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Future-oriented emotions and physical activity: Anticipated and anticipatory emotions as predictors of behavioural intentions and expectations

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ABSTRACT

Recent theories of physical activity motivation highlight the potential importance of affective, or hedonic, factors. These include two conceptually distinct future-oriented emotions involved in contemplating potential future physical activity. Anticipated emotion refers to the emotions one predicts feeling if the future event were to happen, whilst anticipatory emotions are experienced in the moment when thinking about a potential future event. The current study investigated the extent to which both future-oriented emotions vary as a function of participants' current activity levels, and their cross-sectional predictive value for physical activity intentions and behavioural expectations. In response to descriptions of potential future physical and non-physical activity events, 133 participants rated the valence and arousal of both anticipated and anticipatory emotions. They also rated behavioural expectation for each event and completed measures of current physical activity level and future physical activity intention. Results were largely in line with pre-registered predictions. Higher levels of current physical activity were associated with more positive anticipated and anticipatory emotions for potential physical activity events. Furthermore, when controlling for physical activity level, the valence of anticipated emotion for physical activity events predicted physical activity intention ($\beta = 0.39$, 95% CI [0.06, 0.72]), whilst anticipatory emotion valence predicted behavioural expectations ($\beta = 0.52$, 95% CI [0.25, 0.79]). These findings provide preliminary evidence that both types of emotional anticipation may play distinct roles in motivating physical activity engagement, which could be further explored using longitudinal designs and accelerometer data.

1. Introduction

The physiological and psychological benefits of physical activity (PA) are well-established, yet global estimates indicate that 27.5% of adults and 81% of adolescents do not meet the recommended guidelines for PA (Guthold et al., 2018; Guthold et al., 2020). This discrepancy has led exercise psychologists to explore the factors influencing PA engagement and sedentary behaviours. Traditionally, theories of PA motivation have focused on cognitive processes emphasising reasoned determination of behaviour; yet, more recently, arguments for the potential role of affective, or hedonic, factors have gained traction (Brand & Ekkekakis, 2018; Conner et al., 2015; Ekkekakis, 2017; Stevens et al., 2020). For example, the Affect and Health Behavior Framework (AHBF; Williams & Evans, 2014) identifies various potential affective determinants of health behaviours. These include an individual's *affective responses*, which pertain to the mood and emotions experienced during and immediately after PA, and *affective processing*, which involves automatic affective responses and reflective cognitive evaluations of mood and emotions related to past and potential future PA experiences (Stevens et al., 2020). The study presented here examined affective processing of potential future PA experiences as a mechanism contributing to PA engagement.

When contemplating future activities, individuals experience two conceptually distinct, but interrelated, types of future-oriented emotion: anticipated and anticipatory emotions. Anticipatory emotion constitutes the automatic, in-the-moment, affect an individual experiences when thinking about a potential future experience, whilst anticipated emotion refers to the emotions the individual predicts they would feel if the

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future event were to happen (Baumgartner et al., 2008; Stevens et al., 2020). These anticipated emotions involve more cognitive processing, forming part of a broader mental simulation process where a cognitive and emotional representation of the future event is generated (Szpunar et al., 2014; Williams et al., 2019). Evidence suggests that both types of future-oriented emotion serve as influential factors in goal-directed behaviours (Bagozzi et al., 1998; Baumgartner et al., 2008; Carrera et al., 2012; Perugini & Bagozzi, 2001). People are less likely to engage in an activity if they do not foresee it as pleasurable, and/or it does not bring pleasure upon in-the-moment contemplation. Arguably, these future-oriented emotions should influence decisions about PA engagement, viewed as a form of goal-directed behaviour (Eiser & Gentle, 1988).

The potential importance of these two types of future-oriented emotion as motivating factors aligns with dual-process theories of PA, such as the Affective-Reflective Theory of physical inactivity and exercise (ART: Brand & Ekkekakis, 2018) and the Physical Activity Adoption and Maintenance model (PAAM: Strobach et al., 2020). According to these models, PA and sedentary behaviour are shaped by the interaction between automatic affective processes and conscious, reflective-–evaluative processes. PA-related stimuli (e.g. a friend asking if you would like to go the gym this weekend) cue automatic affective valuations that are a function of the relative strength of the positive and negative associations with the PA-related stimuli and one's current state of PA. When sufficient self-control resources are available, then an effortful reflective evaluation process can follow. This evaluation can involve conscious deliberation of PA-related affective states, informed by prior experiences and mental simulations of possible future experiences, alongside higher-order cognitive processes incorporating subjective beliefs and attitudes toward PA. Therefore, within this dual-process framework, anticipatory emotions are automatic affective associations triggered by the PA-related stimuli (e.g. how you feel when the friend suggests going to the gym at the weekend and each time you think about this possible activity thereafter). Alongside this, anticipated emotions form part of an effortful mental simulation process of what will happen and how one will feel if, and when, the future event occurs (e.g. you envisage yourself going to the gym with your friend, imagining the sights and sounds, visualising the different exercises you would complete, as well as considering how you will feel during the activity).

