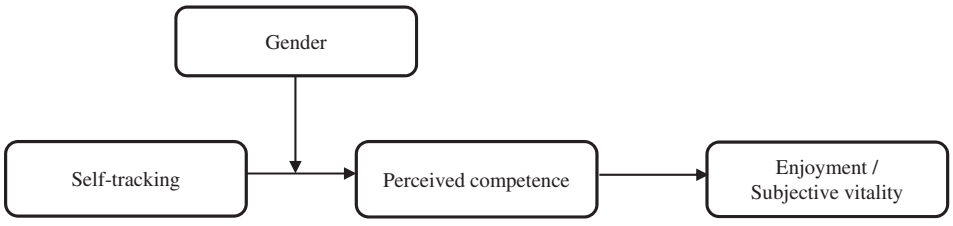

FIGURE 1 Conceptual model for the present research

3.1.1 | Design and method

Amazon's Mechanical Turk (MTurk) was used as the platform for data collection in the present research, as MTurk can be used to obtain high-quality data in a way that is rapid and inexpensive. Indeed, previous research has shown that data collected through MTurk are at least as reliable as data collected through more traditional methods (Buhrmester, Kwang, & Gosling, 2016; Kees, Berry, Burton, & Sheehan, 2017).

Participants were 222 (114 female, 108 male) adults who resided in the United States. Participants were randomly assigned to either a self-tracking condition or a control condition, and then engaged in a riddle-solving task for 6 min (see Appendix S1). The only difference between the experimental conditions was the self-tracking feedback that was received. More specifically, in the self-tracking condition participants were presented with numerical data on their number of attempts and number of correct answers in the top right corner of the screen. In the control condition, an image icon of comparable size was displayed in the same place on the screen but no numerical data was presented. Participants in both conditions were given basic feedback on whether or not they solved each riddle correctly. After the riddle-solving task, participants provided responses to two self-reported measures.

The perceived competence subscale of the Intrinsic Motivation Inventory (see Ryan, 1982) assessed perceived competence (four items; e.g., I think I am pretty good at riddles). Responses were made on a 7-point scale from 1 (*strongly disagree*) to 7 (*strongly agree*). The reliability for this measure was $\alpha = 0.96$.

Task effort was assessed using the items from the study of Jussim, Soffin, Brown, Ley, and Kohlhepp (1992; e.g., I exerted a lot of effort in trying to solve these riddles in the riddle session). Responses were made on a 5-point scale from 1 (*strongly disagree*) to 5 (*strongly agree*). The reliability for this measure was $\alpha = 0.82$.

3.1.2 | Results

Task effort. Participants in both experimental conditions exerted a statistically equivalent and moderately high amount of effort during the riddle-solving task ($M_{\text{self-tracking}} = 3.60$, $SD = 0.98$ vs. $M_{\text{control}} = 3.67$, $SD = 0.92$; F (1, 220) = 0.36, $p = .55$), thereby suggesting that the activity was perceived as effortful.

Perceived competence. Hypothesis 1 posited that self-tracking in effortful activities will increase the perceived competence of females more than males. As shown in Figure 2, this prediction was supported, as a 2 (experimental condition) × 2 (gender) Analysis of variance (ANOVA) revealed a significant interaction on perceived competence (F (1, 218) = 8.49, $p < .01$ [one-tailed]), and even after controlling for task performance or the ratio between number of correct answers and number of attempts (F (1, 217) = 4.16, $p = .02$ [one-tailed]). Among females, self-tracking increased their perceived competence ($M_{\text{self-tracking}} = 3.97$, $SD = 1.63$ vs. $M_{\text{control}} = 3.11$, $SD = 1.29$; $p < .01$ [one-tailed]). Among males, self-tracking had no effect on their perceived competence ($M_{\text{self-tracking}} = 3.60$, $SD = 1.40$ vs. $M_{\text{control}} = 3.86$, $SD = 1.45$; $p = .32$).

