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Self-determination in recreational exercise: Associations with lapse and post-lapse emotions

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ABSTRACT

Objective: Self-determination theory describes how an individual's underlying motives determine self-regulatory outcomes. Building on this, we investigated whether different types of motivation predict lapse in exercise behavior, and particularly the emotional responses to lapse in the form of guilt, anxiety, and relief.
Method: Study 1 entailed a self-report, cross-sectional investigation using structural equation modeling to test study hypotheses (N = 343, M age: 24.30 years, 215 female). Study 2 employed a 21-day daily diary using multilevel modeling to test study hypotheses (N = 89, M age: 25.90 years, 55 female). Motivation was self-reported at the beginning of the study with all other variables self-reported daily.
Results: Autonomous motivation was shown to negatively associate with lapse. When lapse occurred, autonomous motivation was inconsistently associated with the tendency for individuals to feel decreased relief and guilt. In contrast, introjected regulation displayed inconsistent associations with lapse, but increased the likelihood that individuals would experience guilt and anxiety following lapse. External regulation did not reliably predict lapse and emotions across studies.
Conclusions: Our findings suggest autonomous motivation may protect against lapses in goal-directed behavior. Controlling forms of motivation, however, may promote less-optimal emotional processes implicated in poor self-regulation.

1. Introduction

Certain behaviors are essential for good health and overall well-being, such as eating healthy foods or performing exercise. Many individuals have knowledge of the wide-ranging benefits, hence, intend to engage in healthy behavior but fail to follow through with their intentions to the detriment of their health (Kothe, Mullan, & Butow, 2012; Rhodes & de Bruijn, 2013). These lapses are commonplace for individuals in daily life (Wagner & Heatherton, 2015). Plans may change, and unexpected events may arise that demand attention. Individuals may not feel like engaging in the planned behavior or forget that they had intentions in the first place (Carver & Scheier, 2017). These lapses in healthy behavior can lead to significant emotional experiences, which have implications for relapse, goal striving, and disengagement (Shiffman et al., 1996; Webb & Byrd-Bredbenner, 2015). However, it is poorly understood why these emotional experiences are so variable; a lapse in healthy behavior may offer relief to some (Baumeister & Heatherton, 1996) but create guilt and anxiety in others (Stetson et al, 2005). The present study adopts a motivational perspective to assess these affective experiences of lapses in exercise behavior.

Motivation is an essential component of human functioning because it provides energy and direction to any planned behavior. Self-determination theory (SDT) is a theory of human motivation that has been widely used to explain adoption and sustainment of healthy behaviors (Ryan & Deci, 2017). This theory maintains that optimal and durable behavioral engagement is underpinned by autonomous reasons that are interesting and fun (i.e., intrinsic motivation), coherent with all aspects of one's sense of self (i.e., integrated regulation) or personally valuable (i.e., identified regulation). In contrast, controlling motives, such as the desire to avoid feelings of guilt or obtain social approval (i.e., introjected regulation), or external contingencies (i.e., external regulation), are less likely to lead to prolonged and healthy behavioral engagement. A considerable amount of cross-sectional (e.g., Edmunds, Ntoumanis, & Duda, 2006; Vlachopoulos, Kaperoni, & Moustaka, 2011), experimental (e.g., Edmunds, Ntoumanis, & Duda, 2008; Silva et al., 2011), longitudinal (e.g., Gunnell, Crocker, Mack, Wilson, & Zumbo, 2014; Silva et al., 2010; Taylor, Ntoumanis, Standage, & Spray, 2010), and meta-analytic (Teixeira, Carraça, Markland, Silva, & Ryan, 2012) evidence supports this contention in exercise and physical activity contexts.

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Building on this knowledge, attempts have been made to understand how motivation sustains adaptive behavior. Autonomous motives are positively associated with goal-directed effort (Smith, Ntoumanis, Duda, & Vansteenkiste, 2011), persistence, challenge appraisals, and task-oriented coping during difficult goal striving (Ntoumanis et al., 2014a), and negatively associated with impulsive attraction to goal-disruptive temptations and the number of obstacles (to goal attainment) encountered (Milyavskaya, Inzlicht, Hope, & Koestner, 2015). In contrast, controlling motives are unassociated with goal-directed effort (Smith et al., 2011), and positively associated with threat appraisals, disengagement during difficulty (Ntoumanis et al., 2014a), more perceived obstacles and tempting desires (Milyavskaya et al., 2015). Furthermore, personal goal self-concordance (i.e., personal goals pursued for more autonomous reasons) are positively associated with subjective ease in goal pursuit (Werner, Milyavskaya, Foxen-Craft, & Koestner, 2016).

Nonetheless, there have been limited accounts of how the different motivational regulations work to boost or reduce behavior during instances of goal failure. Autonomous motivation may facilitate greater responsiveness to errors during goal pursuit relative to controlling motivation, however this has been demonstrated in neural signals (i.e., error-related negativity), rather than overt behavioral corrections (Legault & Inzlicht, 2013). When a goal is unattainable, autonomous motives are associated with alternative goal engagement even though disengagement from the original goal is more difficult. In contrast, controlling motives are unassociated with alternative goal reengagement (Ntoumanis, Healy, Sedikides, Smith, & Duda, 2014b; Smith & Ntoumanis, 2014). However, this knowledge does not help us understand persistence in the original goal after failure. A deeper appreciation of goal failure and subsequent reengagement can be gained by investigating the emotional experience during lapses in goal-directed behavior (Marlatt & Gordon, 1985). Specifically, motivational regulations may lead to different emotional experiences when individuals fail to do planned exercise (Kinnafick, Thøgersen-Ntoumani, & Duda, 2014).