Dual-process models of PA (e.g. Brand & Ekkekakis, 2018; Strobach et al., 2020) predict that these two future-oriented emotions should interact differently with two proximal antecedents of goal-directed behaviour, behavioural intentions and behavioural expectations. Behavioural intentions can be defined as the extent to which an individual has formulated conscious plans to perform a specified future behaviour, whilst behavioural expectations constitute an estimation of the likelihood that a specific future behaviour will be performed when taking experiential and situational factors into account (Warshaw & Davis, 1985). For instance, whilst you might intend to go to the gym with your friend at the weekend, you might also acknowledge a feeling of dread when thinking about gym-based exercises and a habit of oversleeping at weekends. As a result, the expectation is that the intended gym attendance is unlikely. Sometimes conflated with each other, both constitute distinct factors that influence behaviour, with prospective studies suggests that behavioural expectations are more predictive of behaviour than intentions (e.g. Armitage et al., 2015). In the context of dual-process accounts, intentions arise as a product of the reflective cognitive-evaluative pathway used to plan the future, which includes the prediction of anticipated emotion. In contrast, behavioural expectations incorporate experiential factors and consider situational circumstances; therefore, they will be, in part, a product of anticipatory emotions. Preliminary support for the differential relationship between future-oriented emotions, intentions, and behavioural expectations has been provided in the context of risky behaviours, such as binge-drinking. Carrera et al. (2012) found that anticipated emotions predicted undergraduate students' intentions to drink excessively, whereas anticipatory emotions predicted behavioural expectations regarding excessive drinking.

Theoretically, we have argued that the emotions that accompany thoughts about potential future PA are likely to impact on one's willingness to engage in PA. There is some literature specifically supporting the link between future-oriented emotions and PA motivation/engagement. Most of this work has focused on anticipated emotions, the feelings one predicts they will feel if that event were to happen in the future. For example, the positive emotions anticipated to accompany achievement of a weight loss goal have been shown to predict behavioural intentions to exercise (Bagozzi et al., 1998; Perugini & Bagozzi, 2001). In addition, Dunton and Vaughan (2008) demonstrated that anticipated positive affective consequences of regular participation in PA predicted PA adoption and maintenance across a three-month period. Other work has shown that individuals who do not, relative to those who do, regularly engage in PA, underestimate the enjoyment they will feel when exercising, i.e., they evidence an affective forecasting bias (Loehr & Baldwin, 2014). Experimental manipulations have demonstrated that this affective forecasting bias can be overcome, thereby helping to improve PA intentions (e.g., Helfer et al., 2015; Ruby et al., 2011). Thus, in summary, there is a body of evidence demonstrating that anticipated emotions are important motivators in PA, impacting both PA intentions and behaviour.

Despite the evidence supporting the link between anticipated emotion and PA intentions/behaviour, comparatively little research has explored the role of anticipatory emotions. Bagozzi et al. (1998) discuss anticipatory emotions in relation to body weight goals and dieting/exercise behaviours. However, their method asked participants to rate the extent to which they would feel a variety of different emotions if they were to succeed or fail in achievement of a chosen bodyweight goal. Thus, they actually tapped the construct of anticipated emotion (how one would feel when the potential future event occurs) rather than anticipatory emotion (how one feels now about the potential future event). To date, only a paper by Feil et al. (2022) has considered both anticipated and anticipatory emotions associated with PA. Using a Grounded Theory qualitative methodology, they identified 13 categories of anticipated and anticipatory emotions experienced by regular and non-regular exercisers. Interestingly, both regular exercisers and non-exercisers reported a range of both positive (e.g., enjoyment) and negative (e.g., anxiety) emotions. Thus, very little is known about the role of anticipatory emotions as a motivating factor for PA. Work by Carrera et al. (2012) suggests that anticipatory emotions may have a different relationship with behavioural expectations and intentions compared to anticipated emotions. Also, other work has shown that the two types of future-oriented emotions can be differentiated in the context of depressed mood (Clayton McClure et al., 2024). But, at present, no quantitative work has investigated both anticipated and anticipatory emotions with regards to potential future PA and, in particular, how these future-oriented emotions relate to PA intentions and behavioural expectations.

Therefore, the current study obtained measurements of anticipated and anticipatory emotions for potential future PA events and investigated their relationships with PA intentions and behavioural expectations. Adapting the methodology of Clayton McClure et al. (2024), participants were asked to mentally simulate potential future PA events and non-PA events. For each event they were asked to provide ratings of the valence and arousal for both anticipated and anticipatory emotions. They also provided ratings of behavioural expectation for both sets of events and questionnaire measures were used to assess current PA levels and PA intentions. This methodology allowed us to consider two interrelated research questions.

Firstly, we investigated whether there is a relationship between current PA levels and the valence/arousal of anticipated/anticipatory emotions accompanying potential future PA events. If emotional anticipation is critical in PA motivation, then we would expect it to vary across individuals who are currently active (i.e., have already chosen to

engage in PA) compared to those who are less active. Therefore, we hypothesised that higher levels of current PA will be associated with more positive and intense anticipated and anticipatory emotions for potential future PA activities. The same relationship was not expected for potential future non-PA activities.

