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Physical activity promotion: precise matching of message frames and affect types

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ABSTRACT

Objective: Matching between affect orientations and message frames have been shown to enhance the persuasiveness of health messages. Based on a two-dimensional regulatory model (direction: approach/avoidance, valence: appetitive/aversive), this study examined whether a precise matching between affect and message frame would enhance physical activity (PA) attitudes, intentions, and behaviours.

Design: Using a 2 (gain/loss frames) x 2 (positive/negative end-states) design, 147 college students were randomly assigned to one message-frame condition (gain-positive, gain-negative, loss-positive, or loss-negative). Four identified affect types (approach-positive, approach-negative, avoidance-positive, and avoidance-negative) were considered as matched, respectively, with the four message-frame conditions. The participants were subsequently grouped into fully-matched, direction-matched only, valence-matched only, or unmatched.

Main Outcome Measures: The immediate PA attitude and intention after the experiment and the PA attitudes, intentions, and behaviours at a two-week follow-up were reported.

Results: Post-manipulation and follow-up intentions were greater in the fully-matched as compared with the unmatched group. Follow-up physical activity was more in the valence-matched than the unmatched group. No other differences were found across the matching types.

Conclusion: Findings partially supported the importance of a precise matching between affect orientations and message frames. The affect types may characterize an individual's sensitivity towards the corresponding regulatory information.

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KEYWORDS
Message framing; affect; matching; physical activity; intention; attitude

Introduction

The benefits of physical activity (PA) include, but are not limited to, reducing the risk of chronic diseases and preserving physical and mental function into old age (Blair &

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Morris, 2009). Most adults, however, do not achieve the recommended level of PA for health benefits (Haskell et al., 2007). A global study (Hallal et al., 2012) on PA levels with data from 122 countries had found that a prevalence of 31% of adults were physically inactive.

Health messages are common in PA interventions. Among approaches in message design, message framing has been one dominant approach (Pope et al., 2018). Messages can be framed in terms of gains (i.e., benefits of being physically active) or losses (i.e., costs of not being physically active). Gain-framed PA messages have been suggested as more effective than loss-framed messages for increasing PA (Gallagher & Updegraff, 2012). Previous studies showed that framing effects could be moderated by affect (Ferrer et al., 2012; Lecheler et al., 2013). Studies have shown that both affects and message frames can be classified based on a two-dimensional regulatory model (e.g., de Bruijn et al., 2014; Elliot et al., 2013; Higgins et al., 1994; Lang et al., 1993). This study aimed to examine whether a precise matching between affect and message frame would enhance PA message effectiveness in terms of attitudes, intentions, and behaviours.

Message framing

Drawing from prospect theory (Kahneman & Tversky, 1982), individuals are risk averse when gains are salient. For prevention behaviours such as PA that are perceived as non-risky, gain-framed promotion message are suggested to be more effective, whereas loss-framed messages are more effective for detection behaviours such as cancer screening (Rothman & Salovey, 1997). Despite some supportive findings cumulated in the literature, the findings in meta-analyses have demonstrated that there were no meaningful differences between gain-framed and loss-framed messages (O'Keefe & Jensen, 2006, 2007, 2009). When splitting the analysis by outcome types (i.e., attitudes, intentions, and behaviours), Gallagher and Updegraff (2012), in their meta-analysis, found no significant differences for detection behaviours regardless of the outcome types and a small advantage from gain-framed messages for protection behaviours. They observed that there might be a larger difference for behavioural outcomes and suggested that the framing effects on behaviours may not be mediated completely via attitudes or intentions. A subsequent re-analysis of the data, however, showed that the effect sizes across attitudes, intentions, and behaviours were not statistically different (O'Keefe, 2013).

An exception to the overall null effects of gain/loss-framing appears in the context of PA. The majority of findings showed that gain-framed messages were, indeed, more effective than loss-framed messages for enhancing PA intention (e.g., Arora et al., 2006; Jones et al., 2004) and behaviour (e.g., Latimer et al., 2008; Parrott et al., 2008). In a system review, Latimer et al. (2010), showed that three out of four studies reported gain-frame advantages on PA behaviours, and five out of six studies reported gain-frame advantages on PA intentions. O'Keefe and Jensen (2011) have shown in their meta-analysis that the gain-frame advantage was quite unique for PA but not observed in other prevention behaviours (except dental hygiene behaviours), such that prospect theory is not a reasonable explanation. Although the mechanisms

underlying the framing effect in PA remain unknown, O'Keefe and Jensen suggested advocating gain-framed message for PA is still useful and presumed that a better understanding of the mechanisms would further inform the development of effective messages.

