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The Effects of Feedback Valence and Style on Need Satisfaction, Self-Talk, and Perseverance Among Tennis Players: An Experimental Study

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Grounded in self-determination theory, this experimental study examined whether the valence (i.e., positive vs. negative) and style (i.e., autonomy-supportive vs. controlling) of normative feedback impact the self-talk, motivational experiences (i.e., psychological need satisfaction and enjoyment), and behavioral functioning (i.e., perseverance and performance) of tennis players ($N = 120$; $M_{age} = 24.50 \pm 9.86$ years). Positive feedback and an autonomy-supportive style positively influenced players' enjoyment and perseverance, with psychological need satisfaction and self-talk playing an intervening role. While positive feedback yielded its beneficial effect via greater competence satisfaction and decreased negative self-talk, the beneficial impact of an autonomy-supportive communication style was explained via greater autonomy satisfaction.

Keywords: autonomy, motivation, self-determination theory, support

A key objective of coaches is to motivate their athletes and to help them to improve their skills. One powerful way to achieve this objective is through the delivery of feedback (Wright & O'Halloran, 2013), which can be defined as the provision of competence-related information about athletes' performance on a particular task (Kluger & DeNisi, 1996). Whether athletes find coach feedback truly helpful and motivating likely depends on the type of feedback provided and on the style used to communicate the feedback. Specifically, according to self-determination theory (SDT; Deci & Ryan, 2000; Vansteenkiste, Niemiec, & Soenens, 2010), feedback will yield a motivating effect if it supports athletes' basic psychological needs for competence (i.e., feeling effective) and autonomy (i.e., experiencing a sense of volition), as the satisfaction of these needs nurtures intrinsic motivation (Deci, Koestner, & Ryan, 1999).

To better understand the mechanisms behind effects of feedback on athletes' enjoyment and behavioral functioning (i.e., perseverance and performance), this experimental study examined the role of psychological need satisfaction and self-talk. Specifically, the intervening role of these variables was examined in effects of experimentally manipulated feedback valence (i.e., positive and negative) and style (i.e., autonomy supportive and controlling).

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Feedback Valence

Feedback valence refers to whether the feedback is positive or negative (Whitehead & Corbin, 1991). Positive feedback may highlight athletes' capacity to master the task at hand (i.e., task-based feedback; e.g., Tzetzis, Votsis, & Kourtessis, 2008), to improve their technique or performance relative to the past (i.e., intrapersonal feedback; e.g., Tenenbaum et al., 2001), or to excel in relation to other athletes or a particular norm table (i.e., normative feedback; e.g., Mouratidis, Vansteenkiste, Lens, & Sideridis, 2008). Similarly, the coach can be critical of athletes' failure to master the task, their lack of sufficient progress, or their nonattainment of a specific norm.

Within SDT, it is maintained that the provision of positive (relative to negative) feedback supports athletes' intrinsic motivation as indicated by their task enjoyment and perseverance at the activity (Deci et al., 1999). It has indeed been shown that the more athletes felt their coaches provided positive feedback, the higher their intrinsic motivation (Amorose & Horn, 2000; Mouratidis et al., 2008). Likewise, experimentally induced positive feedback was found to increase pleasure and perseverance during an agility run (Whitehead & Corbin, 1991) and intrinsic motivation for a stabilometer task (Vallerand & Reid, 1984).

Relative to effects of feedback on intrinsic motivation, effects of feedback on performance are more equivocal. Meta-analytic findings indicate that the effect of feedback on performance is smaller in sports compared

with other activities (Kluger & DeNisi, 1996). This is possibly because sport performance has many determinants, which can be affected differentially by feedback. For example, negative feedback may both increase tension (Whitehead & Corbin, 1991) and effort (Weinberg, Gould, & Jackson, 1979), whereby the benefits associated with increased effort cancel out the detrimental effect of tension on performance.

Further, the impact of positive, relative to negative, feedback may depend on the reference standard used to deliver feedback. Although normative feedback may yield fewer benefits compared with intrapersonal or task-based feedback (cf. Ames, 1992), competitive players often receive normative feedback (either implicitly or explicitly) because competition is almost an inherent feature of many sports. Because the delivery of normative feedback is inevitable in some sports contexts, it is important to examine how this type of feedback can be given in a motivating and performance-enhancing way. One key issue in this regard is the communication style used to provide feedback (e.g., Deci et al., 1999), an issue we address next.

Feedback Style

According to SDT, the style used by coaches when providing feedback can be more controlling or more autonomy supportive in nature. When being controlling, coaches pressure athletes to act, think, or feel in prescribed ways (Bartholomew, Ntoumanis, Ryan, Bosch, & Thogersen-Ntoumani, 2011). In contrast, when being autonomy supportive, coaches identify, nurture, and build athletes' inner motivational resources so as to promote a sense of volition (Reeve, 2009). One feature determining coaches' style of feedback is the type of language they use. This language can either be inviting and informational (e.g., "I propose," "I ask," and "you can") or be coercive and threatening (e.g., "you must," "you should," "if you . . . not, then . . . ,"; Vansteenkiste, Simons, Soenens, & Lens, 2004).

In the sport domain, correlational studies have shown that when athletes perceive their coach as relying on autonomy-supportive language when providing corrective feedback, they report greater feelings of positive affect and stronger intentions to persevere (Mouratidis, Lens, & Vansteenkiste, 2010). Further, experimental work has shed light on the causal impact of the type of language used. This language has been experimentally varied in the way tasks were introduced (Savard, Joussemet, Pelletier, & Mageau, 2013), in the way individuals were monitored (Enzle & Anderson, 1993), and in the way feedback was delivered (Ryan, 1982). In each of these contexts, it has been shown that autonomy-supportive (relative to controlling) language promotes positive outcomes, such as task enjoyment, self-efficacy, positive affect, performance, and perseverance (Hooyman, Wulf, & Lewthwaite, 2014; Vansteenkiste, Simons, Lens, Sheldon, & Deci, 2004). Specifically, in the context of feedback, it has been shown that participants who were given positive feedback in a controlling rather than autonomy-supportive way were more likely to lose their interest in the activity at hand (Ryan, 1982; Ryan, Koestner, & Deci, 1991).