Secondly, we investigated the relationships between the valence/arousal of anticipated/anticipatory emotions and PA-related intentions and behavioural expectations. If emotional anticipation is critical in PA motivation, then we would expect individuals reporting more positive and intense emotional anticipation for potential future PA activities to report higher levels of PA intention and behavioural expectation. The same relationship would not be expected for potential future non-PA activities. However, dual-process theories of PA (e.g. Brand & Ekkekakis, 2018; Strobach et al., 2020), along with previous empirical work (Carrera et al., 2012), suggest that anticipated and anticipatory emotions may be differentially associated with intentions and behavioural expectations. Therefore, we proposed two subsidiary hypotheses: that anticipated, but not necessarily anticipatory, emotion would predict intention whilst anticipatory, but not necessarily anticipated, emotion would predict behavioural expectation.

2. Methods

2.1. Transparency and openness

The study was pre-registered (https://osf.io/zx23c), with materials and data openly available (https://doi.org/10.17605/OSF/IO/8NBHR), via the Open Science Framework. https://osf.io/8nbhr/overview?view_only=79205a0bcce64e9fbc39471456721cd2.

2.2. Participants

133 undergraduate psychology students (108 female, 21 male, 4 other/prefer not to say) aged between 18 and 48 years ($\bar{X} = 20.77$, $SD = 5.67$) participated in return for research course credit. The study was reviewed and approved by the Faculty of Health Sciences Research Ethics Committee at the University of Hull. A target sample size of 110–120 was pre-registered. This was based on pilot data using similar measures within a linear mixed models framework (hypothesis 1) and power calculations suggesting this would provide at least 80% power to detect an effect size of 0.1 within hierarchical regression analyses (hypothesis 2).

2.3. Procedure

Participation was completed online using Qualtrics (Provo, UT). After providing informed consent, participants completed the Future Events Task. Following completion of all three blocks of the Future Events Task, participants then completed the two self-report inventories in a counterbalanced order. Due to the online nature of data collection, several attention checks (e.g., "please move this slider to 50″) were presented across the procedure to monitor adherence to task instructions.

2.4. Materials

2.4.1. Future events task

Participants were presented with single-sentence descriptions of twenty hypothetical future events, half of which portrayed the participant partaking in PA (e.g., *You attend a yoga session on campus*) while the other half did not involve physical activity (e.g., *You watch a concert in your local park*). All activities were considered feasible occurrences for undergraduate students, with PA and non-PA events matched for surrounding environment as closely as possible (i.e., one of each event type occurs on holiday, in a garden, in water etc.).

For each event, participants were asked to provide ratings of anticipated and anticipatory emotion using a similar method to Clayton McClure et al. (2024). In line with Baumgartner et al.'s (2008) definitions, anticipated emotions and anticipated emotions were operationalised, respectively, as how participants think they would feel if they were to engage in the activity in the future and how thinking about the future event makes them feel right now. For both future-oriented emotions participants provided ratings of valence (Anticipated - *What will your predominant emotion be in this imagined future scenario?;* Anticipatory - *What is your predominant emotion right now, as you imagine this scenario?*) followed by arousal (Anticipated - *How strong will your emotional reaction to the situation be?,* Anticipatory - *How strong is your emotional experience right now?*).

Participants also provided ratings of behavioural expectation (*Should the opportunity arise in the next 8 weeks, how likely is it that you would engage in this activity?*). The wording for this item mapped onto the theoretical conceptualisation of behavioural expectation as an estimate of the likelihood that a specified future behaviour would be performed (Warshaw & Davis, 1985), with the eight-week time period chosen to align with the PA intention measure (see Section 2.4.3, Wing Kwan et al., 2009). To reflect the potential for valence of events to be negative or positive, these ratings were provided on a slider scale ranging from –50 (*extremely negative*) to + 50 (*extremely positive*). All other ratings were provided on slider scales ranging from 0 to 100.

Responses for anticipated and anticipatory emotion were blocked and presentation of the blocks counterbalanced across participants. To prevent cognitive-evaluative ratings influencing our measurement of future-oriented emotions, behavioural expectation ratings were obtained in a third block (alongside ratings of typicality and simulation vividness – see supplementary materials) always presented after both the anticipatory/anticipated emotion blocks. Participants were presented with all 20 event stimuli, in a randomised order, in each block.

2.4.2. Godin leisure time exercise questionnaire

Participants' current PA levels were assessed using the Godin Leisure Time Exercise Questionnaire (GLTEQ: Godin & Shepherd, 1985). Respondents were asked to indicate how frequently (number of times) they engaged in strenuous (e.g., running, cross country skiing, vigorous swimming, judo), moderate (e.g., fast walking, badminton, easy cycling, easy swimming), and mild (e.g., golf, yoga, archery, fishing from river bank) PA for 30 min or more in their free time during an average week across the preceding six-month period. A total weekly leisure activity score is calculated as (9 × strenuous frequency) + (5 × moderate frequency) + (3 × light frequency). A higher total score is indicative of more PA engagement across the preceding six months. The GLTEQ has demonstrated excellent test-retest reliability ($ICC = 0.98$) and moderate concurrent validity ($r = 0.46$–0.52) with accelerometery measures of PA (Alotaibi et al., 2024).