Considering the substantial variability and mixed findings in the framing studies in promoting health behaviours, including PA, shown in meta-analyses (Gallagher & Updegraff, 2012; O'Keefe & Jensen, 2007, 2009), the direction of health message framing research is moving towards identifying potential moderators (Updegraff & Rothman, 2013). Some dispositional moderators consistently found in the literature include regulatory focus, approach-avoidance motivation, need for cognition, and self-efficacy beliefs (Covey, 2014). The regulatory focus theory (Higgins, 1997, 2005) has been one dominant approach in explaining the effects of message framing. The theory conceptualizes that there are two motivation orientations (i.e., promotion and prevention). Promotion-oriented individuals strive towards gains whereas prevention-oriented individuals want to maintain current status and avoid any losses. Higgins (2005) further suggested that an individual will experience regulatory fit when their motivation orientation is compatible with the goal and means of pursuing that goal. Applying regulatory fit within message framing, it is suggested that individuals "feel right" when the message frames (e.g., gain frame) match with their motivation orientation (e.g., approach-oriented) and thus the message becomes more effective. A systematic review on regulatory fit and health communication (Ludolph & Schulz, 2015) found that the majority of the selected studies confirmed that regulatory fit enhanced message framing effectiveness.

Message framing by valence of end-states

Another approach in understanding the mixed findings was to utilize variations of the operationalization of gain and loss frames (Apanovitch et al., 2003; de Bruijn et al., 2014; Detweiler et al., 1999). Gain- and loss-framed messages can also be presented with consideration of the end-state valences (positive or negative outcomes). For instance, a gain-framed message (e.g. benefits to one's health when participating in PA behaviour) can be presented with either a positive end-state (e.g. enhance heart fitness) or negative end-state (e.g. avoid heart deterioration). Overall, four framing conditions with equivalent content can be formulated with a 2 (direction; gain versus loss) by 2 (end-state valence; positive versus negative) structure. Desired and undesired end-states are considered as the reference standards in the self-regulation system, whereas gain and loss frames describe the "direction" of means (approach vs. avoidance) to achieve the standards (Higgins et al., 1994).

The strategic use of end-states message framing has been found to be advantageous in increasing persuasion for health behaviours, although the findings have been mixed. For instance, Yi and Baumgartner (2009) showed that the presence of gain (i.e., gain frames with positive end-states) was more effective than the absence of loss (i.e., gain frames with negative end-states), and the presence of loss (i.e., loss frames with negative end-states) was more effective than the absence of gain (i.e., loss frames with positive end-states) to enhance the perceived persuasiveness of messages

promoting fruits and vegetable consumption. Yi and Baumgartner considered that their results were consistent with those in Idson, Liberman, and Higgins' (2000) study which examined emotional reactions across the four message types. Idson and colleagues regarded positive end-states as promotion-focused and negative end-states as prevention-focused. Positive (negative) end-states may enhance promotion (prevention) orientations temporarily such that the regulatory orientation matches with gain-framed (loss-framed) messages to create a regulatory fit. Similarly, a meta-analysis of research comparing the effectiveness of various persuasion outcomes across message frames found that gain-framed messages with a positive end-state were more persuasive in increasing PA outcomes than gain-framed messages with a mixture of positive and negative end-states (O'Keefe & Jensen, 2011). O'Keefe and Jensen also speculated that positive and negative end-states could be re-described as promotion- and prevention-focused, respectively. To the contrary, de Bruijn et al. (2014) found that loss-framed messages combined with a positive end-state was most persuasive in exercise guideline adherence compared to the other three message appeals, unexpectedly. They argued that the mismatch between gain/loss frames and positive/negative end-states might lead to the messages being more noticeable and/or more thoroughly processed. Besides, some studies were not able to demonstrate any differences in effectiveness among messages of different end-states (Apanovitch et al., 2003; Detweiler et al., 1999). Examining the possible moderators may enhance our understanding of these mixed findings.

The roles of affect

Affect orientation has been considered as a moderator of framing effects and attracted substantial research attention (Updegraff & Rothman, 2013). Recent research has suggested that affect can be defined beyond the two opposing valences (i.e., positive versus negative). For instance, anger would normally be considered as a negative affect. In fact, the affective system highly intertwines with the motivational system (Yan et al., 2012) and can be categorized based on both direction and valence (Elliot et al., 2013; Lang et al., 1993). Direction indicates the behavioural guidance function of an emotion (i.e., approach vs. avoidance). The intensity of the affect in the positive valence can range from excited (approach) to calm (avoidance). Emotional valence refers to the appetitive (positive) or aversive (negative) motivational systems. The two dimensions are independent. For instance, it has been continuously suggested that anger, which occurs due to a blockage of moving towards a desired goal (Berkowitz, 1993; Carver & Harmon-Jones, 2009), contains an approach motivational tendency despite the negative valence. Thus, four types of affect have been proposed: 1. approach-positive (e.g., happy), 2. approach-negative (e.g., sad), 3. avoidance-positive (e.g., calm) and 4. avoidance-negative (e.g., nervous) (Elliot, 2013; Smith & Bargh, 2008).