In Search of Intervening Mechanisms: The Role of Psychological Need Satisfaction and Self-Talk

The research discussed so far points out that both the valence and style of normative feedback affect athletes' enjoyment, persistence, and performance. An important gap in extant research, however, is the limited empirical attention devoted to intervening processes accounting for these effects. From an SDT perspective, it is argued that athletes' basic psychological need satisfaction plays a key role in accounting for the effects of feedback (Deci & Ryan, 2000). Specifically, it can be reasoned that competence and autonomy need satisfaction would explain the effects of feedback valence and feedback style, respectively. Although a handful of sport-based studies indeed showed that competence need satisfaction accounts for the beneficial effects of positive (relative to negative) feedback (Vallerand & Reid, 1984; Whitehead & Corbin, 1991), to the best of our knowledge, evidence for the intervening role of autonomy need satisfaction with respect to feedback style is absent. Moreover, no feedback-related studies have simultaneously examined both psychological needs simultaneously as intervening variables.

Besides psychological need satisfaction, few other intervening processes have been taken into account within the SDT literature. Yet self-talk may also constitute a viable candidate in the sport context (Tod, Hardy, & Oliver, 2011). Fairly often, athletes engage in self-talk during small breaks during a game. Especially in more technical and individual sports, like table tennis, bowling, or darts, athletes may talk to themselves (Van Raalte, Cornelius, Brewer, & Hatten, 2000). Self-talk is defined as everything individuals say to themselves to either regulate their arousal, direct their attention, evaluate their performance, or be self-reinforcing or self-punishing (Hatzigeorgiadis, Zourbanos, Latinjak, & Theodorakis, 2014). Different types of self-talk can be distinguished on the basis of their valence (Zourbanos, Hatzigeorgiadis, Chroni, Theodorakis, & Papaioannou, 2009). Whereas positive self-talk encompasses self-directed statements to generate energy, to give oneself instructions, or to build confidence, negative self-talk involves messages expressing self-criticism, worries, somatic complaints, and thoughts about disengagement.

Situational factors, such as coach feedback, are likely to activate self-talk (Hardy, Oliver, & Tod, 2009). In this regard, negative, relative to positive, feedback was found to decrease tennis players' positive self-talk and to elicit more negative self-talk (Zourbanos, Hatzigeorgiadis, Tsiakaras, Chroni, & Theodorakis, 2010; Study 3). As for communication style, correlational evidence confirms that athletes use more positive

self-talk when their coach is perceived to rely on an inviting communicating style and to express confidence in them (Zourbanos et al., 2010). In contrast, both cross-sectional (Zourbanos et al., 2010; Study 2) and longitudinal research (Conroy & Coatsworth, 2007) indicate that athletes report using more negative self-talk when they perceive their coaches as controlling.

In turn, self-talk has been found to predict important outcomes. For instance, instructional self-talk, which is one component of positive self-talk, appears to contribute positively to performance (Hatzigeorgiadis, Zourbanos, Galanis, & Theodorakis, 2011). Further, a few studies also found positive self-talk to relate to individuals' positive affect and pleasure (Hardy, Hall, & Alexander, 2001) as well as their effort expenditure (Zourbanos, Hatzigeorgiadis, & Theodorakis, 2007). Negative self-talk, on the other hand, was found to be unrelated (Tod et al., 2011) or even negatively related to performance (Van Raalte, Brewer, Rivera, & Petitpas, 1994). Given the evidence that feedback affects self-talk and that self-talk, in turn, predicts athlete outcomes, it seems plausible to assume an intervening role for self-talk in associations between feedback and athlete outcomes. This assumption has not been put to the test, however.

In addition, little research has addressed the relationship between self-talk and psychological need satisfaction, which according to SDT also represents an intervening process in effects of feedback on athlete outcomes. Because athletes indicate using self-talk for motivational ends (Hardy et al., 2001), Tod and colleagues (2011) proposed that self-talk has a motivational impact. From an SDT perspective, self-talk can be conceived as motivating to the extent it supports the satisfaction of athletes' psychological needs (Vansteenkiste et al., 2010). Indeed, self-talk could serve as a precursor to athletes' need satisfaction and subsequent enjoyment, perseverance, and performance. For instance, instructional or confidence-boosting self-talk (as indicators of positive self-talk) may foster a sense of competence (Hardy, 2006), whereas self-critical self-talk and worrying (as indicators of negative self-talk) may evoke a sense of pressure (Oliver, Markland, & Hardy, 2010) and exacerbate individuals' sense of failure (Delrue et al., 2016).

The Present Study

The central purpose of the present study was to examine the mechanisms underlying effects of feedback valence and communication style on competitive tennis players' enjoyment, perseverance, and performance. Specifically, the study aims at examining the intervening role of both satisfaction of the psychological needs for competence and autonomy, and self-talk.

In addition to this central purpose, this study aimed to contribute to the literature in a number of other ways. Although the (de)motivating role of feedback has been extensively examined (e.g., Carpentier & Mageau, 2013, 2016), the present study extended past work (a) by examining feedback in an ecologically valid setting (i.e., players' tennis clubs), (b) by examining the independent and interactive effects of valence (i.e., positive vs. negative) and style of feedback (i.e., autonomy supportive vs. controlling), and (c) by relying not only on the questionnaires but also on the coding of audiotaped self-talk and on players' objectively recorded perseverance and performance at the tennis court. The experimental study had a 2×2 design crossing a manipulation of valence of feedback with a manipulation of style of feedback.

The following specific hypotheses were formulated. First, we hypothesized that positive, relative to negative, normative feedback (Hypothesis 1a) and autonomy-supportive, relative to controlling, normative feedback (Hypothesis 1b) would increase players' task enjoyment, perseverance, and performance. We also predicted an interaction effect between feedback valence and style, such that the combination of positive feedback with an autonomy-supportive style would yield an additional positive effect (Hypothesis 1c; cf. Curran, Hill, & Niemiec, 2013). Second, we hypothesized that competence need satisfaction would primarily account for the effects of feedback valence (Hypothesis 2a) and that autonomy need satisfaction would primarily account for the effects of communication style (Hypothesis 2b). We further hypothesized that the manipulated feedback may feed into players' experience of need satisfaction not only directly but also indirectly, that is, via the activated self-talk (Hypothesis 2c). For instance, the negative self-talk elicited by the feedback may relate negatively to competence and autonomy need satisfaction over and above the direct effects of the manipulation on need satisfaction.