2.4.3. PA theory of planned behaviour questionnaire

Participants' PA intentions over the forthcoming eight weeks were measured using two items from the theory of planned behaviour (TPB) questionnaire developed by Wing Kwan et al. (2009). These two items ask participants to rate, on 7-point scales (1 = *strongly disagree*, 7 = *strongly agree*), the following: *During the next 8 weeks, I intend to be physically active for at least 30 min on 4 or more days per week* and *During the next 8 weeks, I will try to be physically active for at least 30 min on 4 or more days per week.* Originally designed to assess the facets of the TPB (Ajzen, 1985) with respect to PA in undergraduate students, this inventory also assesses attitudes (5 items), subjective norms (4 items) and perceived behavioural control (5 items). Participants were presented with all 16 items in a randomised order, with only the summed score of the two intention items used for subsequent data analyses.

2.5. Design & analysis plan

We used a within-subjects design in which all participants rated

anticipated emotions (valence/arousal), anticipatory emotions (valence/arousal) and behavioural expectation (likelihood of engagement upon opportunity) in response to both PA and non-PA events. Current PA levels (GLTEQ score) and PA intentions (TPB intention) were both measured as participant-level continuous variables.

Our analysis plan was pre-registered. Our first research question, regarding the relationship between current PA levels and the anticipated/anticipatory emotions accompanying potential future PA events, was assessed using multilevel analysis. Two separate models were computed for dependent variables of valence and arousal, with random intercepts per participant, and fixed factors of emotion type (anticipated vs. anticipatory), event type (PA vs. non-PA) and a continuous, participant-level predictor of GLTEQ score.

Our second research question concerned the relationship between the valence/arousal of anticipated/anticipatory emotions accompanying potential future PA events and future exercise intentions and behavioural expectations. These were assessed using separate hierarchical linear regressions (participant-level) for dependent variables of future PA intentions and behavioural expectations, with predictors of anticipated/anticipatory valence and arousal for PA and non-PA events and GLTEQ score.

3. Results

3.1. Data processing

Prior to analysis, pre-registered screening protocols were applied to our dataset. Four participants failed 2+ attention checks, with a further three participants removed as outliers (>2.5SD) on the continuous participant-level variables (GLTEQ score/TPB intention). No item-level outliers (>3SD) were found (valence/arousal/behavioural expectation), and assessment of skew/kurtosis showed no need for transformation of any variables.

3.2. Descriptive statistics and preliminary analyses

Table 1 presents participant-level descriptive statistics ($N = 126$) and correlations between variables.

For PA events, anticipated and anticipatory emotions were positively correlated with each other on both valence and arousal measures; for non-PA events, all four emotion measures were positively intercorrelated (i.e., higher valence was also correlated with higher arousal). For PA events, only the valence ratings for anticipated and anticipatory emotions were positively correlated with behavioural expectations, whereas for non-PA events, both valence and arousal of anticipated and anticipatory emotions were positively correlated with behavioural expectations.

For PA events, the valence of anticipated and anticipatory emotions, as well as behavioural expectation ratings, were positively correlated with TPB Intention scores. Additionally, behavioural expectation ratings for PA events were positively correlated with GLTEQ scores. The arousal of anticipated emotions for non-PA events was negatively correlated with TPB Intention scores. GLTEQ and TPB Intention scores were also highly correlated with each other.

3.3. Relationship between current PA levels and anticipated/anticipatory emotions

Two separate linear mixed effect models were computed to predict emotional valence and arousal ratings, with random intercepts per participant, and within-subjects fixed factors of emotion type (anticipated vs. anticipatory), event type (PA vs. Non-PA) and a continuous, participant-level predictor of GLTEQ score. These models included 5040 ratings clustered within 126 participants. Model parameters are summarised in Table 2.

The conditional R^2 value for the model predicting valence was 0.16 ($p < .001$) and the inclusion of a random intercept by participant explained significant variance ($p < .001$). For the main effect of emotion type, a significant omnibus effect was found, $F_{(1,4908)} = 4.03$, $p = .045$, although the parameter estimate was not significant, $b = -2.41$, 95% CI [−5.78, 0.96], $p = .161$. The main effect of event type was significant, $F_{(1,4908)} = 33.36$, $p < .001$, with non-PA events rated as more positive than PA events, $b = 7.05$, 95% CI[3.68, 10.42], $p < .001$. The GLTEQ x Event Type interaction was significant, $F_{(1,4908)} = 5.14$, $p = .023$. As GLTEQ score increased, the valence of PA events was rated as more positive, $r_{(2518)} = 0.07$, 95% CI [.03, 0.11], $p < .001$, yet the same relationship was not evident for non-PA events, $r_{(2518)} = 0.01$, 95% CI [−0.03, 0.05], $p = .525$. All other main effects and interactions were

Table 2
Fixed effect estimates for models predicting valence and arousal.