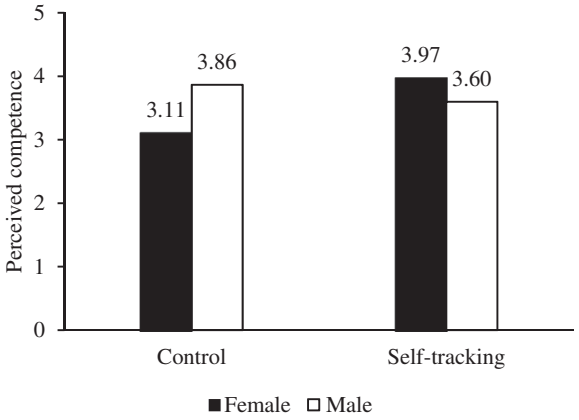

FIGURE 2 Interaction of self-tracking and gender on perceived competence (Experiment 1)

Alternative explanation. Previous research has shown that the congruence between gender and the sex-type of an activity can affect perceived competence (Vancouver & Ilgen, 1989), such that females experience higher levels of perceived competence while completing feminine (vs. masculine) sex-typed activities (Lirgg, Chase, George, & Ferguson, 1996). If so, then the primary finding from Experiment 1 could have arisen due to differences in how females in the experimental conditions perceived the sex-type of the riddle-solving task.

To examine this alternative explanation, participants responded to the question, How would you rate the riddle-solving task in terms of sex?, on a 7-point scale from 1 (*extremely feminine task*) to 7 (*extremely masculine task*). There was no significant difference between experimental conditions on the perceived sex-type of the riddle-solving task among females ($M_{\text{self-tracking}} = 3.84$, $SD = 0.99$ vs. $M_{\text{control}} = 4.05$, $SD = 0.78$; $p = .17$), which ruled out this alternative explanation.

3.1.3 | Discussion

The results of Experiment 1 revealed that self-tracking in effortful activities increases the perceived competence of females more than males, and the sex-type of the riddle-solving task did not account for this effect. As such, these findings offered initial evidence that self-tracking feedback can have a positive effect on females' perceived competence in effortful activities. To provide further support for this assertion, the authors conducted a follow-upexperiment ($N = 162$) that examined the effect of self-tracking in effortless activities on perceived competence. In this modified version of Experiment 1, the riddle-solving task was made easier for participants to solve by providing hints (e.g., "What has hands but cannot clap? Hint: clo_k"). In contrast to Experiment 1, the 2 (experimental condition) × 2 (gender) ANOVA did not reveal a significant interaction on perceived competence [F (1, 158) = 2.33, $p = .13$]. Indeed, self-tracking in effortless

activities had no effect on perceived competence among females ($M_{\text{self-tracking}}$ = 4.88, *SD* = 1.20 vs. M_{control} = 5.33, *SD* = 1.19; *p* = .09) or males ($M_{\text{self-tracking}}$ = 5.04, *SD* = 1.63 vs. M_{control} = 4.86, *SD* = 1.16; *p* = .42). Experiments 2 and 3 were conducted to examine the downstream consequences of self-tracking and their underlying mechanism.

3.2 | Experiment 2

Experiment 2 had two objectives. First, it examined the moderating role of gender in the effect of self-tracking in effortful activities on enjoyment (Hypothesis 2a) and subjective vitality (Hypothesis 3a) . Second, it examined mediated moderation models in which perceived competence mediates the moderating role of gender in the effect of self-tracking in effortful activities on enjoyment (Hypothesis 2b) and subjective vitality (Hypothesis 3b).

3.2.1 | Design and method

Participants were 226 (130 female, 96 male) adults who resided in the United States. Self-tracking was operationalized in the same way as Experiment 1, and participants engaged in a math-solving task for 7 min (see Appendix S2). After the math-solving task, participants provided responses to five self-reported measures.

Perceived competence was assessed in the same way as Experiment 1. The reliability for this measure was α = 0.95.

The interest/enjoyment subscale of the Intrinsic Motivation Inventory (see Ryan, 1982) assessed enjoyment (four items; e.g., I enjoyed solving the riddles very much). Responses were made on a 7-point scale from 1 (*strongly disagree*) to 7 (*strongly agree*). The reliability for this measure was α = 0.96.

A modified version of the Subjective Vitality Scale (Ryan & Frederick, 1997) assessed subjective vitality (four items; e.g., Now that I am finished with the riddle session, I feel alive, and vital). Responses were made on a 7-point scale from 1 (*strongly disagree*) to 7 (*strongly agree*). The reliability for this measure was α = 0.95.

Single items were used to assess task challenge (To what extent did you find the math problems challenging to solve?) and prior task experience (To what extent have you had experience with solving math problems before participating in this experiment?). Responses were made on a 7-point scale from 1 (*not at all*) to 7 (*completely*).