Experimental and correlational research has shown that, relative to controlling regulations, autonomous regulations are associated with positive emotional experiences during exercise (or at least recalled emotional experiences), such as elevated levels of positive affect (Edmunds et al., 2008), vitality (Gunnell et al., 2014), and enjoyment (Banting, Dimmock, & Grove, 2011; Murcia, de San Román, Galindo, Alonso, & González-Cutre, 2008), complementing lower levels of negative affect (Gunnell et al., 2014; Teixeira & Palmeira, 2016) and social physique anxiety (Thøgersen-Ntoumani & Ntoumanis, 2007). These emotional benefits may also extend immediately beyond the exercise session and up to 3 h after exercise has been completed (Guérin, Fortier, & Sweet, 2013; Lutz, Lochbaum, & Turnbow, 2003). This research is valuable but considers emotional response to the activity itself (i.e., what does doing the activity feel like?), it does not help us understand responses to goal failure (i.e., what does not doing the activity feel like?). Filling this gap will help address concerns that psychologists have overlooked processes underlying non-adherence, and particularly the role of affect (Ekkekakis, Zenko, & Werstein, 2018). Hence, we aim to test the idea that motivational regulations lead to affective experiences that help or inhibit individuals respond from a setback and reengage with exercise.

Guilt, anxiety, and relief were selected as potential affective mechanisms explaining successful goal pursuit and failure (Carver, 2009; Hofmann & Fisher, 2012; Leventhal & Zvolensky, 2015). Our decision to investigate these emotions was based on their ability to guide decision-making and behavior, as well as their conceptual links with specific forms of regulation. Controlling motivation (i.e., a composite of introjected and external regulation) has been associated with affective responses following an inability to achieve goals (Study 2, Ntoumanis et al., 2014b). However, this process is likely to be nuanced depending on the dominant motivational regulation. Introjected regulations may promote self-relevant emotions, such as guilt and anxiety, following a lapse in goal-driven behavior because this regulation is associated with the tendency to self-criticize and goal failure would damage contingent self-esteem (Ryan & Deci, 2017). In other words, introjected regulation will lead to guilt and anxiety because goal failure represents exactly what the individual is trying to avoid.[1] Also, introjected regulation should not impact the extent to which lapse elicits feelings of relief given this emotion requires recognition that a threat (e.g., to self) has been avoided (Carver, 2009), rather than realized in the case of a lapse. In contrast, external regulation reflects a wholly external pressure to exercise, hence, goal failure does not conflict with any internalized motive. Alleviating psychological discomfort by not taking part may, therefore, elicit somewhat positive emotional responses (Carver, 2009; Elliot & Devine, 1994). Feelings of relief may follow a slip in exercise behavior, because external regulation reflects a lack of true internalized motive to engage. In comparison to the controlling regulations, autonomous regulations are associated with greater self-acceptance (e.g., Magnus, Kowalski, & McHugh, 2010) and acknowledgement of personal limitations. Thus, autonomous regulations may orient individuals to accept occasional failures in goal pursuit and to not experience these failures as a threat to self-identity. Autonomous regulations are, therefore, not likely to be associated with aversive self-relevant emotions, such as guilt and anxiety, or positive feelings of relief following a lapse in exercise behavior.

1.1. Overview of present studies

Establishing links between an individual's motives and how they are likely to feel following lapse is important, because emotions may influence various processes and outcomes indicative of optimal engagement (Hofmann & Fisher, 2012; Rhodes & Kates, 2015; Williams et al., 2008). As such, the aim of the present studies was to examine whether individuals' behavioral regulations for exercise were associated with a) the regularity in which individuals reported to lapse in engaging in planned recreational exercise, and b) the emotional experiences of individuals when they fail to do planned recreational exercise (i.e., guilt, anxiety, and relief). We limited our investigation to recreational exercise given alternative forms of activity, such as competitive sport, have different structural components that make lapse less likely (e.g., formal competitions, selection processes). Study 1 represented a cross-sectional investigation of the associations between motives, emotional experiences, and lapses in exercise behavior (Figs. 1 and 2).

Building upon this study, Study 2 adopted a diary approach to replicate these tests.[2] Across both studies, it was hypothesized that autonomous motives (i.e., intrinsic motivation, integrated regulation, and identified regulation) would be negatively associated with lapses in exercise behavior, whereas introjected and external regulation would be positively associated with lapses in exercise behavior. In terms of emotions following lapse, autonomous regulations lead to greater self-acceptance (Magnus et al., 2010), hence, it was hypothesized to be unrelated to anxiety, guilt, and relief. Introjected regulation was also expected to be unrelated to relief because this would require avoidance of threat (Carver, 2009), whereas a lapse in exercise behavior for an individual regulated through introjection represents a threat that has been realized. Introjected regulation was expected to be positively associated with guilt and anxiety (Ntoumanis et al., 2014b). Finally,

[1] Although related, introjected regulation is distinct from feelings of guilt because the former construct reflects the preceding desire to avoid such emotion, rather than the consequential affective state *per se*.

[2] In the diary study, we also attempted to investigate whether motives for exercise predicted speed of reengagement in exercise following lapse. However, due to several limitations, including a large number of uncompleted responses to this variable and systematic bias, we did not include this variable in this article.

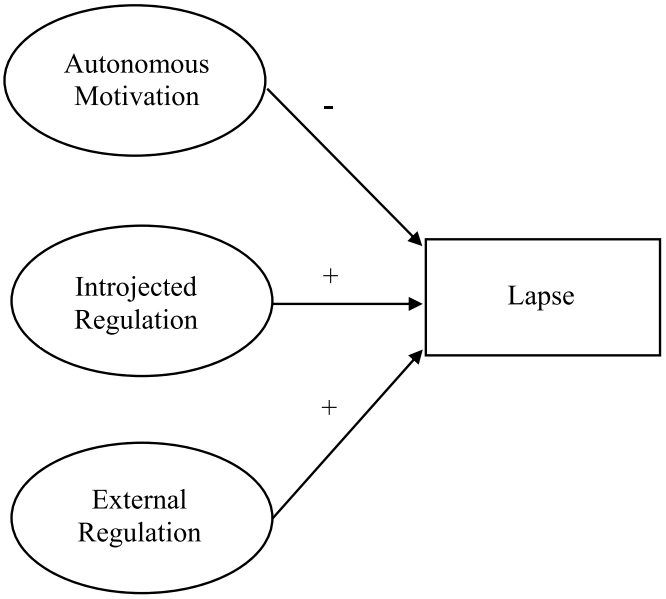

Fig. 1. Model depicting hypotheses in Study 1 between autonomous motivation, introjected regulation, external regulation, and likelihood of lapse in planned exercise.