	Valence		Arousal	
Predictor	*b (SE)*	95% CI	*b (SE)*	95% CI
(intercept)	9.87 (2.02)***	[5.91, 13.84]	54.85 (2.71)***	[49.54, 60.17]
GLTEQ	0.10 (0.05)	[0.01, 0.19]	0.0003 (0.06)	[−0.12, 0.12]
Emotion Type	−2.41 (1.72)	[−5.78, 0.96]	−4.37 (1.72)***	[−7.75, −1.00]
Event Type	7.05 (1.72)***	[3.68, 10.42]	−0.15 (1.72)	[−3.53, 3.22]
GLTEQ*Emotion Type	−0.05 (0.04)	[−0.13, 0.03]	−0.09 (0.04)†	[−0.17, −0.01]
GLTEQ*Event Type	−0.09 (0.04)*	[−0.16, −0.01]	−0.05 (0.04)	[−0.13, 0.03]
Event Type*Emotion Type	−0.06 (2.43)	[−4.83, 4.71]	−1.42 (2.44)	[−6.19, 3.36]
GLTEQ*Event Type*Emotion Type	0.04 (0.06)	[−0.07, 0.15]	0.07 (0.06)	[−0.04, 0.18]

Note. Event type (PA, Non-PA) and emotion type (anticipated, anticipatory) dummy-coded (0, 1); † 0.05 < p < .10; *p < .05 ** p < .01 *** p < .001.

Table 1
Participant-level descriptive statistics (*M* & *SD*) and correlations.

Variable	*M* (*SD*)	1	2	3	4	5	6	7	8	9	10	11	12
1.PA Anticipated Valence	13.62 (13.69)	-											
2. PA Anticipated Arousal	54.86 (14.17)	.17	-										
3. PA Anticipatory Valence	9.38 (12.93)	.83***	.15	-									
4. PA Anticipatory Arousal	47.15 (18.74)	.02	.66***	.17	-								
5. PA Beh. Expectation	52.24 (17.72)	.68***	.17	.71***	.04	-							
6. Non-PA Anticipated Valence	17.50 (9.88)	.61***	.15	.60***	.17	.42***	-						
7. Non-PA Anticipated Arousal	52.82 (14.67)	.15	.79***	.15	.62***	.11	.26**	-					
8. Non-PA Anticipatory Valence	14.86 (11.28)	.40***	.11	.58***	.28**	.37***	.81***	.21*	-				
9. Non-PA Anticipatory Arousal	46.37 (19.08)	.02	.57***	.16	.86***	.03	.26**	.72***	.37***	-			
10. Non-PA Beh. Expectation	62.60 (14.75)	.29**	.20*	38***	.20*	.47***	.53***	.30***	.56***	.27**	-		
11, GLTEQ	36.79 (22.88)	.17	.0004	.09	−0.11	.24**	.04	−0.08	.02	−0.08	−0.02	-	
12. TPB Intention	9.50 (3.54)	.27**	−0.06	.22	−0.05	.27**	.15	−0.18*	.20*	−0.11	−0.04	.51***	-

Note: Valence ratings −50 to +50, all other event ratings 0 to 100, GLTEQ range 0 to 100, TPB Intention range 0–14, *p < .05 ** p < .01 *** p < .001.

non-significant.

The conditional R^2 value for the model predicting arousal was 0.30 ($p < .001$) and the inclusion of a random intercept by participant explained significant variance ($p < .001$). The main effect of emotion type was significant, $F_{(1,4908)} = 17.40$, $p < .001$, with anticipated emotions rated as more intense than anticipatory emotions, $b = -4.37$, 95% CI[−7.75, −1.00], $p < .001$. All other main effects and interactions were non-significant.

3.4. Relationship between the valence/arousal of anticipated/anticipatory emotions and future exercise intentions

A participant-level hierarchical linear regression analysis assessed future-oriented emotions as predictors of PA future intentions. GLTEQ was entered at step 1, with valence and arousal measures for anticipated and anticipatory emotions for both PA and non-PA events at step 2. Collinearity statistics suggested acceptable levels of multicollinearity (max. VIF = 6.91, min. tolerance = 0.15). Model parameters are summarised in Table 3.

The inclusion of GLTEQ score at step 1 accounted for a significant proportion of the variance in PA future intention scores, $R^2 = 0.26$, $F_{(1124)} = 43.70$, $p < .001$. The addition of future-oriented emotion variables at step 2 improved the model fit, $\Delta R^2 = 0.13$, $F_{(8116)} = 2.97$, $p = .005$. The valence of anticipated emotions for PA events, $\beta = 0.39$, 95% CI [0.06, 0.72], $p = .023$, and the valence of anticipatory emotions for non-PA events were both significant predictors of PA future intentions, $\beta = 0.42$, 95% CI [0.11, 0.73], $p = .009$.

3.5. Relationship between the valence/arousal of anticipated/anticipatory emotions and PA behavioural expectations

A further participant-level hierarchical linear regression, using the same predictor variables, investigated future-oriented emotions as predictors of PA behavioural expectations. Model parameters are summarised in Table 4.