Method

Participants

One-hundred and twenty Belgian tennis players aged between 13 and 50 years participated in this study (67.5% male; $M = 24.5$; $SD = 9.86$). Of the participants, 109 players were right-handed (90.8%) and 11 were left-handed. Participants trained on average 3 hr a week ($SD = 3.09$), with substantial variance: Some participants did not participate in regular weekly training, whereas others trained for 16 hr a week. Belgian tennis rankings varied between "nonranked" and "A international." Belgian rankings are also indicated by the points assigned to each ranking. Beginning tennis players, who do not have a ranking yet, are assigned 5 points, whereas world tour players (A international) are assigned 115 points. Most participants had a low ranking (5–35 points; $n = 70$; 58.3%) or a moderate ranking (40–70 points; $n = 28$; 23.3%), and a smaller number of players were highly ranked in Belgium (75–110 points; $n = 22$; 18.4%).

Procedure

Participants were recruited from tennis clubs in Flanders, the Dutch-speaking part of Belgium. Four head coaches were contacted and given information about the study. All of them approved that the tennis players they coached could participate in the study by signing an informed consent statement. Subsequently, players were given information about the aim of the study and were invited to participate. Upon agreement, they also signed an informed consent statement. For participants younger than 18 years, passive consent was obtained from their parents by informing them about the study and asking to return a form by the date on which the experimental phase was scheduled in case they did not want their child to participate in the study. No parents denied their child's participation. Permission to conduct the study was obtained via the institution's research ethics committee.

The study consisted of a premeasurement phase, a tennis exercise, and a postmeasurement phase. The first measurement, involving the assessment of background characteristics and feelings of competence with respect to tennis, took place directly following the completion of the informed consent statement. The actual experiment took place at least 1 day after completion of the premeasure. Participants individually performed tennis drills based on Purcell's (1981) forehand–backhand drive skill test to measure ball control and stroke velocity. Participants were asked to hit balls coming from a tennis ball machine (Pro Match–Pro model) back into the other side of the court, which was divided into different zones. Each zone had its own value, with the most points given to strokes close to the center of the baseline. The experimental phase consisted of an exercise trial and two experimental trials. To standardize the difficulty level of the exercises, the difficulty level of the tennis drills was adjusted as a function of participants' ranking (i.e., low, middle, and high). While performing these trials, participants were asked to verbalize their thoughts, which were recorded by a voice recorder attached to their nondominant arm. The exercise trial consisted of 10 strokes and was used for warming up and familiarizing to the drills. The two experimental trials comprised six rallies of 10 strokes each, divided by rest periods of approximately 20 s in between the rallies. Participants received manipulated feedback from the experimenter between the two experimental trials and were allowed to take some additional rest for approximately 2 min. The difficulty level was raised for the second experimental trial to further challenge the participants and to avoid participants deriving feedback from themselves by comparing their performance on both trials. Upon completion of the second experimental trial, participants received a second-time manipulated feedback. Next, a postexperimental behavioral measure was obtained to measure players' perseverance (described subsequently). Finally, participants completed a questionnaire tapping into their motivational experiences and self-talk during the second experimental trial.

Participants were debriefed individually after completion of the postexperimental measure to inform them that they had been deceived by bogus feedback. Furthermore, participants were asked if they suspected, or heard from others, that the feedback was false. If so, their data were excluded from the study. In total, three participants were excluded.

Manipulated Feedback

Manipulated feedback was provided at the end of both experimental trials. Matched for skill level and gender, participants were randomly assigned to one out of four experimental conditions, which were created by crossing feedback valence (i.e., positive or negative) and style (i.e., autonomy supportive or controlling). To operationalize an autonomy-supportive and controlling communication style, expressions such as "I invite you to . . . " or "I suggest that . . . " were used in the autonomy-supportive condition, whereas statements such as "I expect you to . . . " and "It is now time to prove yourself" were used in the controlling condition. Additionally, whereas the experiment was presented as an "exercise" in the autonomy-supportive condition, it was introduced as a "test" in the controlling condition. To operationalize the valence of feedback, participants in the positive and negative normative feedback conditions were informed after both experimental trials that they had, respectively, done better or worse than most of the players of their age with the same ranking. A complete overview of the feedback manipulations can be found in Appendix.

Pre-Experimental Measures

Trait-competence need satisfaction. The Perceived Competence Scale was used to determine how competent participants generally feel as a tennis player (Williams & Deci, 1996). This scale uses a Likert scale varying from 1 (*not at all*) to 7 (*very much*) and consists of four statements, which were adapted to the tennis context (e.g., "I feel confident in my abilities as a tennis player"; $\alpha = .78$).

Measures During the Experimental Phase

Performance. Participants were asked to hit balls to a court divided in different zones, each with its own value (Purcell, 1981). Strokes close to the center of the baseline were awarded the most points. To prevent tennis players from playing too safely and to make sure that players were unable to infer their own scores, they were informed that stroke velocity would be taken into account, which was actually not the case. The experimenter calculated the score for each rally, which led to a sum score for a trial. Internal consistency for the accuracy scores on both experimental trials was .75 and .72.

Coded self-talk. Self-talk was assessed via the thinking-aloud protocol, which involved asking participants

to verbalize their thoughts during the tennis exercises. The thinking-aloud procedure has a number of benefits. It captures a large amount of self-talk (Blackwell, Galassi, Galassi, & Watson, 1985), and it promotes recall of self-talk later on (Lodge, Tripp, & Harte, 2000). Further, the memory bias is minimized due to the very short time interval between experiencing and reporting self-talk (Blackwell et al., 1985). The verbalized thoughts during the experimental trials were recorded by a voice recorder. Subsequently, they were transcribed verbatim and categorized in positive and negative self-talk using the categories of the Automatic Self-Talk Questionnaire for Sports (Zourbanos et al., 2009). Transcripts of 42 participants were coded by two coders familiar with the self-talk literature, using a coding manual that was developed specifically for the present study. The inter-rater reliability after coding a third of the participants was high ($\kappa = .83$). After disagreements were resolved and the coding manual was completed, one coder continued the coding of the remaining transcripts.