3.2.2 | Results

Task challenge. Participants in both experimental conditions reported a statistically equivalent and moderately high amount of challenge during the math-solving task ($M_{\text{self-tracking}}$ = 4.98, *SD* = 1.31 vs. M_{control} = 5.21, *SD* = 1.08; *F* (1, 224) = 2.02, *p* = .16), thereby suggesting that the activity was perceived as effortful.

Perceived competence. As in Experiment 1, a 2 (experimental condition) × 2 (gender) ANOVA revealed a significant interaction on perceived competence (*F* (1, 222) = 4.18, *p* = .02 [one-tailed]), and even after controlling for prior task experience (*F* (1, 221) = 4.24, *p* = .02 [one-tailed]). Among females, self-tracking increased their perceived competence ($M_{\text{self-tracking}}$ = 4.56, *SD* = 1.31 vs. M_{control} = 3.89, *SD* = 1.58; *p* < .01 [one-tailed]). Among males, self-tracking had no effect on their perceived competence ($M_{\text{self-tracking}}$ = 4.29, *SD* = 1.56 vs. M_{control} = 4.41, *SD* = 1.29; *p* = .68).

Enjoyment. Hypothesis 2a posited that self-tracking in effortful activities will increase the enjoyment of females more than males. As shown in Figure 3, this prediction was supported, as a 2 (experimental condition) × 2 (gender) ANOVA revealed a significant interaction on enjoyment (*F* (1, 222) = 12.80, *p* < .01 [one-tailed]). Among females, self-tracking increased their enjoyment ($M_{\text{self-tracking}}$ = 5.06, *SD* = 1.31 vs. M_{control} = 4.17, *SD* = 1.74; *p* < .01 [one-tailed]). Among males, self-tracking marginally decreased their enjoyment ($M_{\text{self-tracking}}$ = 4.29, *SD* = 1.64 vs. M_{control} = 4.84, *SD* = 1.33; *p* = .07).

Subjective vitality. Hypothesis 3a posited that self-tracking in effortful activities will increase the subjective vitality of females more

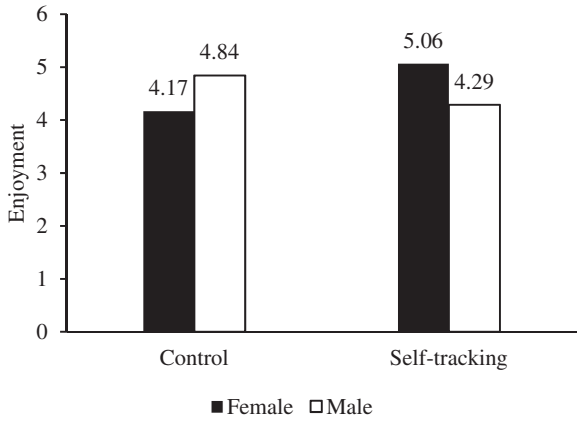

FIGURE 3 Interaction of self-tracking and gender on enjoyment (Experiment 2)

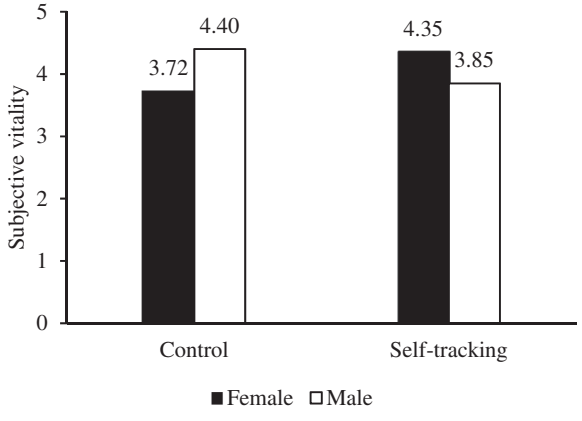

FIGURE 4 Interaction of self-tracking and gender on subjective vitality (Experiment 2)

than males. As shown in Figure 4, this prediction was supported, as a 2 (experimental condition) × 2 (gender) ANOVA revealed a significant interaction on subjective vitality (F (1, 222) = 10.46, p < .01 [one-tailed]). Among females, self-tracking increased their subjective vitality ($M_{\text{self-tracking}}$ = 4.35, SD = 1.30 vs. M_{control} = 3.72, SD = 1.46; p < .01 [one-tailed]). Among males, self-tracking decreased their subjective vitality ($M_{\text{self-tracking}}$ = 3.85, SD = 1.39 vs. M_{control} = 4.40, SD = 1.25; p = .05).