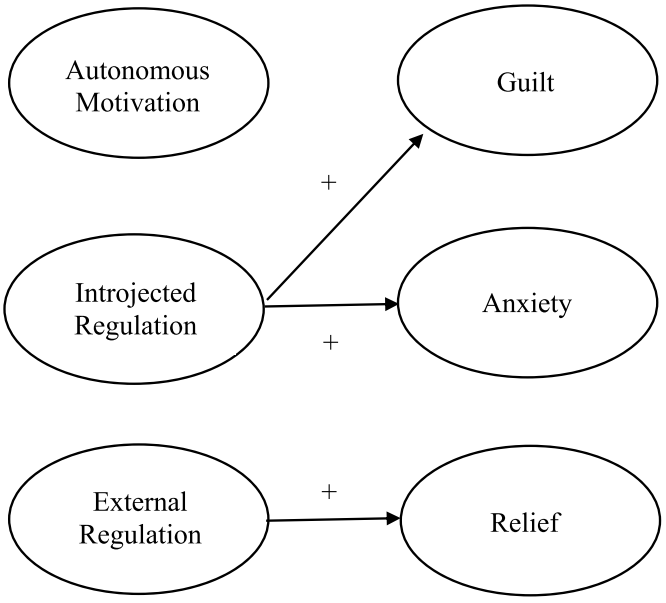

Fig. 2. Model depicting hypotheses in Study 1 between autonomous motivation, introjected regulation, external regulation, and guilt, anxiety, and relief following lapse in planned exercise.

external regulation was expected to be positively associated with relief (Carver, 2009) and unrelated to guilt and anxiety.

2. Study 1

2.1. Methods

Participants and Procedures. Structural equation modeling using *Mplus* software (Muthén & Muthén, 1998–2017) was used to investigate study hypotheses, with motivational regulations and emotional experiences modeled as latent factors and questionnaire items as observed indicators. Frequency of lapse was operationalized as an observed variable. As a result of this approach, an *apriori* sample size calculation (Soper, 2018) suggested a minimum sample size of 345 participants was required. This calculation was based upon an anticipated small effect size (0.25), power of .90, an alpha of 0.05, nine latent factors, and 34 observed variables (which were the greatest number of factors and variables in our tested models). We also followed the conservative rule-of-thumb of 10 observations per item (i.e., 340 participants; Nunnally, Bernstein, & Berge, 1967) to guide our participant recruitment. Accordingly, 350 participants (Mean age = 24.32 years, *SD* = 10.11 years; 220 females; gender not recorded in three participants) were recruited to take part in this study. Participants were recruited from the general public and from Psychology classes at a university in the United Kingdom. Students recruited from Psychology classes were offered course credit for their participation. Participants were required to access an online questionnaire (via a link sent to their email account or displayed on a poster), which took approximately 15 min to complete, and to answer questions pertaining to recreational exercise. The questionnaire provided participants with the following definition: 'recreational exercise refers to any planned jog or run, gym session, exercise class, cross-fit or similar activities. This questionnaire does not concern daily physical activity (such as walking or cycling to work) or competitive sport'.

We asked all participants to respond to an adapted three-item questionnaire measuring exercise intentions (Chatzisarantis, Biddle, & Meek, 1997). The stem was 'please answer the following questions regarding your usual recreational exercise intentions', and the response scale ranged from −3 ('not true at all') to 3 ('completely true'). An example item from this scale was 'I usually intend to exercise'. This scale was used to exclude participants from analyses that never usually intend to do recreational exercise. Seven participants scoring −3 across items were excluded from further analysis, thus giving a final sample of 343 participants. Also, 24 participants reported that they never lapsed in exercise plans, hence, their emotional responses were deemed to be invalid and not used in the analysis. Informed consent was received from participants before involvement, and the study was given ethical clearance from the university ethics committee.

Measures. ***Behavioral regulations for exercise.*** Participants' motivation for exercise was measured using the Behavioral Regulations for Exercise Questionnaire-3 (BREQ-3; Markland & Tobin, 2004; Wilson, Rodgers, Loitz, & Scime, 2006). This measure has factorial validity and reliability (Markland & Tobin, 2004) and has six subscales (intrinsic, integrated, identified, introjected, external, and amotivation) each containing four items. As the focus of this study revolved around planned recreational exercise, the amotivation subscale was considered irrelevant to study aims and therefore not included in subsequent data analysis. Example items include: 'I exercise because it is fun' (intrinsic motivation), 'I exercise because it is consistent with my life goals' (integrated regulation), 'It's important to me to exercise regularly' (identified regulation), 'I feel guilty when I don't exercise' (introjected regulation) and 'I exercise because other people say I should' (external regulation). We asked participants to consider 'recreational exercise' and not 'physical exercise' as in the original questionnaire. Individuals then responded to the items using a response scale ranging from 0 ('not true for me') to 4 ('very true for me').

Guilt. Guilt was measured using the six-item guilt subscale of the Positive and Negative Affect Schedule X (Watson & Clark, 1999). This subscale has been shown to be valid (Watson & Clark, 1999) and reliable (Borelli, Nelson-Coffey, River, Birken, & Moss-Racusin, 2017). We asked participants 'To what extent do you feel the following after you intended to take part in recreational exercise, but didn't?'. Individuals then completed all six items using a response scale ranging from 1 ('very slightly or not at all') to 5 ('extremely'). Example items include 'guilty' and 'blameworthy'.

Anxiety. Anxiety was measured using the six-item State-Trait Anxiety Inventory short form (Marteau & Bekker, 1992), which has been shown to have convergent validity and to be reliable (Marteau & Bekker, 1992). Individuals completed all six items using a response scale ranging from 1 ('not at all') to 4 ('very much'). Example items

include 'I feel calm' and 'I am tense'. All positively worded items were reverse scored, so that higher scores reflected higher levels of anxiety.