Postexperimental Measures

The postexperimental questionnaire asked tennis players to reflect on their experiences during the second experimental trial.

Self-reported self-talk. The questionnaire used to measure positive and negative self-talk was a slightly adapted version of the Automatic Self-Talk Questionnaire for Sports (Zourbanos et al., 2009). Adaptations involved making the questionnaire relevant for the context of tennis. For each statement, participants indicated its frequency during the second tennis exercise on a 5-point Likert scale ranging between 0 (*seldom*) and 4 (*often*). A composite score was created for both positive and negative self-talk ($\alpha = .78$ for both; Zourbanos et al., 2009). Both composite scores correlated significantly with the coded self-talk ($r = .43$, $p < .01$ and $r = .33$, $p < .01$ for positive and negative self-talk, respectively[1]).

Given these findings, a composite measure for positive and negative self-talk was created by averaging the standardized scores obtained via the thinking-aloud procedure and the questionnaire. Such a combined measure is to be preferred because some people are more reserved and verbalize only a small percentage of their thoughts. As a result, the additional assessment of self-talk via self-reports allows for a more complete and, hence, more valid assessment of self-talk. Furthermore, past research has indicated that some self-talk measures are better suited to measure particular self-talk types, whereas other measures are beneficial to capture other types of self-talk (Lodge et al., 2000). For example, instructions are more easily captured with talking aloud, whereas worries are more easily captured by a questionnaire measure.

Manipulation check. To ensure that our manipulation had the intended effect on participants, two items were created, one considering the manipulation of feedback valence ("the experimenter gave positive feedback") and the other tapping into the manipulation of feedback communication style ("the experimenter pressured me to perform well"). Items were scored on a 5-point Likert scale ranging from 1 (*totally disagree*) to 5 (*totally agree*).

Motivational experiences. To measure tennis players' motivational experiences, we used the Intrinsic Motivation Questionnaire (Ryan, 1982), which was adapted to a tennis context. This 20-item scale taps into players' task enjoyment (7 items; e.g., "The second tennis exercise was very amusing to do"; $\alpha = .79$), autonomy need satisfaction (7 items; e.g., "I had the perception that I had to perform the second tennis exercise"; reversed scored; $\alpha = .84$), and competence need satisfaction (6 items; e.g., "While performing the second tennis exercise, I felt I was doing well"; $\alpha = .92$). Participants responded on a 5-point Likert scale ranging between 1 (*not at all*) and 5 (*very much*). To distinguish this competence need satisfaction measure from the more general trait-like competence measure used as a pre-experimental measure, we refer to this variable as state-competence need satisfaction.

Perseverance. A behavioral measure based on the free-choice paradigm (Deci et al., 1999) was used to measure players' perseverance. Tennis players were offered the opportunity to take part in a third trial, consisting of three rallies of 10 balls each. Participation in this free-choice trial was said to be voluntary, so that players could stop playing tennis at this point (perseverance scored as 0). Players who chose to perform this additional trial could choose its difficulty level. They could either choose for the difficulty level of the first experimental trial (perseverance scored as 1), the more difficult level of the second experimental trial (perseverance scored as 2), or an even more challenging tennis drill (perseverance scored as 3). Choosing a more difficult exercise at the end of the second experimental trial can be interpreted as an indication of higher perseverance. Participants were not aware that their choice at that moment was actually a measure of perseverance.

Results

Preliminary Analyses

Descriptive statistics and bivariate correlations among the study variables can be found in Table 1. Independent samples t test revealed that female players trained less, had lower trait-competence satisfaction levels, were less accurate in the first exercise, and showed lower perseverance compared with their male counterparts. An analysis of variance (ANOVA) indicated that trait-competence satisfaction levels, $F(2,117) = 3.97$, $p = .022$, and performance on the first tennis exercises, $F(2,117) = 10.45$, $p < .001$, differed according to skill level. Tennis players with a high ranking felt more competent ($M = 5.48$; $SD = .96$) compared with tennis players with a low ranking ($M = 4.86$; $SD = .89$). Furthermore, the former players

Table 1 Descriptive Statistics, Gender Differences, and Bivariate Correlations Between the Measured Variables

Variables	Male	Female	*t*	1	2	3	4	5	6	7	8	9	10
Pre-experimental measures													
1. Age	25.90	23.79	1.20	–									
2. Training hours/week	3.47	2.14	2.72**	–.27**	–								
3. Trait competence	5.30	4.50	4.07**	–.16	.32**	–							
4. Accuracy first exercise	47.06	52.85	4.09**	.14	.23*	.25**	–						
Experimental measures													
Self-talk													
5. Positive[a]	–.06	.13	–1.17	.07	–.09	.17	–.10						–
6. Negative[a]	–.02	.05	–.44	–.09	–.08	–.36**	–.21*	.08					
Motivational experiences													
7. Autonomy satisfaction	3.95	3.90	.27	.14	.12	.08	.13	–.14	–.28**				
8. State-competence satisfaction	3.13	3.11	.13	.16	.01	.30**	.18*	.02	–.61**	.29**			
9. Enjoyment	3.75	3.74	.12	.26**	–.10	.29**	.12	.08	–.54**	–.45**	.59**		
Behavioral measures													
10. Performance change	–.28	.58	–.80	.05	–.11	.08	.00	–.07	–.18*	.05	.27**	.12	
11. Perseverance	2.41	2.05	1.99*	.13	.11	.19*	.15	.03	–.33**	.23**	.45**	.39**	.18*

Note. [a]This value represents the composite score of self-talk, which was computed by averaging the standardized scores of the self-report and coding procedure.
*$p < .05$. **$p < .01$.

performed better than players with a low or a moderate ranking on the first exercise ($M_{high} = 56.75$, $SD_{high} = 6.85$; $M_{moderate} = 51.83$, $SD_{moderate} = 7.57$; and $M_{low} = 48,81$, $SD_{low} = 7.15$).

