

The Effectiveness of a Motivational Interviewing Primary-Care Based Intervention on
Physical Activity and Predictors of Change in a Disadvantaged Community

Sarah Hardcastle

University of Brighton, UK

Nicola Blake

EastbourneDowns PCT, UK

Martin S. Hagger

Curtin University, Australia

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Author Note

Sarah Hardcastle, Chelsea School, University of Brighton, Eastbourne, UK;
Nicola Blake, Eastbourne Downs, Primary Care Trust, Eastbourne, UK; Martin S.
Hagger, School of Psychology and Speech Pathology, Perth, Australia. All
correspondence should be addressed to Sarah Hardcastle, Chelsea School, University of
Brighton, Denton Road, Eastbourne, East Sussex, BN20 7SP, 01273 643761,
s.hardcastle@brighton.ac.uk

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Abstract

Little research exists on the impact of behaviour change interventions in disadvantaged communities. We conducted a prospective study to explore the effectiveness of motivational interviewing (MI) on physical activity (PA) change within a deprived community and the psychosocial predictors of change in PA including stage of change (SOC), self-efficacy (SE), social support (SS), and variables from self-determination theory (SDT) and the theory of planned behaviour (TPB). Five MI counsellors recruited 207 patients and offered MI sessions to support PA behaviour change. At six-months there were significant improvements in PA, SOC, and SS. A dose-response relationship was evident; those who attended 2 or more MI consultations increased their total PA more than those who attended just one. High attendees also significantly improved SOC, family SS, and external regulation. Hierarchical regression analyses indicated that number of sessions, change in SOC, and identified regulation from SDT predicted 31.3% and 23.3% of the change in total PA and walking respectively (with the addition of friend SS for walking). Change in PBC and attitudes from TPB, friend SS, intrinsic motivation from SDT, and number of sessions predicted 21.7% of vigorous PA changes. Change in amotivation was borderline significant in the final step. MI is an effective approach for promoting PA amongst lower SES groups in the short term. The study demonstrates good translational efficacy, and contributes to a limited number of PA interventions targeting low income groups in the UK.

Key words: Motivational interviewing, physical activity, primary care, socio-economic status, behaviour change, health promotion.

The Effectiveness of a Motivational Interviewing Primary-Care Based Intervention on Physical Activity and Predictors of Change in a Disadvantaged Community

Physical inactivity presents substantial risks to public health and an estimated 60–70% of the adult population do not take sufficient physical activity to prevent chronic illness (Blair 2009). There is now considerable evidence supporting the benefits of regular physical activity in the primary prevention of chronic diseases (Warburton et al., 2006; Orozco et al., 2008) and in the secondary prevention of illness in individuals with existing medical conditions (Wood et al., 2008; Wolin et al., 2009).

Epidemiological studies have established that leading a sedentary lifestyle increases the incidence of at least 17 medical conditions (Friberg et al., 2006; Helmerhorst et al., 2009; Katzmarzyk 2009). Currently, it is reported that 39% of men and 29% of women meet the recommended levels of PA in the UK (The Health and Social Care Information Centre, 2010). However, accelerometer data taken from the 2008 Health Survey for England found that of those claiming to meet recommendations, only a mere 6% of men and 4% of women actually did (Craig et al., 2009). Therefore, sedentary behaviour, and the medical conditions to which it gives rise, is likely to be more widespread than current reports indicate and represent a significant proportion of the disease burden facing the National Health Service (NHS). At a local level, the average healthcare cost of physical inactivity per Primary Care Trust (PCT) is approximately £5 million per year (DoH 2009).