Relief. Relief was measured using the six-item relief subscale of the Achievement Emotions Questionnaire (Pekrun, Goetz, Titz, & Perry, 2002). Research has shown this scale to be reliable (Jarrell, Harley, Lajoie, & Naismith, 2017) and to possess construct and convergent validity (Pekrun, Goetz, Frenzel, Barchfeld, & Perry, 2011). Individuals completed all six items using a response scale ranging from 1 ('strongly disagree') to 5 ('strongly agree'). Example items include 'I feel relief' and 'I feel freed'.

Frequency of lapses in planned exercise. Frequency of lapses in planned exercise was measured using a single item: 'Following intentions or plans to participate in recreational exercise, how often do you fail to do the activity or session?'. This item was measured on a scale ranging from 1 ('never') through 4 ('some of the time') to 7 ('almost all of the time'). This measurement allowed participants to respond relative to their own level of planned exercise. As such, whether participants plan to engage in exercise once per week or daily did not prevent them from using the full range of responses.

3. Results

Preliminary Analysis. For information, descriptive statistics for all variables are presented in Table 1. Confirmatory factor analyses using maximum likelihood estimation was conducted to clarify the factor structure of the measurement scales. Indices used to establish model fit were comparative fit index (CFI) close to 0.95, root mean square error of approximation (RMSEA) < 0.10, and the standardized root mean square (SRMR) < 0.08 (Hu & Bentler, 1999; MacCallum, Brown, & Sugawara, 1996; Marsh, Hau, & Wen, 2004).

High inter-factor correlations (ranging from 0.78 to 0.89) among intrinsic, integrated, and identified subscales may have caused analytical problems if retained in their original form (i.e., multicollinearity). Accordingly, these subscales were estimated to load onto a higher order latent factor termed 'autonomous motivation'. This adapted model had acceptable model fit (S-Bχ^2 (164) = 442.481, $p < .001$; SRMR = 0.05; CFI = 0.95; RMSEA = 0.07 (90% CI: 0.06 to 0.08), but modification indices suggested estimating a correlation between two items ('I consider exercise part of my identity' and 'I consider exercise a fundamental part of who I am') would improve fit. These items share considerable conceptual overlap, in that they both question the extent to which exercise reflects an important part of participants' identity. Accordingly, this modification was made, and adequate model fit was demonstrated (S-Bχ^2 (163) = 333.96, $p < .001$; SRMR = 0.05; CFI = 0.97; RMSEA = 0.06 (90% CI: 0.05 to 0.06).

The guilt scale showed satisfactory fit, albeit a somewhat high RMSEA (S-Bχ^2 (9) = 67.32, $p < .001$; SRMR = 0.03; CFI = 0.95; RMSEA = 0.14 (90% CI: 0.11 to 0.18). The anxiety (S-Bχ^2 (9) = 84.40, $p < .001$; SRMR = 0.06; CFI = 0.91; RMSEA = 0.16 (90% CI: 0.13 to 0.20) and relief (S-Bχ^2 (9) = 188.52, $p < .001$; SRMR = 0.06; CFI = 0.90; RMSEA = 0.25 (90% CI: 0.22 to 0.28) subscales, however, did not show satisfactory fit and were adapted accordingly. For both subscales, two items ('I am worried' and 'I feel upset' from the anxiety scale; 'I feel relief' and 'I feel freed' from the relief scale) were removed because of the relatively low factor loadings (anxiety: 0.61 and 0.46, relief: 0.74 and 0.78) and comparatively high error variance (anxiety: 0.63 and 0.79, relief: 0.46 and 0.40). Acceptable fit was achieved for the modified anxiety (S-Bχ^2 (2) = 3.88, $p = .14$; SRMR = 0.01; CFI = 1.00; RMSEA = 0.05 (90% CI: 0.00 to 0.14) and relief (S-Bχ^2 (2) = 3.72, $p = .07$; SRMR = 0.01; CFI = 1.00; RMSEA = 0.05 (90% CI: 0.00 to 0.13) subscales.

Behavioral regulations predicting frequency of lapse. Autonomous motivation, introjected regulation, and external regulation together explained 29.0% of the variance in frequency individuals reported to lapse in their planned exercise. Structural fit statistics suggest this model fit the data well (S-Bχ^2 (180) = 351.67, $p < .001$; SRMR = 0.05; CFI = 0.97; RMSEA = 0.05 (90% CI: 0.05 to 0.06)). Bootstrapped (1000 samples) standardized coefficients showed autonomous motivation to be negatively associated ($\beta = -0.54$, 95% CI: 0.69 to −0.39, $p < .001$), and external regulation to be positively associated ($\beta = 0.17$, 95% CI: 0.06 to 0.28, $p = .002$) with lapse frequency. No association was found between introjected regulation and lapse frequency ($\beta = 0.10$, 95% CI: 0.02 to 0.23, $p = .13$). The substantive results did not change following the inclusion of age and gender as covariates, with only minimal changes in statistical parameters.

Behavioral regulations and emotions following lapse. Autonomous motivation, introjected regulation, and external regulation together explained 15.7% of the variance in anxiety, 48.6% of the variance in guilt, and 11.4% of the variance in relief following lapse. Structural fit statistics showed this model to represent a good fit (S-Bχ^2 (508) = 885.54, $p < .001$; SRMR = 0.05; CFI = 0.96; RMSEA = 0.05 (90% CI: 0.04 to 0.05)). Bootstrapped standardized coefficients showed autonomous motivation to be negatively associated with guilt ($\beta = -0.26$, 95% CI: 0.43 to −0.11, $p = .002$) following lapse, yet unrelated to anxiety ($\beta = -0.03$, 95% CI: 0.20 to 0.15, $p = .71$) and

Table 1
Descriptive statistics and zero-order correlations for Study 1 variables.