Table 3
Hierarchical regression analysis for variables predicting PA future intentions.

Predictor	*b* (*SE*)	β	95% CI	R^2	R^2_{adj}	ΔR^2
Step 1				.26	.26***	
(intercept)	6.60 (0.52)					
GLTEQ	0.08 (0.01)	0.51***	[0.36, 0.66]			
Step 2				.39	.34***	.13**
(intercept)	7.66 (1.19)					
GLTEQ	0.07 (0.01)	0.46***	[0.31, 0.61]			
PA Anticipated Valence	0.10 (0.04)	0.39*	[0.06, 0.72]			
PA Anticipated Arousal	0.002 (0.04)	0.009	[−0.28, 0.30]			
PA Anticipatory Valence	−0.06 (0.04)	−0.23	[−0.55, 0.09]			
PA Anticipatory Arousal	0.05 (0.03)	0.29	[−0.07, 0.64]			
Non-PA Anticipated Valence	−0.09 (0.05)	−0.25	[−0.57, 0.07]			
Non-PA Anticipated Arousal	−0.05 (0.04)	−0.20	[−0.52, 0.12]			
Non-PA Anticipatory Valence	0.13 (0.05)	0.42**	[0.11,0.73]			
Non-PA Anticipatory Arousal	−0.05 (0.04)	−0.24	[−0.62, 0.14]			

Note. *p < .05, **p < .01 *** p < .001.

Table 4
Hierarchical regression analysis for variables predicting PA behavioural expectations.

Predictor	*b* (*SE*)	β	95% CI	R^2	R^2_{adj}	ΔR^2
Step 1				.06	.05**	
(intercept)	45.33 (2.92)					
GLTEQ	0.19 (0.07)	0.24**	[0.07, 0.42]			
Step 2				.57	.53***	.51***
(intercept)	34.76 (5.01)					
GLTEQ	0.10 (0.05)	0.14*	[0.01, 0.26]			
PA Anticipated Valence	0.28 (0.18)	0.22	[−0.06, 0.50]			
PA Anticipated Arousal	0.25 (0.16)	0.20	[−0.04, 0.44]			
PA Anticipatory Valence	0.71 (0.19)	0.52***	[0.25, 0.79]			
PA Anticipatory Arousal	−0.13 (0.14)	−0.14	[−0.43, 0.16]			
Non-PA Anticipated Valence	−0.11 (0.24)	−0.06	[−0.33, 0.21]			
Non-PA Anticipated Arousal	−0.07 (0.16)	−0.06	[−0.33, 0.20]			
Non-PA Anticipatory Valence	0.09 (0.21)	0.05	[−0.21, 0.32]			
Non-PA Anticipatory Arousal	−0.002 (0.15)	−0.003	[−0.32, 0.32]			

Note. *p < .05 ** p < .01 *** p < .001.

The inclusion of GLTEQ score at step 1 accounted for a significant proportion of the variance in PA behavioural expectation scores, $R^2 = 0.06$, $F_{(1124)} = 7.75$, $p = .006$. The addition of future-oriented emotion variables at step 2 significantly improved the model fit, $\Delta R^2 = 0.51$, $F_{(8116)} = 17.00$, $p < .001$. The valence of anticipatory emotions for PA events, $\beta = 0.52$, 95% CI [0.25, 0.79], $p < .001$, significantly predicted PA behavioural expectations.

4. Discussion

The current study investigated two interrelated research questions concerning the relationship that emotional anticipation of PA holds with, firstly, current PA levels, and secondly, PA-related intentions and behavioural expectations.

With regard to our first research question, previous research has suggested that both anticipated and anticipatory emotions are critical motivating factors for goal-directed behaviours such as PA (Baumgartner et al., 2008). Therefore, we would expect to see differences across those who already choose to regularly engage in PA compared to those who do not. Specifically, we hypothesised that higher levels of current PA would be associated with more positive and intense anticipated and anticipatory for potential future PA activities. This hypothesis was partially supported. Higher GLTEQ scores were associated with higher positive valence of anticipated and anticipatory emotions for potential future PA activities. (but not for potential future non-PA activities). However, GLTEQ scores were not related to measures of arousal; thus, whilst those who are more physically active experience more *positive* future-oriented emotion for future PA activities, we found no evidence that these emotions are more *intense*.