Underlying mechanism. Hypotheses 2b and 3b posited that perceived competence will mediate the moderating role of gender in the effect of self-tracking in effortful activities on enjoyment and subjective vitality. These predictions were supported, as with 10,000 resamples the results of a mediated moderation analysis (Hayes, 2013) yielded a 95% bias-corrected confidence interval that did not include zero for either enjoyment {−0.9006, −0.0286} or subjective vitality {−0.6395, −0.0224}.

3.2.3 | Discussion

The results of Experiment 2 revealed that self-tracking in effortful activities increases the perceived competence, enjoyment, and subjective vitality of females more than males, and that perceived competence explains the moderating role of gender in the effect of self-tracking in effortful activities on these downstream consequences (mediated moderation). It is interesting to note that although females and males did not differ in performance on the math-solving task (F < 1), females had lower levels of performance expectancy than males prior to the task (M_{female} = 6.54, SD = 3.23 vs. M_{male} = 8.66, SD = 6.66; F (1, 224) = 9.99, p < .01). Thus, it seems that females might be more likely to underestimate themselves and, as a result, perceive self-tracking feedback as informational and affirming of their self-determined competence, which could explain the moderating role of gender in the effect of self-tracking in effortful activities on perceived competence and task experience. Experiment 3 was conducted to provide evidence for this assertion.

3.3 | Experiment 3

Experiment 3 examined the effect of an experimental manipulation that is designed to prompt overestimation on the positive effect of self-tracking feedback on perceived competence and task experience in effortful activities among females.

3.3.1 | Design and method

Participants were 327 (205 female, 122 male) adults who resided in the United States. The cover story for this study was that the authors were developing an app for a word-scramble quiz and wanted to evaluate the app for proper functioning. Participants were invited to get familiar with the word-scramble quiz for 3 min before moving to the main testing session. After these 3 min, participants in the experimental (overestimation) condition received positive performance feedback (You have performed better than 90% of our participants). In the control (non-overestimation) condition, participants did not receive any feedback.

Then, participants provided their expectation for performance in the main testing session (i.e., number of quizzes that one expects to solve correctly) as a manipulation check, such that those in the overestimation condition should have higher performance expectancies than those in the non-overestimation condition. Following this manipulation check, participants engaged in the word-scramble quiz for 7 min. Self-tracking was operationalized in the same way as Experiments 1 and 2 and was manipulated in the main testing session only (see Appendix S3). After the word-scramble quiz, participants provided responses to four self-reported measures.

Perceived competence was assessed in the same way as Experiments 1 and 2. The reliability for this measure was α = 0.99.

Enjoyment was assessed in the same way as Experiment 2. The reliability for this measure was α = 0.97.

Subjective vitality was assessed in the same way as Experiment 2. The reliability for this measure was α = 0.96.

Task challenge was assessed in the same way as Experiment 2.

3.3.2 | Results

Performance expectancy. The manipulation was found to be effective, as participants in the overestimation condition reported higher performance expectancies than those in the non-overestimation condition ($M_{\text{overestimation}}$ = 10.60, SD = 9.99 vs. $M_{\text{non-overestimation}}$ = 8.71, SD = 7.11; F (1, 325) = 3.85, p = .05). Moreover, the manipulation was more effective for females ($M_{\text{overestimation}}$ = 10.45, SD = 10.37 vs. $M_{\text{non-overestimation}}$ = 7.69, SD = 7.28; p = .03) than for males ($M_{\text{overestimation}}$ = 10.84, SD = 9.40 vs. $M_{\text{non-overestimation}}$ = 10.47, SD = 6.52; p = .70), which was not surprising given males' tendency to overestimate themselves. Indeed, among participants in the non-overestimation condition males reported higher performance expectancies (M = 10.47, SD = 6.52) than females (M = 7.69, SD = 7.28), p = .02. As a result, the effectiveness of the manipulation could have been muted among males.

Task challenge. Participants in both experimental conditions reported a statistically equivalent and moderately high amount of challenge during the word-scramble quiz ($M_{\text{overestimation}}$ = 5.56, SD = 1.11 vs. $M_{\text{non-overestimation}}$ = 5.40, SD = 1.25; F (1, 325) = 1.56, p = .21), thereby suggesting that the activity was perceived as effortful.