		Mean	*SD*	Potential Range	Correlations									
					1	2	3	4	5	6	7	8	9	10
1	Age[a]	24.30	10.10	–										
2	Gender[b]	.37	.48	–	.17**									
3	Intrinsic motivation[c]	2.84	0.92	0–5	.06	.09								
4	Integrated regulation[c]	2.33	1.21	0–5	.15**	.21**	.74**							
5	Identified regulation[c]	2.96	0.89	0–5	.14*	.16**	.77**	.83**						
6	Introjected regulation[c]	2.20	1.04	0–5	-.04	.01	.43**	.52**	.57**					
7	External regulation[c]	0.77	0.85	0–5	-.17**	-.04	-.13*	-.11*	-.09	.14*				
8	Anxiety[d]	2.49	0.70	1–4	.04	-.16**	.15**	.17**	.25**	.39**	.07			
9	Guilt[d]	2.69	1.03	1–5	-.17**	-.13*	.10	.19**	.23**	.57**	.23**	.44**		
10	Relief[d]	1.58	0.75	1–5	.01	.03	-.21**	-.24**	-.28**	-.19**	.19**	-.19**	.09	
11	Likelihood of lapse[e]	3.14	1.34	1–7	-.10	-.09	-.41**	-.47**	-.45**	-.19**	.24**	-.09	-.02	.20**

Note. SD = Standard deviation; Gender: 0 = female; 1 = male.
*$p < .05$ **$p < .01$.
[a] $N = 339$
[b] $N = 341$
[c] $N = 342$
[d] $N = 319$
[e] $N = 343$.

relief (β = −0.11, 95% CI: 0.33 to 0.06, $p = .25$). In contrast, introjected regulation was positively associated with feelings of guilt (β = 0.80, 95% CI: 0.65 to 0.96, $p < .001$) and anxiety (β = 0.42, 95% CI: 0.26 to 0.58, $p < .001$), but not relief (β = −0.15, 95% CI: 0.33 to 0.07, $p = .14$). Finally, external regulation was not associated with guilt (β = 0.10, 95% CI: 0.03 to 0.22, $p = .12$) nor anxiety (β = −0.07, 95% CI: 0.20 to 0.05, $p = .27$), but positively associated with relief (β = 0.24, 95% CI: 0.09 to 0.39, $p = .002$) following lapse. The substantive results did not change following the inclusion of age and gender as covariates, with only minimal changes in statistical parameters.

3.1. Brief discussion

Study 1 provides initial evidence that individuals motivational regulations for recreational exercise are associated with the likelihood of lapsing in exercise behavior and unique emotional responses following the lapse. In line with hypothesized relationships, autonomous motivation and external regulation were associated with less and more lapses in exercise behavior, respectively, and introjected regulation showed no association. Introjected regulation was positively implicated in poor quality emotional experiences following a lapse, with higher anxiety and guilt reported. This is likely because introjected regulation reflects partially internalized pressure to engage in behavior (Ryan & Deci, 2017). The data also evidenced that external regulation was positively associated with relief, likely due to the motives behind exercise behavior lacking relevance to the self (Carver, 2009). We expected autonomous motivation to be unrelated to emotional experiences following lapse. However, autonomous motivation was negatively associated with guilt, suggesting stronger links with post-lapse emotion than initially thought. It remains possible, however, that links between motivation and lapse prevalence may be explained by differences in planned exercise (i.e., individual's that plan more exercise each week may be at higher risk of lapse). Accounting for planned exercise may thus enable a better examination of proposed relations.

4. Study 2

Study 1 showed that motives underpinning exercise behavior are associated with emotional experiences that have implications for re-engagement and long-term behavior. However, the data were cross-sectional, and reports of lapse and emotions were general retrospective accounts which did not refer to a specific lapse event. Hence, Study 2 built upon these findings by implementing a diary study over a period of 21 days. Specifically, this study established whether behavioral regulations for exercise predicted (a) the likelihood that individuals lapsed, and (b) the extent to which individuals experienced guilt, anxiety and relief when they did lapse.

4.1. Methods

Participants. Participants were recruited from the public and Psychology classes at a university in the United Kingdom by word of mouth, email, and poster advertisement. Students recruited from Psychology courses were offered course credit for their participation. Eighty-nine participants (Mean age = 25.9 years, *SD* = 8.6 years; 55 females) took part in this study between December 2016 and September 2017. We based our sample size on attempting to obtain at least 50 Level-2 units (i.e., participants) to achieve accurate fixed effects parameter estimates and standard errors (Maas & Hox, 2005).

Procedure and Measures. Prior to this study, ethical clearance was given by the university ethics committee. Inclusion criteria for this study was that participants had some intention to take part in structured recreational exercise within the next 21-day period. After giving informed consent, participants provided their age, gender, and unique identification number (initials and date of birth), the latter of which helped facilitate anonymous tracking of questionnaires over the data collection period. Participants were provided with the same definition of recreational exercise as used in Study 1. They were then asked to complete an online measure of motivation for recreational exercise (see below), and informed that a researcher would be in touch about the remainder of the study.

Following completion of the initial demographics and motivation questionnaire, participants were asked via email to complete a brief online questionnaire each evening for a period of 21-days. Reminders were sent every two days in the early evening and it was suggested to participants that they set-up a calendar reminder on their phone to facilitate questionnaire completion.

Behavioral regulations for recreational exercise. As in Study 1, the BREQ-3 questionnaire was used to measure motivation for recreational exercise. This contextual measure of motivation should partially explain motivation at the situational level (Vallerand, 1997) whilst avoiding common method bias associated with implementing a situational measure of motivation alongside other situational measures (e.g., guilt, anxiety; Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). Intrinsic, integrated, and identified subscales were again aggregated to form an 'autonomous motivation' variable.