Bivariate correlations showed that older tennis players reported greater enjoyment. The amount of training hours correlated positively with players' trait-competence need satisfaction and with their performance on the first tennis exercise. Based on these results, we systematically controlled for sex, age, training frequency, and skill level in the main analyses. Because positive self-talk was unrelated to both the outcomes and the need satisfaction, we decided not to include this variable in the main analyses. All analyses were conducted with and without background characteristics to reduce the probability of false positives. No differences were found between the results of the two sets of analyses.

Manipulation check. An ANOVA indicated that participants receiving positive feedback reported that the experimenter was more positive while giving feedback ($M = 4.45$) than participants receiving negative feedback ($M = 2.81$; $F(1, 94) = 90.04$, $p < .001$). Participants receiving feedback with an autonomy-supportive style reported feeling less pressured by the experimenter ($M = 1.70$) than participants receiving the controlling feedback ($M = 2.39$; $F(1, 94) = 9.86$, $p = .002$). These findings show that the manipulations were successful.

Primary Analyses

Hypothesis 1: Effects of feedback valence and communication style. A multivariate analysis of covariance showed a significant main effect for feedback valence (Wilks's $\lambda = .73$, $F(5,83) = 6.00$, $p < .001$) and for communication style (Wilks's $\lambda = .88$, $F(5,83) = 2.36$, $p = .047$). The interaction effect was not significant (Wilks's $\lambda = .94$, $F(5,83) = 1.09$, $p = .38$). Table 2 presents the means and standard deviations of the outcome variables according to the different feedback conditions.

Follow-up univariate ANOVAs concerning feedback valence indicated that participants receiving positive, relative to negative, feedback used negative self-talk less frequently and showed higher levels of state-competence need satisfaction, enjoyment, and perseverance (see Table 2). With regard to communication style, follow-up univariate ANOVAs showed that tennis players in the autonomy-supportive, relative to controlling, communication condition reported higher autonomy need satisfaction and enjoyment, and scored higher on perseverance.[2]

Hypothesis 2: Intervening effects of self-talk and need satisfaction. Structural Equation Modeling (SEM) analyses using MPlus 7 (Muthén & Muthén, 1998–2015) were used to test for the intervening role of negative self-talk and psychological need satisfaction. The solutions were generated on the basis of maximum likelihood estimation. Five latent variables were

Table 2 Means and Standard Deviations for the Four Experimental Conditions (Positive vs. Negative Feedback Crossed With an Autonomy-Supportive vs. Control Communication Style) and ANOVA Results for Feedback Valence Effects and Feedback Communication Style Effects

		Positive Feedback	Negative Feedback	Effects of Feedback Valence		
		M (*SD*)	*M* (*SD*)	*F*(1, 90)	*p*	Effect Size
Autonomy-supportive style	Negative self-talk	−.23 (.64)	.13 (.90)	11.24	.001	.11
	Autonomy satisfaction	4.13 (.67)	4.10 (.61)	3.42	.07	.04
	State-competence satisfaction	3.50 (.64)	2.67 (.72)	68.83	<.001	.43
	Enjoyment	4.01 (.44)	3.73 (.61)	19.50	<.001	.18
	Performance change	.33 (6.08)	1.44 (5.48)	.06	.80	.00
	Perseverance	2.54 (.72)	2.34 (.88)	13.47	<.001	.13
		Autonomy-Supportive Communication	**Controlling Communication**	**Effects of Feedback Style**		
		M (*SD*)	*M* (*SD*)	*F*(1, 90)	*p*	Effect Size
Controlling style	Negative self-talk	−.37 (.73)	.46 (1.00)	.50	48	.01
	Autonomy satisfaction	4.03 (.67)	3.48 (1.06)	5.13	.026	.05
	State-competence satisfaction	3.79 (.64)	2.26 (.77)	.29	59	.00
	Enjoyment	4.00 (.54)	3.14 (.70)	7.22	.009	.07
	Performance change	.21 (5.94)	−.31 (5.27)	.65	.42	.01
	Perseverance	2.64 (.70)	1.50 (1.10)	4.67	.033	.05

Note. ANOVA = analysis of variance.

constructed. The number of parcels created depended on the total number of items used to assess constructs, and each parcel was created by a set of randomly selected items. Trait-competence need satisfaction was modeled by creating two parcels, whereas three parcels were used for autonomy and state-competence need satisfaction and perceived enjoyment. Little, Cunningham, Shahar, and Widaman (2002) recommend random parceling when items stem from a common pool, which was the case in our study. An important advantage of random parceling is that parcels contain roughly equal amounts of common factor variance, resulting in balanced factor loadings (Little et al., 2002). Finally, negative self-talk was indicated by the standardized scores of the thinking-aloud procedure (i.e., coded self-talk) and the thought listing procedure (i.e., self-reported self-talk). Goodness-of-fit was evaluated using the root mean square error of approximation (RMSEA), the standardized root mean square residual (SRMR), and the comparative fit index (CFI). Combined cut-off values of .06 for RMSEA, .08 for SRMR, and .95 for CFI were used as criteria for good fit (Hu & Bentler, 1999).

First, a confirmatory factor analysis modeled the five study variables (trait-competence need satisfaction, negative self-talk, state-competence need satisfaction, autonomy need satisfaction, and interest/pleasure) using 13 indicators. To overcome a problem with local underidentification, the residual variance of one parcel regarding trait-competence need satisfaction was fixed to zero. This solution was preferred above using all four items as individual indicators of the latent variable so as to ensure sufficient power for the analyses. Results showed a good fit ($\chi^2(56) = 69.11$; RMSEA = .04; SRMR = .05; CFI = .98) with all indicators loading moderately to strongly on the latent factors, ranging from .49 to .94 (mean $\lambda = .79$; all $p < .001$).