Perceived competence. Hypothesis 4 posited that overestimation will decrease the positive effect of self-tracking in effortful activities on the perceived competence of females. As shown in Figures 5 and 6, this prediction was supported, as a 2 (experimental condition: self-tracking) × 2 (gender) × 2 (experimental condition: overestimation) ANOVA revealed a significant three-way interaction on perceived competence (F (1, 319) = 2.78, p = .05 [one-tailed]). More specifically,

gender moderated the effect of self-tracking in effortful activities on perceived competence in the non-overestimation condition (F (1, 154) = 6.92, p < .01 [one-tailed]) but not in the overestimation condition (F (1, 165) = 0.19, p = .67). Consistent with Experiments 1 and 2, among females in the non-overestimation condition self-tracking increased their perceived competence ($M_{\text{self-tracking}}$ = 3.91, SD = 1.78 vs. M_{control} = 2.94, SD = 1.73; p < .01 [one-tailed]). Among males in the non-overestimation condition self-tracking had no effect on their perceived competence ($M_{\text{self-tracking}}$ = 3.84, SD = 1.92 vs. M_{control} = 4.44, SD = 1.81; p = .17; see Figure 5). In the overestimation condition, self-tracking had no effect on perceived competence among females ($M_{\text{self-tracking}}$ = 4.04, SD = 1.71 vs. M_{control} = 4.41, SD = 1.67; p = .26) or males ($M_{\text{self-tracking}}$ = 3.56, SD = 1.68 vs. M_{control} = 4.16, SD = 1.69; p = .13; see Figure 6).

Enjoyment. Hypothesis 4 posited that overestimation will decrease the positive effect of self-tracking in effortful activities on the enjoyment of females. As shown in Figures 7 and 8, this prediction was supported, as a 2 (experimental condition: self-tracking) × 2 (gender) × 2 (experimental condition: overestimation) ANOVA revealed a significant three-way interaction on enjoyment (F (1, 319) = 3.00, p = .04 [one-tailed]). More specifically, gender moderated the effect of self-tracking in effortful activities on enjoyment in the non-overestimation condition (F (1, 154) = 6.80, p < .01 [one-tailed]) but not in the overestimation condition (F (1, 165) = 0.20, p = .65). Consistent with Experiment 2, among females in the non-overestimation condition self-tracking increased their enjoyment ($M_{\text{self-tracking}}$ = 4.73, SD = 1.55 vs. M_{control} = 4.03, SD = 1.76; p = .02 [one-tailed]). Among males in the non-overestimation condition self-tracking marginally decreased their enjoyment ($M_{\text{self-tracking}}$ = 4.19, SD = 1.86 vs. M_{control} = 4.91, SD = 1.47; p = .09; see Figure 7). In the overestimation condition, self-tracking had no effect on enjoyment among females ($M_{\text{self-tracking}}$ = 4.93, SD = 1.56 vs. M_{control} = 5.27, SD = 1.31; p = .31) or males ($M_{\text{self-tracking}}$ = 4.43, SD = 1.44 vs. M_{control} = 4.97, SD = 1.35; p = .11; see Figure 8).

Subjective vitality. Hypothesis 4 posited that overestimation will decrease the positive effect of self-tracking in effortful activities on the subjective vitality of females. As shown in Figures 9 and 10, this prediction was supported, as a 2 (experimental condition: self-tracking) × 2 (gender) × 2 (experimental condition: overestimation) ANOVA revealed a significant three-way interaction on subjective

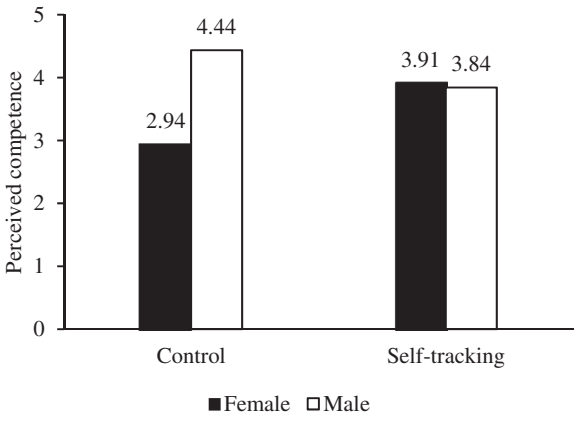

FIGURE 5 Interaction of self-tracking and gender on perceived competence in the non-overestimation condition (Experiment 3)