Daily diary questionnaire. Participants recorded their unique participant ID number and the day of the week the questionnaire referred to. Participants were provided with a definition of recreational exercise and asked: 'Did you do recreational exercise today?'. If they answered 'yes', participants moved straight on to questions about the following day's exercise plans. If participants answered 'no', however, they were asked the supplemental question: 'Did you plan to do recreational exercise today?'. If participants answered 'no', they moved on to the questions regarding the following days exercise plans. If they answered 'yes', however, they completed questions measuring the extent to which they experienced guilt, anxiety, and relief following lapse (see below). Therefore, only participants that stated they lapsed (i.e., that they did not do recreational exercise that day, but did plan to) completed questions concerning emotions. All participants then responded to questions about the following day's exercise plans: 'Do you plan or intend to take part in a recreational exercise session tomorrow?' and 'If you do plan on taking part in a recreational exercise session tomorrow, what type of exercise do you plan on doing? If not applicable, type N/A'.

Emotions. The two highest loading items from each measure of emotion used in Study 1 were used in this study and were presented following the stem: 'To what extent did you feel the following when you intended to exercise today, but didn't?'. The two items used were: 'dissatisfied with self' and 'guilty' (guilt), 'I felt calm' and 'I was upset' (anxiety), and 'I felt relief' and 'I felt free' (relief). The item 'I felt calm' was reverse scored prior to analysis. All response scales were increased to 1–9 to maximize item measurement sensitivity.

Lapse. Lapse was calculated by comparing participants' stated intentions to do planned recreational exercise, with the following day's reported exercise. In other words, participants lapsed if they intended to exercise the following day but did not carry out any planned exercise.

Analysis. Because emotion and lapse data varied within participants over time, a multilevel analysis with repeated measures data clustered within participants was implemented with *MLwiN* software (version 2.3; Rasbash, Steele, Browne, & Prosser, 2015). This multilevel approach elicits more accurate standard errors as well as reduced type one error rates, compared to falsely implementing single level regression equations (Nezlek, 2011). Level 2 predictor variables (i.e., motivational regulations) were grand-mean centered.

Prior to testing the effects of predictor variables on study outcomes, intercept-only models were constructed for each emotion and lapse to detail the amount of variance at both levels of the outcome variable. Following these base models, main analyses were conducted by adding motivational predictor variables. First, the extent the behavioral regulations predicted whether participants lapsed in their exercise plans

was assessed. Lapse was dummy coded ('1' = yes; '0' = no) and analyzed using multilevel logistic regression. Second, whether the behavioral regulations predicted guilt, anxiety, and relief was investigated using multilevel linear regression. We also examined whether these results persisted after controlling for planned exercise (i.e., the amount of exercise individuals planned over the 21-day measurement period), age and gender.

5. Results

Descriptive Analysis. Out of a possible 1869 daily questionnaires, 1544 were completed (mean number of completed questionnaires per person = 17.35 ± 4.32). Of the completed questionnaires, 78% (1200) were completed on the day proposed, with 96% (1481) completed either on the proposed day or the day after. Participants stated they intended to exercise on the following day on 873 out of 1544 days. Following these intentions, participants recorded the following day that they did not exercise (i.e., lapsed) on 196 occasions (2.20 ± 2.19 lapses per person, range 0–11 lapses), they did participate in exercise on 529 occasions (5.94 ± 4.25 exercise days per person, range 0–18 exercise days), and 148 instances were not reported the following day. As such, lapse prevalence rate was 27% (196 out of 725 occasions). On 34 of the 196 occasions that participants were identified to have lapsed, participants stated the following day that they did not (i.e., participants stated that they did not intend to exercise, even though they reported an intention the preceding day).

Primary Analysis. Our model with lapse as the outcome variable was comparable to binary logistic regression. Hence, this model does not need to meet the assumptions of linearity and normally distributed residuals. The normality of the level 2 residuals of the emotional responses was visually inspected and no major deviations from normality were observed. Correlations between the motivational predictor variables ranged from $r = .03$ to .41, indicating that multicollinearity was not an issue in the models.

As shown in Table 2 (unadjusted analysis) autonomous motivation was negatively associated with lapse and introjected regulation showed a weak positive trend with lapse. Adjusting for planned exercise, age and gender (Table 3) led to weaker evidence of the association between autonomous motivation and lapse, but more credible evidence of the association between introjected regulation and lapse. No associations were found between external regulation and lapse in either analysis. In the models investigating the relationships among motivation and emotional response to lapse, autonomous motivation was negatively associated with relief in both analyses, and weak evidence for a negative association with guilt became more credible when adding the control variables. Autonomous motivation was unrelated to anxiety. Introjected regulation was positively associated with guilt in both analyses. Weak evidence of a positive association between introjected regulation and anxiety became stronger with the inclusion of the control variables. Introjected regulation was unrelated to relief in both analyses. No associations among external regulation and emotions were found.

5.1. Brief discussion

Study 2 used longitudinal data to demonstrate that contextual motivation (i.e., motives for exercise) predicts lapse in exercise behavior and associated emotional responses. The findings highlight novel distinctions between different motivational regulations. Some evidence demonstrates that motives underpinned by intrinsic value or coherence with one's sense of self can sustain long term health behavior; specifically, through fewer lapses. This process was complemented by no evidence of emotional responses that may compromise future engagement or well-being. In fact, contrasting with hypotheses and Study 1 findings, autonomous motivation may play a role in reducing relief following lapse. In line with hypotheses, but in contrast with findings from Study 1, introjected regulation positively associated with lapse, particularly when controlling for planned exercise. Moreover, introjected regulation again showed positive associations with guilt and anxiety following a lapse. Collectively, these findings substantiate arguments suggesting introjects are insufficient for optimal engagement relative to more autonomous variants of motivation and may even drive disengagement because of adverse emotional consequences (Ryan & Deci, 2017). In contrast to Study 1 findings, external regulation did not predict lapse or emotions. This outcome conflicts with our theorizing that relief following lapse would be associated with external regulation because the underlying reasons for participation are not coherent with the self.