Physical activity participation also varies by socio-economic status (SES); individuals of a lower SES are less likely to adopt and maintain a healthy lifestyle (McNeill et al., 2006; Kamphuis et al., 2009). Subsequently, a positive relationship has been found to exist between socioeconomic position and PA status (Giles-Corti & Donovan, 2002; Saavedra et al., 2008; Sallis et al., 2009), with social class, income,

and education all found to be significantly related to participation (Stamatakis & Chaudhury, 2008). The inverse association between SES and health is now well established (Shaw et al., 1999; Kamphuis et al., 2007), with individuals of a lower SES having higher risks for both morbidity and all-cause mortality than their higher counterparts (Huisman et al., 2005; Mackenbach et al., 2008). For example, between 2001 and 2006 the death rate from coronary heart disease in the 20% most deprived areas in England was nearly 60% higher than the rate in the least 20% deprived (BHF 2009). The socially disadvantaged also experience a disproportionate increase in the prevalence of most chronic diseases (Everson-Rose and Lewis 2005, James et al., 2006) and psychosocial stress (Latkin and Curry 2003). Despite the compelling evidence of the need to target socially disadvantaged groups, reviews point to the paucity of data on the impact of behaviour change interventions amongst disadvantaged communities (Hillsdon et al., 2005; Michie et al., 2009), with only three (Sykes and Marks 2001; Lowther et al., 2002; Steptoe et al., 2003) RCT's conducted within the UK. Furthermore, there have been few interventions that target low SES individuals within primary care (Dutton et al., 2007; Parra-Medina et al., 2010). Therefore, building evidence towards the 'what works and for whom' requirement among disadvantaged groups is in its infancy (Michie et al., 2009).

Interventions adopting motivational interviewing (MI), a one-to-one client-centred counselling technique, have shown promise in promoting PA in comparison to standard treatments or controls (Carels et al., 2007; Bennett et al., 2007; Hardcastle et al., 2008; Benbassat et al., 2008; Miller & Beech 2009). Reviews have revealed that both number and duration of MI sessions are related to behaviour change. For example, review-level evidence found MI to outperform traditional advice giving in 80% of studies (Rubak et al., 2005). Of MI encounters lasting 60 minutes, 81% of studies

demonstrated an effect compared to only 64% of studies with an MI encounter equal to or less than 20 minutes. Furthermore, an effect was found in only 40% of studies with only one counselling session, but in 87% of studies with more than five. Previous MI research has included the use of ‘adaptations’ of MI as opposed to ‘pure’ MI and the optimal dose to promote autonomous forms of motivation and sustained PA change is unclear (Martins & McNeil, 2009). Furthermore, many studies have combined MI with other strategies (e.g., a pedometer), making it difficult to determine the unique contribution of MI to behaviour change (Martins & McNeil, 2009). In addition, there remains a dearth of evidence as to how and why MI interventions might work (Burke et al., 2003).

MI is recognised as technique that is not based on any one particular theory. It has shown to be linked to constructs from a number of social psychological models of health behaviour and represents an integrated set of theory-based components (Hagger, 2009; Orbell, Hagger, Brown, & Tidy, 2006). Specifically, MI has been shown to provide three of the key components that support psychological needs based on self-determination theory (SDT; Deci & Ryan, 1985; Markland, Ryan, Tobin, & Rollnick, 2005), to enhance self-efficacy from social cognitive theory (SCT; Bandura, 1977; Rohsenow et al, 2004), and to increase attitudes and perceived behavioural control (PBC) from the theory of planned behaviour (TPB; Ajzen, 1985; Hagger & Chatzisarantis, 2009; McEachan, Conner, & Lawton, 2011).

MI has been shown to be related to SDT in that its key components provide support for each of the psychological needs for competence, autonomy, and relatedness (Markland et al., 2005; Markland & Vansteenkiste 2007; Vansteenkiste & Sheldon 2006). The structure provided by the practitioner, such as helping the client develop appropriate goals and providing positive feedback, targets the psychological need for

competence. The provision of autonomy support by using client-centred strategies like rolling with resistance, exploring options, and letting the client make decisions, all support the need for autonomy. The involvement of the client by the practitioner in terms of expressing empathy, demonstrating an understanding of the client's position, and avoiding judgemental talk, supports the need for relatedness. Together, the satisfaction of these needs through MI is likely to foster increased autonomous motivation to engage in PA and result in increased adherence. MI has also been shown to be closely linked with SE with some of the techniques adopted targeting change in this construct. Specifically, setting personally-relevant goals, providing individualized feedback, and using visual imagery to compare the current and desired outcomes of PA are all MI components that have been adopted to enhance SE. Indeed, the enhancement of SE is proposed to be one of the mechanisms by which MI changes PA behaviour (Miller & Rollnick, 2002).