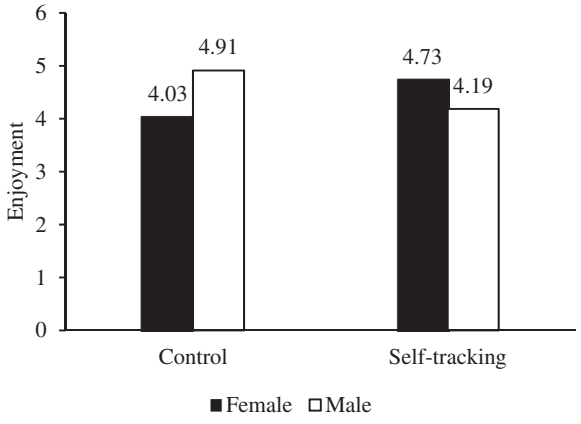

FIGURE 7 Interaction of self-tracking and gender on enjoyment in the non-overestimation condition (Experiment 3)

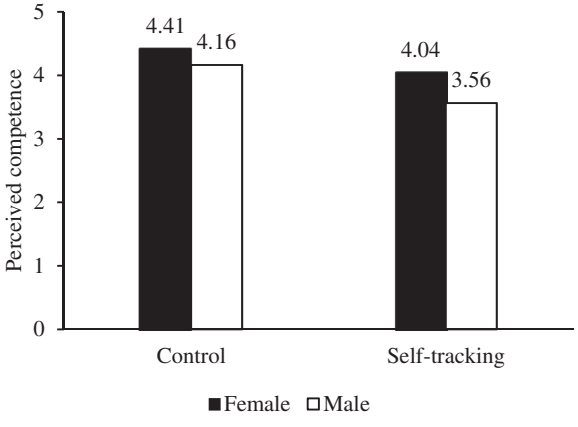

FIGURE 6 Interaction of self-tracking and gender on perceived competence in the overestimation condition (Experiment 3)

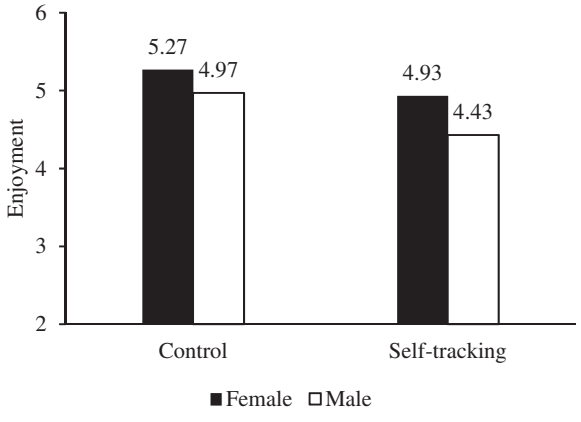

FIGURE 8 Interaction of self-tracking and gender on enjoyment in the overestimation condition (Experiment 3)

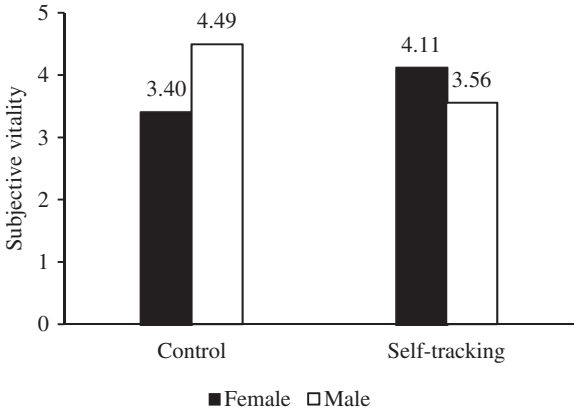

FIGURE 9 Interaction of self-tracking and gender on subjective vitality in the non-overestimation condition (Experiment 3)