Past findings supported predominantly that approach or avoidance affects would moderate the effectiveness of gain-loss framing. For instance, Gerend and Maner (2011) found that the participants in the fear condition (avoidance-negative) exposed with a loss-framed message ate more fruit and vegetables compared to

Table 1. Examples of the affect types and framed messages for physical activity promotion.

Approach-positive affect	Approach-negative affect	Avoidance-positive affect	Avoidance-negative affect
Happy, content, and Joy	Sad, disappointed, and depressed	Calm, relieved, and relaxed	Nervous, worried, and tense
Gain-positive messages	**Gain-negative messages**	**Loss-positive messages**	**Loss-negative messages**
If you participate in regular physical activity, you will…		*If you do not participate in regular physical activity, you will…*	
Physical aspects (11 statements)			
enhance immunity	avoid immunity weakening	forgo immunity strengthening	incur immunity weakening
enhance muscle strength	avoid muscle weakening	forgo muscle strengthening	incur muscle weakening
enhance agility and flexibility	avoid agility and flexibility weakening	forgo agility and flexibility enhancement	incur agility and flexibility weakening
Psychological aspects (8 statements)			
help improve moods	avoid negative moods	forgo moods improvement	incur negative moods
help improve psychological state	avoid poor psychological state	forgo psychological state improvement	incur poor psychological state
help improve processing speed	avoid processing speed decline	forgo processing speed improvement	incur processing speed decline
Social aspects (4 statements)			
help widen social network	avoid social network shrinkage	forgo social network widening	incur social network shrinkage
help improve interaction with people	avoid problems interacting with people	forgo the improvement in interacting with people	incur problems interacting with people
help make friends	avoid being alone	forgo the opportunity to make friends	incur loneliness

those being exposed to a gain-framed message. For the anger condition (approach-positive), gain-framed message was more influential than a loss-framed message in terms of health-behaviour changes. Yan et al. (2012) showed that it is the emotional functions (approach vs. avoidance) rather than emotional valence (positive vs. negative) that moderate the gain/loss framing. Gain-framed messages were more effective for those happy or angry, whereas loss-framed messages were more effective for those fearful.

As reviewed above, both message frames and affect orientations can share the two common dimensions of the regulatory systems, namely direction (i.e., approach vs. avoidance) and valence (i.e., positive vs. negative). Drawing from the regulatory fit theory (Higgins, 1997, 2005), we hypothesized that a precise matching between affective orientations and message frames would enhance the effectiveness of the messages. This study was the first attempt to conceptually and empirically link these two-dimensional systems.

Purpose of study

The aim of the study was to investigate the effects of a precise matching between affect orientation and health message frames on PA attitudes, intentions, and behaviours. Health message frames: 1. gain-positive, 2. gain-negative, 3. loss-positive and 4. loss-negative were considered as matched with affective orientations: 1. approach-positive, 2. approach-negative, 3. avoidance-positive, and 4. avoidance-negative, respectively (see also Table 1). Specifically, full matching of affective orientations with message frames (i.e., on both direction and valence) was expected to increase

intentions, attitudes and PA levels more than partially-matched (i.e., direction-matched only or valence-matched only) and unmatched conditions.

Methods

Participants

The participants were Hong Kong Chinese college students aged between 18 and 35 years. To be eligible, individuals had to be able to read and understand the research materials written in Chinese, had no physical conditions that limit PA, and did not meet the PA recommendation (i.e., $<$ 150 minutes of moderate-to-vigorous PA per week; Haskell et al., 2007) for the past month.

A wide range of effect sizes of the framing-by-affect interaction (partial η^2 of .03 to .13) was observed in the literature (Chang, 2007; Gerend & Maner, 2011; Yan et al., 2010). The sample sizes of these previous studies ranged from 133 to 240. A smaller effect might be found as affect type was observed rather than manipulated in this study. A sample size of 153 was required to detect the effect of a single regression coefficient (see the statistical analysis section below) with a small-to-moderate effect size ($f^2 = .07$), with 17 predictors, at an alpha level of .05, with a power of .90 (Faul et al., 2009). The participants ($N = 150$) were recruited through the participant pool of an introductory psychology course in which the participation was a required assessment component, with an option of alternative assignments. Three cases providing poor quality data were excluded. A sample of 147 participants ($M_{age} = 20.25$, $SD = 2.15$; 60% being women) was included in the subsequent analyses. We acknowledge that the current analysis was underpowered in detecting the possible small effect size. This analysis was only powered to detect small-to-moderate effects as seen in a few related studies.