5.2. General discussion

Autonomous and controlling motivational regulations differentially predict health behavior engagement (Ng et al., 2012). However, despite calls to investigate non-adherence (Ekkekakis et al., 2018), much less is known about whether these motivations can play a role when the behavior is not carried out. As such, the aim of the present studies was to investigate whether individuals' lapses in planned behavior, as well as the associated emotional experiences (i.e., guilt, anxiety, and relief) can be predicted from the underlying reasons individuals have for wanting to engage. Our investigation focused specifically on recreational exercise, thus our results should not be extrapolated to other domains (e.g., competitive sport) because of different motivational factors. Across the two studies, autonomous motivation was a predictor of more adaptive health behavior patterns and less potentially aversive emotional experiences. The link between introjected regulation and lapse was not convincingly demonstrated across the two studies, however, introjected regulation consistently increased the likelihood of poor-quality emotional experiences following a lapse. External regulation played little role in shaping emotional experiences across the two studies.

Our hypotheses that autonomous motivation would be associated with fewer lapses in exercise behavior following a lapse was supported, but not when planned exercise was included in the Study 2 analysis. This suggests that the effects of autonomous motivation on exercise (dis)engagement could be indirect via one's exercise intentions (Hagger

Table 2
Multilevel models investigating motivational predictors of lapse in planned exercise and post-lapse emotional responses.

Predictor	Lapse		Guilt		Anxiety		Relief	
	OR (95% CI)	*p*	*b* (95% CI)	*p*	*b* (95% CI)	*p*	*b* (95% CI)	*p*
Intercept	0.56 (0.48, 0.65)	< .001	4.69 (4.24, 5.15)	< .001	4.35 (3.95, 4.74)	< .001	2.57 (2.26, 2.88)	< .001
Autonomous motivation	0.81 (0.66, 0.99)	.04	−0.57 (−1.21, 0.08)	.08	0.21 (−0.35, 0.77)	.46	−0.50 (−0.94, −0.06)	.03
Introjected regulation	1.20 (0.99, 1.45)	.07	0.66 (0.03, 1.29)	.04	0.51 (−0.03, 1.06)	.07	0.02 (−0.42, 0.45)	.95
External regulation	0.92 (0.71, 1.18)	.50	−0.33 (−1.15, 0.50)	.43	0.10 (−0.61, 0.81)	.78	−0.48 (−1.04, 0.08)	.09
Level 1 error	–	–	2.71 (2.07, 3.35)	< .001	1.68 (1.28, 2.08)	< .001	0.96 (0.73, 1.18)	< .001
Level 2 error	1.22 (1.07, 1.38)	.002	2.28 (1.09, 3.47)	< .001	1.85 (0.96, 2.74)	< .001	1.21 (0.64, 1.77)	< .001

Note. OR = Odds ratio; CI = Confidence interval; Multilevel logistic regression used to estimate lapse.

Table 3
Multilevel models investigating motivational predictors of lapse in planned exercise and post-lapse emotional responses, controlling for the amount of exercise planned over the 21-day measurement period, age and gender.

Predictor	Lapse		Guilt		Anxiety		Relief	
	OR (95% CI)	*p*	*b* (95% CI)	*p*	*b* (95% CI)	*p*	*b* (95% CI)	*p*
Intercept	0.57 (0.49, 0.65)	< .001	4.58 (4.12, 5.04)	< .001	4.17 (3.80, 4.55)	< .001	2.66 (2.37, 2.96)	< .001
Autonomous motivation	0.88 (0.72, 1.07)	.21	−0.70 (−1.37, −0.02)	.04	0.03 (−0.51, 0.58)	.91	−0.47 (−0.90, −0.04)	.03
Introjected regulation	1.22 (1.01, 1.47)	.04	0.78 (0.15, 1.41)	.02	0.71 (0.20, 1.22)	.01	−0.06 (−0.46, 0.35)	.79
External regulation	1.06 (0.83, 1.34)	.66	−0.29 (−1.11, 0.54)	.49	0.30 (−0.37, 0.97)	.38	−0.42 (−0.95, 0.10)	.12
Planned exercise	0.97 (0.94, 1.00)	.03	0.09 (−0.01, 0.20)	.09	0.11 (0.02, 0.20)	.01	−0.09 (−0.15, −0.02)	.01
Age	0.98 (0.96, 1.00)	.01	−0.01 (−0.06, 0.05)	.80	0.01 (−0.04, 0.05)	.79	0.04 (0.00, 0.08)	.03
Gender	0.75 (0.56, 1.00)	.05	−0.30 (−1.33, 0.73)	.56	−1.11 (−1.95, −0.28)	.01	0.03 (−0.64, 0.69)	.94
Level 1 error	–	–	2.71 (2.07, 3.36)	< .001	1.68 (1.28, 2.07)	< .001	0.96 (0.73, 1.18)	< .001
Level 2 error	1.16 (1.04, 1.30)	.01	2.07 (0.96, 3.19)	< .001	1.41 (0.67, 2.14)	< .001	0.92 (0.46, 1.39)	< .001

Note. OR = Odds ratio; CI = Confidence interval; Gender: 0 = female; 1 = male; Multilevel logistic regression used to estimate lapse.

& Chatzisarantis, 2009). Autonomous motivation also likely reduced goal failure in the present study by acting as a motivational input to increase the salience of longer-term goals (Berkman, Kahn, & Livingston, 2016). Hence, autonomously motivated individuals experience fewer and less intense temptations and obstacles during goal pursuit than counterparts with lower autonomous motivation (Leduc-Cummings et al., 2017; Milyavskaya et al., 2015). Autonomous goals are more chronically and easily activated, relative to controlling goals (Milyavskaya et al., 2015), which makes carrying out intentions an easier and less fatiguing endeavor (Moller, Deci, & Ryan, 2006).