Next, we modeled psychological need satisfaction and negative self-talk as intervening variables in associations between the manipulations and the outcomes. Specifically, we modeled contrast-coded feedback valence (negative feedback coded 0 and positive feedback coded 1) as a predictor of both negative self-talk and state-competence need satisfaction, with negative self-talk also being modeled as a predictor of state-competence need satisfaction. State-competence need satisfaction, in turn, was modeled as a predictor of players' enjoyment, performance change, and perseverance (see Figure 1). Performance change was operationalized with a residual score indicating change in performance from the first to the second tennis exercise to take differences in performance on the first tennis exercise into account. This residual score was computed by regressing performance in the second exercise on performance in the first exercise and by saving the unstandardized residual score from this analysis. Next, both contrast-coded communication style (controlling communication style coded as 0 and autonomy-supportive communication style coded as 1) and negative feedback were modeled as a predictor

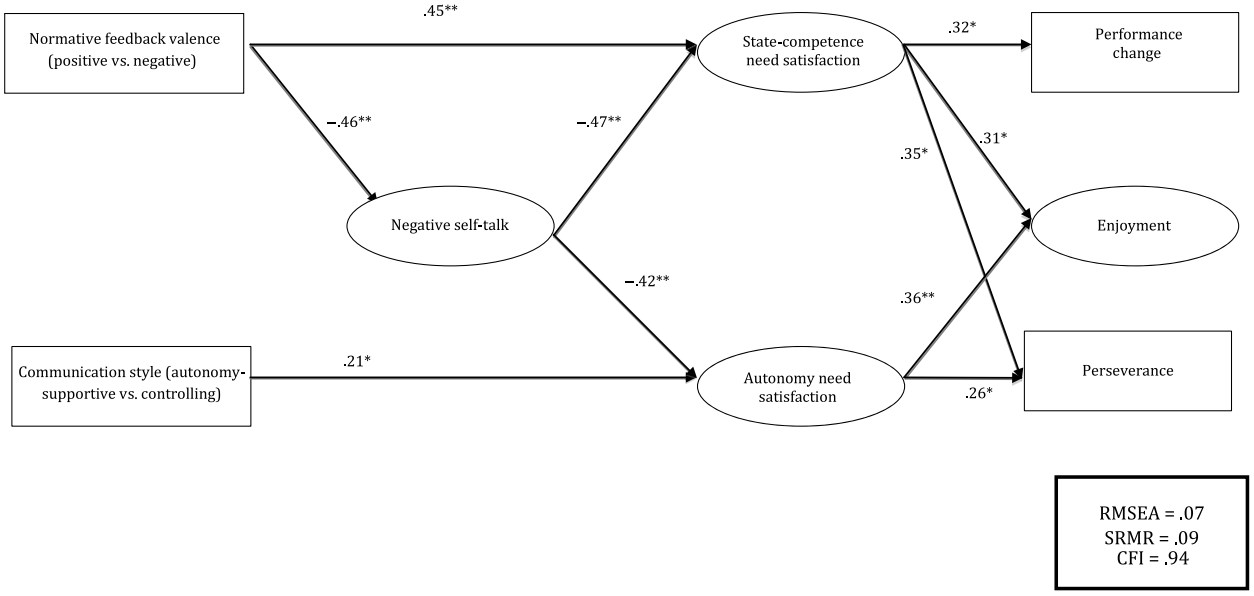

Figure 1 — Structural model tested in the SEM analysis. *$p < .05$, **$p < .01$

of autonomy need satisfaction, which, in turn, was modeled as a predictor of perseverance and enjoyment.

Results showed acceptable model fit with all pathways being significant and in the predicted direction ($\chi^2(135) = 191.87$; RMSEA = .07; SRMR = .09; CFI = .93).

Next, we evaluated the intervening role of self-talk and state-competence and autonomy need satisfaction by means of tests for indirect effects (MacKinnon, Lockwood, & Williams, 2004). The indirect effects are computed on the basis of the product of the association between an independent variable and the intervening variable (the α association) and the association between the independent variable and the dependent variable (the β association) divided by the standard error of this product. Because traditional methods to estimate indirect effects (such as the Sobel test) have low power and a high probability of Type I errors, MacKinnon et al. (2004) proposed a bias-corrected bootstrap method. This method is based on a resampling approach and involves the calculation of confidence intervals to determine the significance of an indirect effect. When significant, such an effect indicates that an independent variable is related indirectly to a dependent variable through an intervening variable.

The indirect effects of feedback valence through negative self-talk and, subsequently, state-competence need satisfaction to enjoyment ($\beta = .12$, $p = .005$), perseverance ($\beta = .08$, $p = .003$), and performance change ($\beta = .06$, $p = .02$) were all significant. These effects are consistent with the prediction that negative self-talk and state-competence need satisfaction represent intervening mechanisms through which feedback valence is related to enjoyment, perseverance, and performance change. The indirect effect of feedback style through autonomy to enjoyment ($\beta = .09$, $p = .044$) reached significance, which was not the case for perseverance ($\beta = .06$, $p = .14$), indicating that autonomy represents a significant intervening variable in the association feedback style with enjoyment but not with perseverance.

Ancillary Analysis

Because negative self-talk may not only predict but also stem from low need satisfaction, we tested a second model. Specifically, we modeled contrast-coded feedback valence as a predictor of state-competence need satisfaction, whereas contrast-coded communication style was modeled as a predictor of autonomy need satisfaction. In turn, both need satisfaction variables were modeled as predictors of negative self-talk, which in turn served as a predictor for the outcome variables. Results indicated a good fit of the model ($\chi^2(130) = 178.58$; RMSEA = .06; CFI = .94; SRMR = .09). However, within the model using state-competence and autonomy need satisfaction as predictors for negative self-talk, negative self-talk was no longer related to the outcomes. This might indicate that the two psychological needs are more proximal indicators for the outcomes compared with negative self-talk.

Discussion

Coach feedback is presumed to play a pivotal role in the maintenance and even enhancement of players' motivational functioning, perseverance, and performance (Mouratidis et al., 2008). Grounded in SDT, the

present experimental study was designed to examine the mechanisms behind effects of two critical features of feedback, that is, its valence and the way in which the feedback is communicated.

Valence and Style of Feedback

With regard to feedback valence, positive (relative to negative) normative feedback caused tennis players to experience their play as more enjoyable and led them to persevere more during a free-choice period afterwards. These findings are consistent with research in the laboratory (Deci et al., 1999) and extend this work to a more ecologically valid setting. Moreover, competence need satisfaction played an explanatory role in these associations, with positive feedback enhancing tennis players' competence need satisfaction, which, in turn, was associated with greater intrinsic motivation, both self-reported and behavioral (Vallerand & Reid, 1984).