Our second research question built on previous research that established that future-oriented emotions are predictive of two proximal antecedents of goal-directed behaviour, intentions and behavioural expectations (Baumgartner et al., 2008; Carrera et al., 2012). Thus, our overarching prediction was that individuals who report more positive

and intense emotional anticipation of potential future PA activities would report higher levels of PA intention and behavioural expectation. However, dual-process theories of PA (e.g. Brand & Ekkekakis, 2018; Strobach et al., 2020), alongside research by Carrera et al. (2012), suggest anticipated and anticipatory emotions may be differentially associated with intentions and behavioural expectations; therefore, we proposed that anticipated, but not necessarily anticipatory, emotion would predict PA intention whilst anticipatory, but not necessarily anticipated, emotion would predict PA behavioural expectation. Our results on PA intentions demonstrated that the valence of anticipated emotions associated with PA events did add significant predictive power beyond that accounted for by current PA levels, equating to a medium-sized standardised effect ($\beta = 0.39$). However, the valence of anticipatory emotions associated with non-PA events was also a significant predictor of PA intentions. When predicting behavioural expectation, valence of anticipatory emotions for PA events added significantly to model fit, with a large standardised effect ($\beta = 0.52$). These effect magnitudes are greater than those found by Carrera et al. (2012) when predicting binge-drinking intention/expectations, suggesting meaningful differences in our dependent measures according to levels of future-oriented emotion. This is particularly true for behavioural expectations, where a total of 57% of variance was explained – and which may constitute a better proxy for subsequent behaviour (Armitage et al., 2015). Thus, overall, our data was in line with our overarching hypothesis and the more specific predictions that anticipated emotions should relate to intention, and anticipatory emotions to behavioural expectations (cf. Carrera et al., 2012).

This research constituted the first investigation of both anticipated and anticipatory emotions in the context of PA. The two types of future-oriented emotion were highly correlated and undifferentiated with respect to valence; however, anticipated emotions were more intense than anticipatory emotions. This supports previous work suggesting that the in-the-moment affect an individual experiences when thinking about a potential future experience represents a weaker 'foretaste' of the feelings one expects if the event were to occur (Anderson et al., 2023; Clayton McClure et al., 2024; Ernst et al., 2018). Moreover, the findings support the notion that both types of emotional anticipation are potentially important motivating factors with respect to PA. Individuals who are currently active, relative to those who are not, believe future PA activities will bring more positive emotions, and they experience more 'in-the-moment' positive emotions when thinking about those events. These emotions, potentially, go some way to explaining why they continue to engage in PA; conversely, the muted emotions felt by those who are currently less active likely fuel persistence of sedentary choices. Further support for these propositions came from our findings that future-oriented emotions were predictive of PA intention and behavioural expectations. These findings are in line with previous work that has demonstrated the importance of anticipated emotion in PA motivation (e.g., Loehr & Baldwin, 2014); furthermore, they extend previous findings by demonstrating that anticipatory emotions, how we feel right now when thinking about potential future PA, are also important in motivating PA engagement. As such, our findings align with dual-process accounts (e.g., Brand & Ekkekakis, 2018; Strobach et al., 2020) that suggest hedonic influences on PA engagement are twofold, comprising automatic affective processes, i.e., anticipatory emotions, and conscious, reflective–evaluative processes that include anticipated emotions.

Dual-process frameworks of PA (e.g., Brand & Ekkekakis, 2018; Strobach et al., 2020) predict that the two future-oriented emotions should interact differently with PA intentions and behavioural expectations. Within these frameworks, intentions arise as a product of the reflective cognitive-evaluative pathway used to plan the future, which includes the prediction of anticipated emotion. In contrast, behavioural expectations incorporate experiential factors and consider situational circumstances; therefore, they are, in part, a product of anticipatory emotions. Our findings supported this distinction; we established that more positive anticipated emotions, but not anticipatory emotions, for PA events predicted intention. Conversely, the valence of anticipatory emotions for PA events was predictive of behavioural expectations. Our findings extend the previous work of Carrera et al. (2012); they evidenced the differential relationship between future-oriented emotions, intention and behavioural expectation in the context of binge-drinking, a risky behaviour that is detrimental to health. Conversely, our investigation focused on PA, a behaviour generally considered to be beneficial to health.

It is interesting to note that, across both research questions, the effects that emerge were driven by the valence, rather than the intensity, of the anticipated and anticipatory emotion. Furthermore, data presented in the supplementary materials shows that participants' ratings of the typicality, but not vividness, of PA events were significantly positively correlated with GLTEQ score. This suggests that the more physically active participants have more past PA experiences that bear similarities to those used as stimuli in the current study. However, these same participants do not seem to be using these past experiences to generate more vivid and emotionally intense mental simulations of the potential future PA events. Instead, it is the valence of future-oriented emotions associated with PA events that varies; PA events are viewed more positively. Previous research has suggested that imagery-based simulation of future events can amplify motivation and behavioural engagement for planned future activities (Ji et al., 2021). Within that context, our findings suggest that focusing on the anticipation of positive, rather than negative, emotions associated with PA within such imagery-based simulations could be critical for motivating individuals to engage in future PA.