Design and procedure

A 2 (gain/loss frames) $\times$ 2 (positive/negative end-states) factorial design with 2 between-participants factors was used in this study. Individual differences in affect were measured and defined into 5 affect types. For the purpose of the current analysis, the design was transformed so that the effects of four matching types according to the assignment of the experimental condition and the identified affect type (i.e., fully-matched, direction-matched, valence-matched, and unmatched) could be compared. The details of the matching and the analytical approach can be found in the analysis section.

Upon providing informed consent, screening questions were administered to check eligibility. The participants completed a survey including questions on PA behaviour (baseline), affect orientation, demographic and health-related factors and randomly assigned to receive one of the four sets of PA messages. A researcher then read the PA messages according to the assigned condition to the participant to enhance the confidence that the participants had paid attention to the messages. The participants then completed the manipulation check and the remaining parts of the survey including immediate PA intentions and attitudes. Participants returned two weeks later to

complete a follow-up recording their PA intentions, attitudes and behaviours for the last seven days. Non-Chinese instruments were translated to Chinese using a back-translation procedure for accuracy. The research protocol was approved by the Human Subjects Ethics Sub-Committee, City University of Hong Kong.

Materials

PA framed messages in Chinese was adopted from Li et al. (2014) study displayed in four versions of pamphlets (gain-positive, gain-negative, loss-positive, or loss-negative) consisting of 11 physical, 8 psychological and 4 social impacts of PA participation. Each statement was equivalent in terms of content for all versions except for when gain-framed it began with "if you participate in regular physical activity, you will … " and loss-framed messages will begin with "if you do not participate in regular physical activity, you will … " For positive end-states, the statements were designed to end with a desirable outcome with regards to PA (e.g. enhance muscle strength). For negative end-states, statements ended with undesirable consequences regarding PA (e.g. avoid muscle weakening). Sample messages are shown in Table 1.

Instruments

Manipulation check

Immediately the pamphlets were read, a manipulation check was conducted. The meanings of positive and negative end-states were explained to the participants. Participants were asked to rate on a 7-point (1 = *strongly disagree*, 7 = *strongly agree*) scale whether the pamphlet emphasized 1) the presence of positive end-states for PA participation (gain-positive), 2) the absence of negative end-states for PA participation (gain-negative), 3) the presence of negative end-states for non-participation (loss-negative) and 4) the absence of positive end-states for non-participation (loss-positive).

Affect orientations

Affect orientations were measured using an affect scale adopted from Smith and Bargh (2008) study. The scale consisted of 12 different affects that could be categorized into four types: 1) approach-positive (happy, content, and joyful), 2) approach-negative (sad, disappointed, and depressed), 3) avoidance-positive (calm, relieved, and relaxed) and 4) avoidance-negative (nervous, worried, and tense). The participants rated how much they feel in accordance with each affect trait on a 9-point scale (1 = *not at all*; 9 = *very much*). The Cronbach's alpha coefficients of the subscales ranged from .82 to .96.

Physical activity attitude

This was assessed by five items adopted from van't Riet et al.'s (2010) study. The participants rated on a 7-point scale, indicating whether participating in PA for at least 5 days within 2 weeks for 30 minutes each time was: 1) very bad – very good, 2) very unimportant – very important, 3) not very sensible –very sensible, 4) not nice at all –

Table 2. Sample characteristics and experimental outcomes by matching conditions (N = 147).

	Unmatched ($n = 57$)		Valence-matched only ($n = 27$)		Direction-matched only ($n = 31$)		Fully-matched ($n = 32$)	
	Mean	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*
Sample characteristics/ covariates								
Age (years)	20.35	2.89	20.12	1.31	20.11	1.56	20.32	1.71
Women	0.65	0.48	0.59	0.50	0.52	0.51	0.59	0.50
Household income	4.76	1.83	4.17	1.73	4.26	1.90	4.34	1.59
BMI (kg/m^2)	20.50	2.57	19.48	2.62	20.89	3.51	20.58	2.62
Number of chronic diseases	0.16	0.49	0.07	0.27	0.16	0.37	0.31	0.54
Baseline physical activity (METs)	1252.82	1109.53	1494.85	1395.94	1208.90	914.59	1191.39	1152.59
Experimental outcomes								
Immediate physical activity attitude	4.87	1.18	4.90	1.11	5.14	0.67	4.95	1.04
Immediate physical activity intention	4.86	1.07	4.84	0.98	5.09	0.83	4.99	1.19
Follow-up physical activity attitude	4.29	1.34	4.15	1.14	4.51	0.93	4.78	1.23
Follow-up physical activity intention	4.10	1.19	4.19	1.22	4.42	1.04	4.68	1.39
Follow-up physical activity (METs)	1742.51	1612.57	1729.50	1522.98	1887.61	1643.51	1438.09	881.24