In addition to behavioral outcomes, our analysis focused on emotional experiences following lapses in goal driven behavior. Stemming from evidence showing autonomously motivated individuals may cope with lapse more adaptively (Weinstein & Ryan, 2011), we conservatively expected autonomous motivation would not associate with guilt, relief, and anxiety. In fact, the influence of autonomous motivation may be stronger than anticipated. Across the two studies autonomous motivation was unrelated to anxiety. However, autonomous motivation was negatively associated with relief in the diary study but not the cross-sectional study. We did not hypothesize a negative association between autonomous motivation and relief, but this relationship is conceptually defendable. Relief requires individuals have at least some expectation that a behavior will be threatening (Carver, 2009). Autonomously motivated individuals, on the other hand, experience lower threat responses (Hodgins et al., 2010), so a major ingredient for relief to occur is absent. In addition, it seems incompatible that autonomously motivated individuals would experience relief when they do not do something that they find pleasurable (Banting et al., 2011; Guérin et al., 2013) and enjoyable (Murcia et al., 2008). In addition, autonomous motivation was negatively associated with guilt in the cross-sectional analysis and in the diary study when planned exercise, age and gender was controlled for. Autonomous regulation positively associates with the tendency to be kind to oneself (Magnus et al., 2010), hence, it is plausible that lower guilt occurs when a lapse in intentions occurs. While these findings imply that autonomous motivation may dampen emotional experiences during a temporary lapse that may encourage long-term behavioral disengagement, the inconsistent nature of our findings suggests caution should be taken with this interpretation.

As hypothesized, introjected regulation stimulated feelings of guilt and anxiety following a lapse in behavior across both studies and was unrelated with relief. The large effect sizes suggest that these relationships are substantial. Introjected motives have been implicated in leading to elevated levels of guilt and anxiety previously (e.g., Sabiston et al., 2010), but this relationship had yet to be demonstrated during acts of disengagement. The findings align well with theory maintaining that introjected motivated individuals' self-esteem is contingent upon engagement (Ryan & Deci, 2017). As a result, the pronounced feelings of the guilt and anxiety after a lapse are a manifestation of impaired self-esteem (Crocker & Park, 2004; Pila, Sabiston, Brunet, Castonguay, & O'Loughlin, 2015). Despite this idea, our findings revealed inconsistent evidence that introjects promote lapse. Our data contradicts the idea that introjects can be powerful motivators in the short-term (Teixeira et al., 2012) or help orient attention to reparatory behaviors (Graton & Ric, 2017). More likely is that the negatively valanced affect associated with introjected regulation, including guilt, hampers self-control processes (Hofmann & Fisher, 2012; Muraven, Collins, Morsheimer, Shiffman, & Paty, 2005; Tice, Bratslavsky, & Baumeister, 2018). This explains why introjected regulation may not promote long-term behavioral engagement (Pelletier, Fortier, Vallerand, & Briere, 2001) and individuals possessing controlled motives find progress towards their goals a more difficult undertaking (Leduc-Cummings et al., 2017; Werner et al., 2016).

As expected, external regulation was unassociated with anxiety and guilt. This finding is consistent with theory maintaining that externally regulated individuals' self-esteem is unlikely to be at stake when a lapse occurs (Ryan & Deci, 2017). In fact, we expected that external regulation would be positively associated with feelings of relief and lapse, but this was only found in Study 1. External regulation may play less of a role in specific incidents of lapse, like those investigated in Study 2, compared to the more general processes examined in Study 1. Moreover, the link between external regulation, lapse and relief may be complex. If the external contingency driving behavior, rather than the behavior itself, represents a threat to the individual of some kind, then failure to carry out the behavior will trigger this threat and not provide relief. Indeed, external regulation in academic contexts, such as the threat of punitive measures for non-engagement, has been shown to positively associate with anxiety (Pekrun et al., 2002). On the contrary, if the behavior poses a greater threat, compared to the contingency, then relief will occur. Overall, it can be concluded that external contingencies, such as incentives and coercions, do not reliably predict goal-directed exercise behavior (Finkelstein et al., 2016; Ng et al., 2012) and offer little protection in preventing lapse (Marlatt & Donovan, 2005; Wagner & Heatherton, 2015).

6. Limitations and future directions

These studies enhance knowledge of the motivational and emotional processes underpinning lapse. Nonetheless, a limitation was that lapse was measured via self-report. Complementary measures of lapse may come in the form of gym attendance records in the exercise domain, biomarkers in response to medication adherence, or parental reports of homework completion in the academic domain. A second future direction would be to investigate the specifics around lapse and exercise disengagement. The reasons individuals give for lapsing may moderate the relationship between motivation and emotions following lapse. For example, greater experiences of guilt and anxiety following lapse may occur due to factors perceived to be controllable (i.e., an individual that does not feel up for exercise), compared to uncontrollable factors (i.e.,

an individual that is injured; Wagner & Heatherton, 2015). Similarly, experiences of relief following lapse may be more likely to positively relate to external regulation when lapse is perceived by individuals to free them from external pressures, rather than to expose them to the undesirable consequences which initially generated the external motives. With respect to the specifics of exercise, the duration of exercise individuals typically engage in may explain lapse likelihood and emotional responding. For instance, failing to complete a 90-min exercise session may elicit a different emotional response relative to failing to complete a brief 20-min bout. Third, individuals' motivation for exercise was only measured at one time-point in the present studies. We made this decision because we wanted to focus on contextually-based motives. Nonetheless, individuals' reasons for engaging in exercise and physical activity contexts can also change over time (Taylor, 2017), particularly in individuals undergoing major changes in their exercise behavior or plans (Silva et al., 2011). Multiple measurements of motivation may better capture these dynamics and may provide more temporally-based evidence linking motivation with emotion and lapse. Finally, we implicated the role of perceived threat in processes involving controlling motivation regulations. It would be of interest to investigate the relative threat posed by the underlying motivation, compared to the behavior, and the different emotional and behavioral consequences.

7. Conclusion

This study provides evidence linking individuals' motivational regulation for goal-directed behavior with their post-lapse emotional experiences and tendency to lapse. Specifically, our findings show autonomous motivation is important for reducing the likelihood of lapse. More controlling motives, in contrast, showed weak links with lapse, and in the case of introjected regulation may facilitate self-regulatory failure by promoting maladaptive emotional responses.

Conflicts of interest

None.

Declaration of conflicting interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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