The lack of arousal effects may reflect a more complex relationship between current PA levels, the intensity of emotion experienced when anticipating future PA, and intentions/expectations regarding future PA. Correlations between ratings for non-PA events suggest a relatively simple picture. Measures of valence and arousal were correlated with each other, and these measures were also correlated with behavioural expectations. Thus, when anticipated/anticipatory emotions were more positive they also tended to be more intense and these were associated with higher expected engagement in non-PA activities. However, the same relationships were not evident for PA events. Valence and arousal measures were not correlated with each other, and arousal ratings were not correlated with behavioural expectations ratings, GLTEQ scores or TPB Intention scores. High arousal simulations might have different relationships with valence and different effects across active and inactive individuals. Furthermore, ratings of anticipated/anticipatory emotional arousal were likely to be influenced by the perceived level of exertion and resultant physiological arousal associated with different types of PA; this likely complicates the picture further. For instance, for the active individual, contemplating potential future PA likely results in intense positive anticipated/anticipatory emotions which then motivates further PA engagement. However, for the inactive individual, considering potential future PA might lead to equally intense, yet more likely negative, anticipated/anticipatory emotions that drive them further towards inactivity. To tease apart these potential pathways, future research could explore the role of anticipated and anticipatory emotions in active and sedentary individuals separately.

One anomalous finding that requires further consideration is that the valence of anticipatory emotions associated with non-PA events was also a significant predictor of PA intentions. The non-PA events covered a range of general everyday activities, and the in-the-moment affect associated with these might have corresponded closely with participants' incidental affect, i.e. their more general, current, emotional state. The AHBF (Williams & Evans, 2014) identifies incidental affect as a potential affective determinant of health behaviour, and this has been empirically supported by a longitudinal diary study which found incidental affect to be predictive of PA intention (Zhang & Huang, 2024). This explanation is made tentatively because our study did not explicitly measure participants' incidental affect; future research should include

such measures to disentangle the role of the different potential affective determinants of PA intention.

The current study represents an important preliminary investigation of the role of anticipated and anticipatory emotions for potential future PA events. However, we must acknowledge that some methodological choices may limit the findings and any subsequent conclusions. There are notable divergences in our measurement of behavioural expectation and intentions. Whilst they were matched on timeframe (next eight weeks), the latter was a general measure of PA intention (30+ minutes, 4 times per week), whilst the former was a measure of completion likelihood for each of the specific PA activities if the opportunity arose (minimum once). Furthermore, the measure of intention used seven-point likert scales as it was embedded within the TPB questionnaire (Wing Kwan et al., 2009), whilst the measure of behavioural expectation used 100-point slider scales like those used to measure anticipated/anticipatory emotion. This may have led to the relationship between emotions and expectations appearing stronger because they were assessed at the same level of specificity.

Other methodological factors within the current research require acknowledgement and provide avenues for future research. Descriptive data from our sample suggests it reflected a broad range of current PA level, with 53% of the sample considered sufficiently active using Godin and Shepherd's (1985) suggested cut-off on the GLTEQ (≥ 24 calculated using only moderate and strenuous scores). Furthermore, 51.2% of participants scored > 9 across the two TPB intention items, suggesting overall agreement with regard to meeting recommended PA guidelines across the forthcoming eight weeks. However, it is important to acknowledge that our participants were all undergraduate students who were, primarily, young adults. In this respect, the sample's homogeneity benefited our study design; it allowed us to select hypothetical future events that we were confident were relevant to the cohort. However, it does limit the generalisability of our findings. Therefore, future research does need to extend work to a broader age range and widen the sample demographic.

The controlled manipulations within our study allowed for the measurement of anticipated and anticipatory emotions for the same potential future PA events and to explore their predictive role for PA intentions and behavioural expectations. However, the cross-sectional nature of the design has shortcomings. It meant that we did not measure future PA levels; therefore, we cannot establish whether the two types of emotional anticipation predict actual engagement in PA behaviour. Furthermore, the data obtained about current PA levels is based on retrospective self-report. While the GLTEQ has been shown to have moderate concurrent validity with accelerometery measures of PA (Alotaibi et al., 2024), it is still potentially susceptible to recall bias (van Poppel et al., 2010). A cross-sectional design is also vulnerable to order effects; ratings of anticipated and anticipatory emotions were counterbalanced, as were responses on the GLTEQ and TPB questionnaires. However, within the current study, participants always provided ratings of future-oriented emotion at the outset with measurement of behavioural expectation, intention, and past behaviour afterwards. This was a deliberate design decision to prevent ratings of future-oriented emotion being coloured by measurements involving cognitive-evaluative reflection about past, or potential future, PA. However, this means we cannot rule out the possibility of future-oriented emotions influence responses on the GLTEQ or TPB questionnaires. Future research should extend the current work by using longitudinal designs that, ideally, incorporate ecological momentary assessments and more objective accelerometer data. This would overcome the limitations of the current cross-sectional design and, in addition, extend understanding of future-oriented emotions beyond intentions and behavioural expectations, instead tapping actual PA behaviour.

In conclusion, the current study represents an important preliminary investigation of the role of anticipated and anticipatory emotions for potential future PA events. Findings demonstrated that both types of emotional anticipation vary across individuals dependent upon their current PA levels and that they may serve as motivating factors that tie into intentions and behavioural expectations. Future research needs to extend these findings to examine how they impact on future PA behaviour, but they present promising findings with respect to understanding the emotional mechanisms that underlie PA motivation.

CRediT authorship contribution statement

Rachel J. Anderson: Writing – original draft, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **J. Helgi Clayton McClure:** Writing – review & editing, Methodology, Formal analysis.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.peh.2026.100437.

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