very nice, and 5) no fun at all – a lot of fun. The Cronbach's alpha coefficients were .83 after the manipulation and .85 at the follow-up.

Physical activity intention

PA intentions was measured by three items adopted from van't Riet et al.'s (2010) study. The participants rated the extent they planned to participate in PA and whether they would consider to be physically active (1 = *definitely not*; 7 = *definitely*). In addition, they reported their likelihood to participate in regular PA in the next 6 months (1 = *very unlikely*; 7 = *very likely*). Internal consistency was satisfactory at both time points ($\alpha = .79$).

Physical activity

The Chinese version of the International Physical Activity Questionnaire (Macfarlane et al., 2007) was used to assess PA participation at baseline and follow-up. The questionnaire records participants' frequency and duration of vigorous-intensity PA, moderate-intensity PA, walking and sitting over the past seven days. Responses were transformed into metabolic equivalents (METs [min/week]) by calculating the sum of the weighted minutes of vigorous- (8 METs), moderate-intensity PA (4 METs), and walking (3.3 METs).

Statistical analysis

As the affect scale (Smith & Bargh, 2008) had only been used in a western sample, principal axis factoring and parallel analysis (O'Connor, 2000) were conducted to examine how well it adapted to the current population. In this study, the highest score among the four affect subscales indicated the participants' affect type. The affect type was considered as mixed if the highest scores were tied in more than one subscale.

For each of the four manipulation check items, an ANOVA was conducted to examine the score differences across the four message-frame conditions. The score of the manipulation check item that matched with message-frame condition was expected to be higher than the mismatched manipulation check items.

To test the effects of matching, we decided to conduct multiple univariate tests rather than a multivariate test (e.g., MANOVA), although multiple PA outcomes were included. Based on the criteria described by Huberty and Morris (1989), multiple univariate tests would be appropriate for this study because 1) the outcomes were related but conceptually distinct as the framing effects varied by outcome types (e.g., Gallagher & Updegraff, 2012), and 2) the results could be compared with previous findings in the univariate contexts. As advocated by Plonsky and Oswald (2017), and Wampold and Freund (1987), multiple regression models were used instead of ANOVAs because the standardized regression coefficients allow a straightforward interpretation of the predictive power of the predictor on the criterion, controlling for other variables in the equation, and show the relative importance of the predictor. Importantly, these models are conceptually and statistically equivalent.

Dummy codes were created for categorical variables with multiple levels including affect types (approach-positive as the reference) and matching types (unmatched as the reference). Baseline and follow-up PA behaviours were square-root transformed to enhance normality of the distributions. Matching levels were defined by how the affect types (1. approach-positive, 2, approach-negative, 3. avoidance-positive, and 4. avoidance-negative) matched with the message frames (1. gain-positive, 2. gain-negative, 3. loss-positive, and 4. loss-negative). Fully-matched conditions referred to the matching between affect and frame on both direction and valence (e.g. approach-positive and gain-positive). Partially matched conditions include direction-matched only (e.g., approach-positive and gain-negative) and valence-matched only (e.g., approach-positive and loss-positive). Lastly unmatched conditions referred to no matching at all between affective orientations and message frames on either direction or valence (e.g. approach-positive and loss-negative) and included those with mixed affect type.

One hierarchical multiple regression analysis with two steps was conducted for each outcome (including immediate attitude, immediate intention, follow-up attitude, follow-up intention, and follow-up behaviour) controlling for age, gender, household income (ranged from 1 to 7 for various income brackets), body mass index (kg/m^2), number of chronic diseases (from a list of 20), baseline PA behaviours, affect types, and message-frame conditions (including gain/loss frames, positive/negative end-states, and their interaction). In Model 1, gain/loss frames, positive/negative end-states, and their interaction effect were entered as independent variables. In Model 2, affect types and the matching types were added. Variance inflation factors were computed

Table 3. Standardized regression coefficients predicting the experimental outcomes (N = 147).