Research to examine whether intervention effects are due to changes in theoretical constructs targeted or extraneous factors is relatively sparse (Lewis et al., 2006; Napoliano et al., 2008). As such, the current study measures some of the most likely psychosocial predictors of behaviour change (Amireault et al., 2008; Lorenzten et al., 2007). Self-efficacy (Lewis et al., 2006; Burke et al., 2008), social support (Parks et al., 2003), autonomous forms of motivation from SDT (Chatzisarantis & Hagger 2009; Edmunds et al., 2008), and attitudes and perceived behavioural control from the TPB (Courneya & Bobick, 2000) have all been identified as important candidate psychosocial mediators of the effects of intervention on PA research.

Based on the evident health and cost implications of leading an inactive lifestyle (Blair 2009), the robust findings linking lower SES to undesirable lifestyle behaviours (Kamphuis et al., 2009) and consequently poorer health (Mackenbach et al., 2008), as

well as the limitations of previous MI research, the purpose of this study was threefold: (1) to investigate the effectiveness of using MI within the primary care setting to increase PA amongst lower SES groups, (2) to examine the degree of support needed to facilitate PA, and (3) to explore the psychosocial predictors of PA behavioural change.

Method

Participants and Recruitment

Participants were recruited via opportunistic and purposive sampling procedures. Qualified healthcare professionals (e.g., family physicians, practice nurses) referred eligible participants to the 'Lifestyle Change Facilitation Service' (LCFS). The inclusion criteria were patients that were either sedentary or insufficiently active who did not exhibit contra-indications for PA. Since the focus of the study was to explore the efficacy of the intervention in disadvantaged communities, we recruited participants from electoral districts with overall low SES (NHS East Sussex Downs & Weald, 2009). Healthcare professionals selected eligible patients that met the inclusion criteria for the study during routine consultations. Subsequently, the sample sizes required ranged between 183 and 285 participants. Power analysis determined a need for approximately 250 at follow-up in order to have an 80% chance of detecting meaningful changes in outcome variables with an assumed alpha level of 0.05. Our aim was to recruit a total of approximately 300 patients to allow for participant attrition at follow-up. During an initial appointment, patients were introduced to the research and given a participant information sheet. Once consent was obtained, patients were required to complete a questionnaire. Following the initial appointment, a follow up appointment (45 mins to 1 hour) was offered, with the number and frequency of follow up sessions at the patient's discretion (with a maximum of 12). Six months following a patient's initial appointment, questionnaires were posted for self-completion. Approval

was obtained from Brighton West NHS Ethics Committee and the Sussex NHS Research Consortium prior to the commencement of the study.

Counselling Intervention

The behaviour change intervention known as the LCFS is delivered across selected GP practices within the Hastings and Rother district in the South East of England targeting wards with the lowest life expectancy. Based predominantly on the application of MI (Miller & Rollnick, 2002), but also the Transtheoretical Model (TTM) (Prochaska & DiClemente, 1983), the LCFS seeks to provide patients with 1:1 behaviour change counselling (Hastings & Rother PCT, 2008). MI integrated with a stage-matched approach (Wilson & Schlam, 2004), was implemented by five Lifestyle Change Facilitators (LCF's). Patients were not told reasons for change; instead, the focus was on exploring ambivalence and eliciting self-directed 'change talk' (Amrhein et al., 2003). When appropriate, LCF's adopted the protocol of Rollnick et al., (1997); this technique began with two questions: (1) "On a scale of 1 to 10 (with 10 being the highest), how important is it for you to increase your PA level?" and (2) "On a scale of 1 to 10, if you did want to increase your PA level, how confident are you that you could do so?" Following the patient's response, the LCF followed with two probing questions: (1) "Why did you not choose a lower number?" to elicit positive motivational statements from patients and (2) "What would it take for you to give a score of 9 or 10?" to elicit the barriers that the patients typically experienced. The LCF then summarized the patient's responses and, if barriers were cited by the patient, prompted the patient to identify potential solutions, whilst seeking permission to list additional resolutions. Where appropriate, the consultation ended with a goal set by the patient, linked to the solutions discussed (Resnicow et al., 2001). The nature of each

consultation was unique to the patient and visit, with different strategies employed depending on patient need and readiness to change.