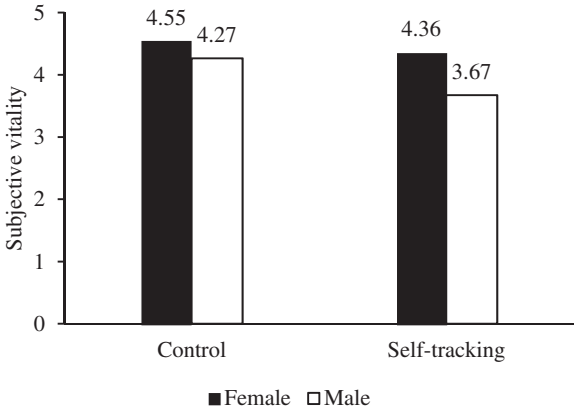

FIGURE 10 Interaction of self-tracking and gender on subjective vitality in the overestimation condition (Experiment 3)

vitality (F (1, 319) = 3.63, p = .03 [one-tailed]). More specifically, gender moderated the effect of self-tracking in effortful activities on subjective vitality in the non-overestimation condition (F (1, 154) = 10.96, p < .01 [one-tailed]) but not in the overestimation condition (F (1, 165) = 0.91, p = .34). Consistent with Experiment 2, among females in the non-overestimation condition self-tracking increased their subjective vitality ($M_{\text{self-tracking}}$ = 4.11, SD = 1.44 vs. M_{control} = 3.40, SD = 1.60; p = .01 [one-tailed]). Among males in the non-overestimation condition self-tracking decreased their subjective vitality ($M_{\text{self-tracking}}$ = 3.56, SD = 1.56 vs. M_{control} = 4.49, SD = 1.42; p = .02; see Figure 9). In the overestimation condition, self-tracking had no effect on subjective vitality among females ($M_{\text{self-tracking}}$ = 4.36, SD = 1.40 vs. M_{control} = 4.55, SD = 1.31; p = .53) and a negative effect on subjective vitality among males ($M_{\text{self-tracking}}$ = 3.67, SD = 1.47 vs. M_{control} = 4.27, SD = 1.13; p = .05; see Figure 10).

3.3.3 | Discussion

The results of Experiment 3 revealed that among females, overestimation decreases the positive effect of self-tracking in effortful activities on their perceived competence, enjoyment, and subjective vitality. In the non-overestimation condition in which females tended to underestimate themselves relative to males, self-tracking had a positive effect on perceived competence and task experience among females but not males. However, this effect was eliminated when females were prompted to overestimate themselves. Such results offer direct evidence that gender differences in self-estimation can shape the effect of self-tracking in effortful activities on perceived competence and task experience.

4 | GENERAL DISCUSSION

Despite the increasing use of self-tracking technologies, little empirical research has examined the effect of self-tracking in effortful activities on consumers' task experience. Thus, the present research was designed to begin to fill this empirical gap by investigating the effect of self-tracking among different segments of the consumer population (namely, females vs. males) while they engaged in a variety of cognitively effortful tasks (namely, riddle-solving task, math-solving task, and word-scramble quiz). A set of three experiments provided systematic support for the authors' hypotheses. In Experiment 1, self-tracking in effortful activities had a stronger positive effect on perceived competence among females than males. In Experiment 2, self-tracking in effortful activities had a stronger positive effect on enjoyment and subjective vitality among females than males, and perceived competence was shown to explain (mediate) this interaction (moderation) effect. In Experiment 3, overestimation (via an experimental manipulation) attenuated the positive effect of self-tracking in effortful activities on the perceived competence and task experience of females. Table 1 presents a summary of the three experiments.

4.1 | Theoretical contributions

It is important to consider the theoretical contributions of the present research. First, these experiments shed light on the effect of self-tracking in effortful activities. Although previous research (Etkin, 2016) revealed a negative effect of self-tracking on enjoyment, this research was limited by its focus on effortless activities only. In addition, the present research highlights the role of gender in moderating the effect of self-tracking in effortful activities on consumers' task experience, such that self-tracking in effortful activities has a positive impact on the perceived competence and task experience of females but not males. Furthermore, perceived competence explained the process whereby gender moderates the effect of self-tracking in effortful activities on task experience. To the authors' knowledge, the present research is the first to demonstrate a causal link between self-tracking in effortful activities and task experience via perceived competence among females.