	Immediate PA attitude		Immediate PA intention		Follow-up PA attitude		Follow-up PA intention		Follow-up PA behaviour	
	M1	M2	M1	M2	M1	M2	M1	M2	M1	M2
Age	.10	.10	.03	.05	.10	.09	.09	.10	-.01	.01
Women	-.02	-.03	-.11	-.10	-.06	-.05	-.13	-.13	.02	.03
Household income	.07	.08	.20*	.23**	-.09	-.08	.10	.13	.06	.08
BMI	-.04	-.05	.23**	.22*	-.01	-.03	.10	.09	-.05	-.03
Number of chronic diseases	-.06	-.04	-.02	-.03	-.16*	-.17†	-.06	-.05	.06	.10
Baseline physical activity	.10	.10	.03	.05	.12	.13	.07	.08	.36***	.36***
Message-frame conditions										
Gain frame (vs. loss)	-.34**	-.45**	-.19†	-.20	-.41***	-.47***	-.16	-.17	-.03	-.14
Positive end-state (vs. negative)	-.09	-.16	-.12	-.13	-.19†	-.22†	-.08	-.08	-.19	-.27*
Gain frame × positive end-state	.16	.32†	.28*	.32*	.32*	.41*	.13	.15	.18	.32*
Affect types										
Approach-positive		–		–		–		–		–
Approach-negative		.00		-.05		-.02		-.08		-.04
Avoidance-positive		-.07		-.06		.02		-.10		-.05
Avoidance-negative		-.10		-.04		.04		-.11		-.12
Mixed		-.09		.01		-.16		-.05		.16
Matching types										
Unmatched		–		–		–		–		–
Valence-matched only		.06		.07		-.05		.08		.17
Direction-matched only		.19		.17		.12		.14		.22*
Fully-matched		.01		.21*		-.04		.22*		.09
R^2	.10	.15	.14*	.18*	.13*	.18*	.07	.12	.15**	.20*
ΔR^2		.04		.04		.05		.05		.05

† $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$.

Note. PA = physical activity, M1 = Model 1, M2 = Model 2. Baseline physical activity and follow-up physical activity scores were square-root transformed to enhance normality.

to detect multicollinearity in the full model. Differences among the effects of direction-matched only, valence-matched only, and fully-matched groups were compared by testing the equivalence of their regression coefficients by Wald tests at post-estimation. A set of sensitivity analyses was conducted to examine how the exclusion of those with mixed affect type would influence the results.

Results

Principal component factor analysis for the 12-Items affect scale

The Kaiser-Meyer-Olkin measure of sampling adequacy was .83, and the Bartlett's test of sphericity was significant (χ^2 (66) = 1453.10, $p < .001$), indicating satisfactory factorability. The principal axis factoring revealed six factors with eigenvalues great than zero (5.81, 1.43, 0.82, 0.65, 0.17, and 0.02). The parallel analysis and the scree plot, however, indicated four factors should be retained. The four-factor solution was

selected and examined using both varimax and promax rotations of the factor loading matrix.

The promax rotation provided the best-defined factor structure. All 12-items contributed to a simple factor structure and had met minimum criteria of having a primary factor loading of .30 or above, and a cross-loading of .30 or below. The items "happy", "content" and "joyful" had factor loadings between .81 and 1.00 on approach-positive affect type. "Sad", "disappointed" and "depressed" had factor loadings between .58 and .90 on approach-negative affect type. The affect items "calm", "relieved" and "relaxed" had factor loadings between .69 and .83 on avoidance-positive affect type and "nervous", "worried" and "tense" had factor loadings between .66 and .97 on avoidance-negative affect type. Factor labels were used in consistency with the proposed affect orientation types in Smith and Bargh's study (2008) and previous literature on affect motivational orientation (Elliot, 2013).

Descriptive statistics by matching levels

The participants read one set of the framed messages: gain-positive ($n = 35$, 24%), gain-negative ($n = 40$, 27%), loss-positive ($n = 36$, 24%), and loss-negative ($n = 36$, 24%). Based on the affect scores, the participants were classified into the approach-positive ($n = 49$, 33%), approach-negative ($n = 10$, 7%), avoidance-positive ($n = 21$, 14%), avoidance-negative ($n = 41$, 28%), or mixed ($n = 26$, 18%) affect types. Affect types were checked with message frame conditions to classify the participants into either fully-matched ($n = 32$, 22%), direction-matched only ($n = 31$, 21%), valence-matched only ($n = 27$, 18%), or unmatched ($n = 57$, 39%) groups. Those that had tied affect type scores ($n = 26$) were grouped as unmatched. Table 2 presents the descriptive data by matching types.