Feedback valence did not directly affect performance, but there was an indirect effect via competence need satisfaction, which was associated with better performance. Possibly, the lack of a direct effect is due to the fact that performance was based on the precision of players' strokes when engaging in the second exercise, immediately after they received feedback (Wulf, Chiviacowsky, & Lewthwaite, 2010). Players' performance in this context may still depend heavily on well-established interindividual differences, such as talent or technique (Kluger & DeNisi, 1996). Yet positive feedback may yield an effect in the longer run as it enhances intrinsic motivation and perseverance, thereby leading athletes to train more effectively (Whitehead & Corbin, 1991). Another explanation is that the type of feedback in this study was normative in nature and, hence, not task-specific or individualized. Although knowing that one outperforms others on a tennis task may boost athletes' competence need satisfaction and intrinsic motivation, for their performance to improve, they may need more specific task-oriented feedback (Tzetzis et al., 2008), an issue that needs to be tested in future research.

Apart from the valence of feedback, the style through which the feedback was communicated was found to be critical. To the extent players were given feedback in an autonomy-supportive and informational rather than in a controlling and evaluative way, they experienced the task as more enjoyable and were more likely to persevere during a free-choice period. The manipulation of communication style involved both the framing of the activity (e.g., as an exercise rather than a test) as the use of controlling language (e.g., should, have to, must, . . .). Therefore, it is unclear in the present study whether the obtained differences between both conditions can be attributed to (a) the way the activity is framed, (b) the use of controlling language, or (c) both. Future studies may want to disentangle these different ways to increase pressure and study them separately.

The effects of feedback valence and style were independent of one another, indicating that both matter in predicting players' motivational functioning (see also Sheldon & Filak, 2008). Somewhat unexpectedly, we did not obtain evidence for interactive effects between valence of feedback and style of feedback. This lack of interactions is inconsistent with findings from a number of correlational studies (e.g., Curran et al., 2013). Because only a few studies to date addressed this possibility of an interaction between the valence of feedback and the style of communication and because these studies are quite different in terms of design and selection of outcome variables, more research addressing this possibility is needed.

The results for feedback style are in accordance with Ryan (1982), indicating that inviting and informational, relative to controlling and evaluative, feedback made participants persevere more in a hidden figure puzzle task. Although correlational studies found similar evidence for the critical role of an autonomy-supportive feedback style in the realm of sports (e.g., Mouratidis et al., 2010), to the best of our knowledge, this is the first experimental study to address this issue in the context of sports. Interestingly, in line with SDT, autonomy need satisfaction accounted for the effect of feedback style on players' motivational and behavioral functioning. These findings indicate that feedback given in an autonomy-supportive way supports tennis players' basic psychological need for autonomy, which, in turn, relates to higher perseverance and greater enjoyment.

The Role of Self-Talk

Another unique feature of the present study was the consideration of players' self-talk as an additional explanatory mechanism in the relation between manipulated feedback and players' motivational and behavioral functioning. Tennis players are known to engage in self-talk fairly often (Van Raalte et al., 1994). Rather than relying on self-reports only, tennis players were asked to verbalize their thoughts and feelings during the experiment, which were audio recorded and coded by external coders. To increase the validity of the assessment of self-talk, we created a combined score of self-reported and coded self-talk (Lodge et al., 2000). Interestingly, negative self-talk was activated by the induction of negative (relative to positive) normative feedback. Presumably, negative feedback served as a model, thereby awakening the critical voice of the players themselves (Zourbanos et al., 2007). In turn, negative self-talk was related to diminished competence and autonomy need satisfaction above and beyond the effect of manipulated feedback valence and style, thus potentially aggravating the already present detrimental effects of controlling and negative normative feedback. Presumably, negative self-talk functions as a self-fulfilling prophecy such that the engagement in critical and anxiety-enhancing self-talk eventually relates negatively to competence and autonomy need satisfaction.

A number of additional findings and issues regarding self-talk require discussion. First, whereas negative

self-talk was impacted by the manipulation, this was not case for positive self-talk. Thus, neither positive normative feedback nor an autonomy-supportive style caused tennis players to be more positive toward themselves. Possibly, negative self-talk is more susceptible to social influences than positive self-talk (Theodorakis, Hatzigeorgiadis, & Zourbanos, 2012). In addition, positive self-talk was unrelated to competence and autonomy need satisfaction. Possibly, what needs to be taken into consideration is the tone of the verbalized self-talk. One and the same positive self-statement could be verbalized in an informational fashion or in a more evaluative and pressuring fashion, with resulting consequences for participants' autonomy and competence need satisfaction (Oliver et al., 2010). Thus, it is possible that some tennis players engaged in rather evaluative positive self-talk, which would suppress the beneficial effects of more informational positive self-talk.

Second, although self-talk was modeled as a predictor of needs, it is also possible that self-talk arises as a function of low need satisfaction. That is, when athletes feel more pressured and inadequate because they notice that they are doing poorly, they may engage in self-talk to cope with this experience (Delrue et al., 2016). In our data, this alternative possibility received less support because a model in which competence and autonomy need satisfaction were predictors of negative self-talk revealed that negative self-talk was no longer related to the outcomes. As such, psychological need satisfaction appears to be a more proximal predictor of the outcomes than negative self-talk, indicating that negative self-talk precedes competence and autonomy need satisfaction rather than the other way around. Still, because in this study both self-talk and psychological need satisfaction were measured with regard to the same tennis exercise, it is impossible to conclude with certainty that self-talk undermined need satisfaction or the other way around. Most likely, associations between these variables are reciprocal in nature, a possibility that can be explored in future studies relying on multiple assessment points.

Limitations and Future Directions

First, this study did not take into account relatedness need satisfaction (i.e., the desire to experience warm and caring relationships). We considered this need as less appropriate for the current study as tennis players performed individually under the supervision of an experimenter they barely knew. Manipulating relatedness support may require an established relationship between experimenter/coach and tennis player, which was not the case in the current study. Also, the study focused on need satisfaction only and primarily included desirable outcomes. Future experimental research could also include measures of need frustration and more negative outcomes (Bartholomew et al., 2011).