Intervention Fidelity

All LCF's participated in two MI courses; delivered by an accredited MINT (Motivational Interviewing Network of Trainers) trainer. The first was a two-day introduction, whilst the second was a four-day advanced course. Both events focused on the principles of MI and emphasized the key underlying spirit (Emmons & Rollnick, 2001). All LCF's were then required to tape record an MI consultation and have this assessed using a coding format advocated by Miller and Mount (2001). This assessment included the degree to which LCF's adhered to the spirit of MI, their use of key skills and of MI-consistent and MI-inconsistent responses. LCF's also attended monthly team meetings and bi-monthly clinical supervision in which discussion of MI implementation could take place. Finally, all LCFs were observed during three patient consultations to assess adherence and confidence in delivering MI, and gained at least 6 months experience within routine consultations prior to data collection.

Measures

Physical activity. Self-reported PA was assessed using the short version of the International Physical Activity Questionnaire (IPAQ) (Booth et al, 2000). The IPAQ collects data on the intensity, frequency and duration of PA in the previous seven days. Median MET-minutes for varying intensity PA are calculated. A total PA score is calculated by adding up scores from the various intensity domains. The IPAQ has acceptable reliability and criterion validity (against the MTI accelerometer) (Craig et al., 2003). Data cleaning and scoring followed the procedures outlined in the guidelines for use of the IPAQ (see <http://www.ipaq.ki.se/>).

Psychological variables. *Physical Activity Stage of Change* was assessed using the PA Stages of Change (SOC) flow chart (Blair et al., 2001) which classified

participants as either in pre-contemplation, contemplation, preparation, action, or maintenance, based on their 'yes' or 'no' response to five questions. *Self-efficacy* was assessed with the Self Efficacy for Exercise Scale (SEE), a revision of McAuley's (1990) Self Efficacy Barriers to Exercise measure, consisting of nine situations that might affect participation in exercise (example items include "tired", "busy", "weather", and "bored") with responses given on a 5-point scale ranging from 1 (not at all) to 5 (very much). The scale displayed high internal consistency (Cronbach alpha = 0.86). *Behavioural Regulation in Exercise* was assessed with the BREQ-2 (Mullen et al., 1997) which operationalizes exercise motivation along a graded self-determination continuum and includes amotivation, external, introjected, identified, and intrinsic regulation categories. The sub-scales displayed acceptable internal consistency (Cronbach's alpha for amotivation = 0.63; external regulation = 0.71; introjected regulation = 0.68; identified regulation = 0.65; intrinsic motivation = 0.89). *Attitude* was assessed via response to the statement "For me, exercising over the next two weeks would be..." This statement was then paired with six bipolar, 7-point adjective scales to assess both instrumental and affective attitudes. Instrumental attitude was assessed by responses on three items ("useless-useful", "foolish-wise", "harmful-beneficial"), whilst affective attitude was measured via responses to the remaining three items ("un-enjoyable-enjoyable", "boring-interesting", "stressful-relaxing"). The scale displayed acceptable internal consistency (Cronbach alpha = 0.68). *Perceived Behavioural Control* (PBC) was measured along three dimensions using 7-point Likert scales. The questions used were "How confident are you over the next two weeks that you could exercise regularly if you wanted to do so?" ("Very unconfident-very confident"), "How much personal control do you feel you have over exercising regularly over the next two weeks?" ("Very little control-complete control"), and "How much I exercise in the next

two weeks is completely up to me?” (“Strongly agree-strongly disagree”). The scale displayed high internal consistency (Cronbach alpha = 0.86). *Social Support* was assessed using the Social Support for Physical Activity Scale (Sallis et al., 1987). The scale lists 13 statements in which participants are required to score the frequency in which the statement has occurred over the last month in relation to both friends and family, using a 6 point scale ranging from 0 (does not apply) to 5 (very often). Scores for each category were totalled in order to give two separate scores (between 0 and 65). The scale displayed high internal consistency with (Cronbach’s alpha for Social Support from Friends = 0.82; Social Support from Family = 0.85).