Manipulation check

An ANOVA was conducted for comparison of each manipulation check item across the four message-frame conditions. The scores were different across the message-frame conditions for all of the manipulation items: 1) gain-positive item, F (3, 143) = 25.72, $p < .001$, 2) gain-negative item, $F(3, 143) = 6.89$, $p < .001$, 3) loss-positive item, $F(3, 143) = 12.61$, $p < .001$ and 4) loss negative item, $F(3, 143) = 18.47$, $p < .001$. Post hoc analyses using the Bonferroni test were conducted. There was a total of 10 significant differences out of 12 multiple comparisons (3 pairs for each manipulation item). All of them were in the expected directions. No difference was found between gain-positive and gain-negative conditions on the manipulation item for gain-positive, and between gain-negative and loss-negative conditions on the manipulation item for gain-negative.

Effects of message-frame conditions on physical activity outcomes

The effects of message-frame conditions were reported based on the results in Model 1 of the hierarchical regression analyses. The interaction effects between gain/loss frames and positive/negative end-states were significant on immediate PA intention, β

Table 4. Predicted means of the physical activity outcomes by message-frame conditions and by matching types.

	Immediate PA attitude		Immediate PA intention		Follow-up PA attitude		Follow-up PA intention		Follow-up PA behaviour	
	Mean	*SE*	*Mean*	*SE*	*Mean*	*SE*	*Mean*	*SE*	*Mean*	*SE*
Message-frame conditions										
Gain-positive	4.91	0.18	4.70	0.21	4.99	0.18	4.34	0.22	40.32	2.83
Gain-negative	4.47	0.17	4.11	0.20	4.45	0.17	4.09	0.21	36.87	2.72
Loss-positive	5.08	0.18	4.29	0.20	4.96	0.17	4.32	0.21	32.39	2.78
Loss-negative	5.40	0.19	4.60	0.21	5.41	0.18	4.51	0.22	41.45	2.90
Matching types										
Unmatched	4.81	0.16	4.14	0.19	4.92	0.16	4.03	0.20	33.70	2.57
Valence-matched only	4.98	0.22	4.36	0.25	4.79	0.21	4.29	0.26	40.89	3.40
Direction-matched only	5.30	0.21	4.65	0.24	5.22	0.20	4.45	0.25	42.88	3.29
Fully-matched	4.84	0.19	4.74	0.22	4.81	0.19	4.68	0.23	37.20	3.04

$= .28$, $p = .045$, and follow-up PA attitude, $\beta = .32$, $p = .023$. When adjusted for affect types and matching types (see results of Model 2), the interaction effects on immediate PA attitudes, $\beta = .41$, $p = .01$, and follow-up PA behaviour, $\beta = .22$, $p = .049$, also became significant. Table 3 shows the results of all hierarchical multiple regression analyses. Consistent across the PA outcomes, positive end-states were more effective than negative end-states in the gain-framed messages as revealed in the predicted means of the full models (see Table 4), whereas negative end-states were more effective than positive end-states in the loss-framed messages.

Effectiveness of matching on physical activity intention, attitude and behaviour

The regression results indicated that individuals at the fully-matched level was higher than those at the unmatched level in both immediate PA intention, $\beta = .21$, $p = .046$, and follow-up PA intention, $\beta = .22$, $p = .038$. PA intentions in the valence-matched only or direction-matched only groups were not different from that of the unmatched. Individuals in the direction-matched only group reported more follow-up PA behaviour than those in the unmatched group, $\beta = .22$, $p = .049$, whereas follow-up PA behaviour in the fully-matched or valence-matched only group was not different from that of the unmatched. Regarding immediate and follow-up PA attitudes, no difference was found across the matching levels. The greatest variance inflation factor was 2.05 indicating multicollinearity was not an issue. No differences in the PA outcomes were found among valence-matched only, direction-matched only, and fully-matched groups based on the results of the Wald tests. The results of the sensitivity analyses showed that the exclusion of the participants with mixed affect type had little effect on the pattern of the results, although the statistical power was reduced. The results of the sensitivity analysis are available on request.

Discussion

This study aimed to examine the effects of matching health message frames with dispositional affect orientations on PA attitudes, intentions, and behaviours. The findings

partially supported the importance of affect in message framing. Matching affect orientation with message frame was significantly more likely than unmatched circumstances to increase PA intention and, partially, behaviour.

Consistent with the findings in Yi and Baumgartner (2009) and O'Keefe and Jensen (2011) studies, positive end-states were more persuasive than negative end-states in gain-framed messages to promote PA, whereas negative end-states were more effective than positive end-states in loss-framed messages. The results further support the speculation that positive end-states are promotion-oriented and thus match with gain-framed messages, and vice versa for negative end-states, to create regulatory fit. Positive/negative end-states may be able to arouse temporarily the promotion/prevention orientations of the message recipients and thus make gain/loss-framed message more effective.