A second limitation has to do with the generalizability of our findings, as only Flemish competitive tennis players participated and as only normative feedback was examined. Additional research needs to examine whether these results hold for other types of feedback (e.g., task-based and intrapersonal feedback), in other individual sports, in team sports, or in different cultures. For example, Peters and Williams (2007) found that negative, relative to positive, normative feedback causes less perseverance in a darts throwing task for European Americans but did not impact perseverance for East Asian participants. Furthermore, using negative, compared with positive, self-talk more frequently was detrimental to European American participants' performance, while being beneficial for East Asian participants. Thus, reactions on negative feedback and negative self-talk may depend to some extent on cultural background.

Third, SEM analyses tested a complex model within a rather small sample, resulting in less than optimal power. A lack of sufficient power may not only preclude one to obtain true effects but may also lead one to detect a statistically significant effect that does not reflect a true effect. As a result, we deem it important that future research replicates the current findings with a more extended sample (Button et al., 2013).

Conclusion

This study showed that positive (relative to negative) normative feedback led to more enjoyment and more behavioral perseverance in a tennis task because it nurtured tennis players' competence need satisfaction. Likewise, an autonomy-supportive (compared with a controlling) communication style to give feedback supported players' autonomy need satisfaction, which, in turn, enhanced game enjoyment and perseverance. Negative self-talk played an intervening role in the effects of feedback on psychological need satisfaction. Tennis players seem to adopt the negative tone inherent in negative feedback and to become self-critical, thereby forestalling their own autonomy and competence need satisfaction and, in turn, undermining their feelings of enjoyment and behavioral perseverance. Overall, on the basis of these findings, it can be advised to coaches to avoid using negative normative feedback and to be as autonomy supportive as possible when providing feedback.

Notes

1. More valid information regarding the relationship between self-reported and recorded self-talk is provided elsewhere (De Muynck, Delrue, Zourbanos, Hatzigeorgiadis, & Vansteenkiste, 2017). In order to further validate the self-talk measure used in the current study, additional variables were measured during the data collection. Because these variables were not useful to the scope of the current study, they were not mentioned in Method section and were omitted from the analyses. Specifically, need for achievement, fear of failure, perceived pressure, dominant achievement goal pursuit, and reasons underlying the dominant achievement goal pursuit were also measured, besides the constructs listed in the manuscript.

2. Additional contrast analyses comparing the experimental conditions with a stand-alone neutral comparison group (receiving no feedback) showed that tennis players in the controlling negative feedback condition reported less enjoyment, $t(115) = -4.37$, $p < .001$, displayed less state-competence need satisfaction, $t(115) = -5.36$, $p < .001$, and persevered less during the free-choice period, $t(41.27) = -3.33$, $p = .002$. Additionally, two other conditions also differed in some way from the neutral condition. First, tennis players receiving autonomy-supportive, negative feedback experienced less state-competence need satisfaction, $t(115) = -3.27$, $p = .001$, whereas tennis players receiving controlling positive feedback condition reported more state-competence need satisfaction, $t(115) = 2.33$, $p = .02$, compared with those in the neutral condition.

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Appendix: Feedback Manipulations

Autonomy-Supportive Communication Style	Controlling Communication Style
Positive feedback following the first experimental trial	
Let us see if I can give you some feedback regarding the first series of exercises. There are norms for this exercise, based on the rankings of tennis players, which allow for comparison. I can tell you that you did well on the first part of this exercise, compared to other players your ranking. This is positive, as it shows that you are capable to focus well and be consistent in your strokes. I propose we proceed to the second set of exercises. I would like to challenge you further by increasing the difficulty level. This is done by increasing the dispersion of the tennis balls. I want to ask you to try showing a similar level of focus and consistency, despite the more difficult shots. I wish you all the best!	Let us see how you scored on this test, which is an important indication of your worth as a tennis player. There are norms for this test, based on the rankings of tennis players. You score well on the first part of this test, as could be expected from someone your ranking. You manage to hold your focus and be persistent for a relative long time period. However, attaining a particular proficiency level is only the beginning, consolidating is much more difficult. It's now time for the second part of this test. This is more difficult because we will increase the dispersion of the tennis balls. We expect from players your skill level that they perform equally well in this part. It's time to prove yourself.
Negative feedback following the first experimental trial	
Let us see if I can give you some feedback regarding the first series of exercises. There are norms for this exercise, based on the rankings of tennis players, which allow for comparison. I can tell you that you did not do so well on the first part of this exercise, compared to other players your ranking. This exercise requires a lot of focus and consistency in your strokes. The lower performance indicates that you could not manage very well to focus and be persistent. I propose we proceed to the second set of exercises. I would like to challenge you further by increasing the difficulty level. This is done by increasing the dispersion of the tennis balls. I want to ask you to try showing a similar level of focus and consistency, despite the more difficult shots. I wish you all the best!	Let us see how you scored on this test, which is an important indication of your worth as a tennis player. There are norms for this test, based on the rankings of tennis players. Your score on the first test shows that you won't set the world on fire. With regard to focus and consistency, more can be expected from a player your ranking. It's now time for the second part of this test. This is more difficult because we will increase the dispersion of the tennis balls. We expect from players your skill level that they perform better than you did so far. It's time to prove yourself.
Positive feedback following the second experimental trial	
Let's take a look at how you did on the second exercise trial, compared to other players your ranking. Again, I can see that you did very well. You adapted smoothly to the more difficult strokes and you kept focused throughout the entire exercise. Producing consistent strokes seems to be a quality of yours.	Let's evaluate how you scored on the second part of this test, compared to other players your ranking. Again, you performed very well, as I expected from someone your ranking. You proved being able to manage these more difficult strokes. Your consistency in strokes is appropriate.
Negative feedback following the second experimental trial	
Let's take a look at how you did on the second exercise trial, compared to other players your ranking. Again, I need to inform you that you did less well. Ensuring consistent strokes and focusing throughout the entire exercise is not an easy thing to do. Nonetheless, I would like to invite you to keep training your consistency.	Let's evaluate how you scored on the second part of this test, compared to other players your ranking. Again, your performance was not what we expect from a player your ranking. You did not sufficiently take your chance to prove yourself on these more difficult strokes. You really have to enhance your consistency in order to be able to perform at a higher level.