Socio-economic Status

Occupation, education, and income are traditionally used to indicate SES and have been consistently shown to be very useful in describing and evaluating health inequalities. In the current study we collected multiple indicators of SES in order to ensure that we were able to clearly identify participants as representative of disadvantaged groups¹. These included highest educational attainment (HEA), occupation, and household income. HEA was measured according to highest educational qualification on five levels (University degree or higher degree; A levels, NVQ level 3, O level/CSE/GCSE or NVQ 1 or 2; other qualification and no qualifications. Occupation was based on participants selecting a particular type (e.g., admin, clerical, managerial, routine manual, unskilled manual, homemaker etc.). Income was based on average household income per year before taxes and participants were asked to tick one of the following options: <10, 000; 10,001-15,000; 15,001-20, 000; 20, 001-30, 000; 30, 001-50, 000; 50, 001-100, 000; >100,000.

¹ The rationale for using multiple indicators of SES was based on the principle that any one indicator considered in isolation provides only a partial indication of SES (Galobardes et al., 2007). Income was used since it has been shown to have a dose-response relationship with health (Lynch et al., 2000) and is one of the best indicators of living standards. Educational attainment was used in addition to occupation because it’s argued to be associated with greater exposure to health messages and a greater capacity to seek, understand, internalize and act upon these messages (Cerin & Leslie, 2008).

Criteria Used to Characterise the SES of the Sample

In order to confirm that participants in the current sample were from low SES backgrounds, we identified household income as the primary criterion. In order to be classified as a member of the 'lower SES group' the reported annual household income had to be £20,000 or less. On this basis, 120 participants met this criterion and were classified as low SES. A further 34 participants responded to the income question with 'prefer not to say' and who could not be classified according to income. We therefore used additional indicators (occupation and HEA) to confirm whether these participants were from 'lower' SES backgrounds. Those who were unemployed ($n = 6$) were also added to the 'lower' SES group. Participants ($n = 17$) reporting an education level of 'no qualifications' or 'other qualifications' were included in the 'lower SES group'. The other ($n = 11$) participants did not meet the criteria for the 'lower SES group' on either occupation or educational attainment.

Data Analysis

Using a last observation carried forward (LOCF) intent to treat analysis throughout, a series of repeated-measures ANOVAs with Bonferroni corrections for multiple tests were used to determine the effectiveness of the intervention in changing PA and the psychological variables related to behaviour change from baseline to six-month follow-up. We calculated change scores on all behavioural and psychological variables by subtracting baseline scores from follow-up scores. Finally, a MANOVA was used to examine the effects of consultation attendance on PA behaviour change. In all cases, univariate follow-up F -tests were used to identify the location of specific differences identified in the multivariate analyses. A one-way ANOVA was used to explore the effect of MI dose (1-6 sessions) on PA change. Where appropriate, univariate follow-up F -tests were used to examine the location of the differences.

Finally, hierarchical regression analyses were conducted to explore the predictors of change in PA.

Results

A total of 207 patients participated in the study, of which 64 were allocated to the 'higher SES group' and 143 to the 'lower SES group'. The majority (84%) of the 'lower SES group' had a household income of £20,000 or less, with 29% ($n = 41$) reporting a household income of £10-15,000, and 43% receiving an annual household income of less than £10,000. Sixty-five percent ($n = 135$) of those recruited were female, 70% were aged over 50 years, and 94% classified themselves as White-British. With respect to PA, 60% were insufficiently active at baseline (i.e., not meeting the recommendations as outlined in the Chief Medical Officer's report; DOH, 2004). Sixty-five percent ($n = 134$) of patients completed both assessments. Participants that completed both assessments attended a significantly greater number of MI sessions ($M = 2.50$ sessions, $SE = 0.13$, $p < .001$), and tended to be less physically active at baseline ($M = 952.62$ MET-minutes, $SE = 135.97$, $p = .05$), compared to those who completed only one assessment.