Matching effects on PA attitude, intention, and behaviour

Intention

Fully matching affect orientation with message frame orientation was more effective than not matching in raising intentions to regularly participate in PA immediately after the manipulation and at a two-week follow-up. This was consistent with the theory of regulatory fit (Higgins, 1997, 2005), in which individuals have predetermined regulatory orientations that regulate their perceptions toward approach or avoidance stimuli. The use of the appetitive or aversive reference standards may also be relevant to the regulatory or motivational systems. Affects and the motivational systems are intertwined. Previous studies showed that inducing affects was able to activate different motivational systems (Bradley et al., 2001; Yan et al., 2010). When the individual is presented with a health message frame which matches their affect type indicating the activated motivational system, they would be more likely to pay attention to and absorb the information more effectively.

Behaviour

PA behaviour was higher among those in the direction-matched only group than those in the unmatched group. Surprising, no difference was observed between the fully-matched and the unmatched. On one hand, the findings suggest that a certain degree of matching is effective than not matching at all, which, to some extent, was consistent with our predictions. On the other hand, this pattern of results could not be meaningfully interpreted by the theories and concepts mentioned above. It was speculated that the advantageous findings in the direction-matched group might be contributed by an optimal degree of ambivalence or discomfort that enhances attention and/or chance given the limitations of the current research design.

Matching between message frames and affect types may enhance PA intention via a heuristic route in which individuals feel right about the information (Cesario et al., 2004), whereas mismatch may create the ambivalence or discomfort that leads to two opposing effects which are enhancing or avoiding attitude-relevant information processing via the central processing route depending on whether the information is perceived as agreeable or disagreeable (Clark et al., 2008). It was speculated that a

moderate amount of mismatch (as in the direction-matched group) may lead to a perception that the information is more agreeable, whereas a high degree of mismatch (as in the unmatched group) may lead to a perception that the information is disagreeable. The effects of valence-matching might be less profound than those of direction-matching as shown in their effects in the regression models. This central processing route may be more relevant to actions than intentions, as actions require more regulatory resources as evident in the literature on intention-behaviour gap (Rhodes & de Bruijn, 2013; Sheeran, 2002).

Attitude

No matching effects were found on PA attitudes. Although affect is an influential factor on attitude change, it is also intertwined with the cognitive process. The central processing route is essential for attitude change in which connects both cognitive and affective elements and affect alone would not be sufficient. In the current study, affect type may not be an ample driver in changing PA attitudes as participants may process the messages based on a more heuristic route.

Limitations

Several limitations in the current study warrant for improvements in future studies. First, the current sample consists of only college students which are not representative of the general population of young adults and thus limit generalizability. Second, the effect size of matching was small (e.g., $f^2 = .03$ for immediate PA intention, which achieved a power of .58). Thus, a larger sample size is needed to detect some other smaller effects statistically. Third, the sample sizes for affect types were not balanced. The sub-sample sizes of some matching combinations were too small which restricted more detailed analyses. However, this uncontrolled design enabled an observation of the natural distribution of each affect type. Fourth, the differences among the naturally occurred affect types might be limited. To enhance the evidence for cause-and-effect relations, future studies may create matched and unmatched conditions by affect manipulation. Fifth, one behavioural outcome of this study was intention, which was found weakly associated with actual behaviour in the literature (Rhodes & de Bruijn, 2013; Sheeran, 2002). To strengthen the quality of the outcome measurement, behavioural expectations, which may elicit more reflective processing than intentions (Armitage et al., 2015), can be considered in future studies. Last but not least, a self-report measure of PA was used. As self-report measures are subjective, the accuracy of PA levels may be hindered (Dyrstad et al., 2014; Prince et al., 2008). A use of accelerometers to assess PA is suggested for future studies to increase objectivity and precision of PA energy expenditure (Troiano et al., 2008).

Conclusion

The current study showed that a precise matching between affect and message frame on a two-dimensional regulatory model would enhance PA intentions and, partially, behaviours. However, such effects were not observed in attitudes. Although some of

the findings were promising, the evidence was yet inconclusive. More evidence is needed to substantiate this proposition. Among various behavioural domains, O'Keefe and Jensen (2011) noted that the framing effects on PA seem to be the exception rather than the norm and the underlying mechanisms have not been well understood. Hence, the effects should also be tested in other health-related behaviours and populations to determine the generalizability and enhance the understanding of the underlying mechanisms.

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