Second, these experiments contribute to the literature on feedback instrumentality. Although previous research has focused considerable attention on how different types of feedback (e.g., verbal

TABLE 1 Summary of the three experiments

Experiment	Manipulation(s)	Task	Moderator	Dependent variable	Hypotheses	Sample (*N*)	Age distribution
1	Self-tracking	Riddle-solving	Gender	Perceived competence	H1	222	18–29 [25%] 30–49 [59%] >50 [16%]
2	Self-tracking	Math-solving	Gender	Task experience	H2a, H2b, H3a, H3b	226	18–29 [29%] 30–49 [56%] >50 [15%]
3	Self-tracking Overestimation	Word-scramble	Gender	Task experience	H4	327	18–29 [26%] 30–49 [56%] >50 [18%]

Note: All hypotheses were supported.

feedback, text-based feedback, or video feedback) can affect consumers (Boyer, Miltenberger, Batsche, & Fogel, 2009; Heslin & Latham, 2004; Johnson, Perlow, & Pieper, 1993), the present research examined the effect of non-verbal, numeric feedback—self-tracking feedback—on consumers' task experience. The findings suggest that self-tracking might be an important approach to influencing consumers' perceived competence, enjoyment, and subjective vitality, thereby adding to the existing constellation of external stimuli that are known to affect consumers' psychological needs and experiences.

4.2 | Practical implications

The present research has important practical implications for the use of self-tracking technologies. First, those who manufacture and market self-tracking products such as activity trackers might consider adding features that allow consumers to track effortful activities, such as swimming and boxing. Beyond physical fitness, self-tracking can be used in other effortful daily activities, such as writing, reading, and cleaning. For example, tracking the number of pages/words read might increase the enjoyment of reading, and tracking the number of objects cleaned might increase the enjoyment of cleaning. It is necessary, though, to take steps to keep such activities challenging, as among consumers with high performance expectancies self-tracking might undermine their task experience. It is critical for marketers to exercise caution when implementing feedback into their self-tracking products, as positive messages can be a source of encouragement but also can be detrimental if they promote overestimation. As described in SDT (Niemiec, Soenens, & Vansteenkiste, 2014; Niemiec & Spence, 2017; Williams et al., 2011), marketers are encouraged to use accurate, effectance-relevant feedback in order to support perceived competence.

Second, those who plan to add self-tracking as an optional feature into their products (e.g., workout equipment, sports gear) might consider marketing this feature more heavily toward females, as based on these experiments self-tracking in effortful activities has a stronger positive effect on the task experience of females. Such targeted promotion might help marketers to enhance consumer satisfaction, increase usage frequency, and facilitate brand attachment. However, this is not to suggest that self-tracking will have a uniformly beneficial effect among females. For example, when females were made to overestimate themselves in Experiment 3, self-tracking in effortful activities did not have a positive effect on their task experience. Hence, the results of the present research suggest that those who market self-tracking products might consider targeting consumers with low self-confidence at a given task, as self-tracking in effortful activities might help such individuals enhance their perceived competence and improve their task experience.

4.3 | Limitations and directions for future research

Several limitations deserve mention. First, all of the experiments in the present research were conducted via MTurk, which might have limited the representativeness of the samples (compared to the general US population). Although data obtained through MTurk are at least as reliable as data collected using more traditional methods (Buhrmester et al., 2016; Kees et al., 2017) and tend to be more demographically diverse than standard Internet samples and typical US college samples (Buhrmester et al., 2016), it is prudent to take care in generalizing these results to the broader population. Indeed, it is important for future research to replicate these findings in non-MTurk samples.

Second, the present research focused on the effect of self-tracking in *cognitively* effortful activities. Although it is reasonable to expect analogous findings in *physically* effortful activities, it is important to examine this assumption empirically. Furthermore, as the experimental tasks were likely to be perceived as fun, at least initially, it is important to examine the effect of self-tracking in boring and/or mundane activities. Indeed, self-tracking feedback might even reduce task boredom by providing interactive elements that could attenuate non-task-related mind wandering and enhance enjoyment.

Third, the present research examined the effect of self-tracking on initial task engagement. With repetitive task engagement, consumers can obtain reference points for task performance based on their own or others' experience, which can influence task experience because self-tracking feedback can be used in relation to this reference point. Reference points can even assist in the development of

more objective self-estimations, thereby buffering against overestimation, which can attenuate the negative effect of self-tracking on task experience. It is important for future research to investigate how reference points can alter the effect of self-tracking on task experience.

Finally, it is important for future research to examine the role of autonomy in relation to self-tracking. Although the authors did not intend for their experimental designs to include autonomy-thwarting features, the negative effect of self-tracking on task experience among males in Experiments 2 and 3 warrants additional investigation into the potential detrimental effect of self-tracking on perceived autonomy.

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CONFLICT OF INTERESTS

The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author, D. Jin, upon reasonable request.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of this article.

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