Regarding engagement with the intervention, participants attended an average of 2.16 ($SE = 0.10$) counselling sessions over the six-months intervention period, with 45%, 23%, 15%, 8%, 5%, and 4% attending 1, 2, 3, 4, 5, or 6 plus consultations respectively. Table 1 shows the baseline characteristics for all participants at baseline, and for the 'lower' and 'higher' SES groups. Participants in the higher SES group had significantly higher levels of PBC, amotivation, extrinsic regulation, and introjected regulation, and lower SOC for PA compared to the lower SES group. As a consequence, we controlled for the effect of variations in SES in all analyses by including SES category as a control variable. In analyses of variance, SES was included

as a covariate and in the regression analyses, SES was included as an initial predictor along with other demographic variables in the first step prior to testing hypotheses of the predictors of PA variables.

INSERT TABLE 1 ABOUT HERE

Table 2 displays the baseline and six-month follow-up scores for all variables. Repeated measures ANOVAs with Bonferroni corrections revealed a significant increase in total PA at six-months ($F(1, 205) = 19.80, p < .001$) with an average increase of 743.86 Met-minutes per week ($SE = 98.96$). Although significant differences were not detected for moderate-intensity PA, both walking ($F(1, 205) = 15.37, p < .001$) and vigorous PA ($F(1, 205) = 4.96, p < .05$) significantly increased. Furthermore, a MANOVA was used to explore change in the four PA domains between those insufficiently and sufficiently physically active at baseline. The MANOVA revealed a significant effect on PA for PA status at baseline (Wilks' Lambda = .92, $F(3,199) = 6.14, p < .001, \eta^2_p = .09$); those who were insufficiently active at baseline increased their PA significantly more ($M = 876.67$ Met-minutes/per week, $SE = 114.12$) than those already meeting the guidelines ($M = 441.05, SE = 139.48$), $F(1,201) = 5.55, p < .05, \eta^2_p = .03$. Those who were insufficiently active at baseline also significantly increased their moderate-intensity PA compared to those meeting the minimum recommended levels at baseline ($F(1,201) = 16.87, p < .001, \eta^2_p = .08$). Overall, the proportion of inactive patients at six-months decreased from 60% to 32%. The psychological variables that significantly increased between baseline and follow-up were SOC ($F(1,201) = 50.14, p < .001, \eta^2_p = .20$), social support from friends ($F(1,201) = 5.60, p < .05, \eta^2_p = .03$), and social support from family ($F(1,201) = 14.47, p < .001, \eta^2_p = .07$).

INSERT TABLE 2 ABOUT HERE

Two multivariate analyses of variance (MANOVA) were conducted to explore the effects of consultation attendance (patients attending 1 hour of MI vs. patients attending 2 hours or more) on the PA outcomes and psychological variables respectively. The MANOVA with PA outcomes (total PA, vigorous, moderate, walking) as the dependent variable revealed a borderline significant effect for attendance (Wilks' Lambda = .96, $F(3,196) = 2.50$, $p = .06$, $\eta^2_p = .04$). Univariate follow-up F -tests were used to examine the location of the differences and are shown along with mean differences in Table 3. Specifically, those who attended two or more MI consultations increased total PA ($M = 923.90$ MET-minutes/per week, $SE = 144.52$) more than those just attending one ($M = 455.95$, $SE = 87.90$), $F(1,201) = 6.83$, $p < .01$, $\eta^2_p = .03$). Similarly, participants attending two or more MI sessions reported greater walking ($M = 616.84$, $SE = 108.14$) than those attending only one session ($M = 304.53$, $SE = 66.85$), $F = 4.46$, $p < .05$, $\eta^2_p = .02$). Change in Vigorous PA was approaching significance between high ($M = 346.43$, $SE = 77.12$) and low attendees ($M = 121.74$, $SE = 69.44$), $F = 3.26$, $p = .07$, $\eta^2_p = .02$).

INSERT TABLE 3 ABOUT HERE

The MANOVA with psychological variables as the dependent (SOC, Behavioural regulation, Attitudes, PBC, and Social Support) variables revealed a significant main effect for attendance (Wilks' Lambda = .90, $F(11,176) = 1.85$, $p < .05$). Univariate follow-up tests and mean differences are also shown in Table 3. Specifically, those who had two or more MI consultations increased their SOC ($M = 0.74$, $SE = 0.06$) more than those just receiving one ($M = 0.46$, $SE = 0.07$), $F(1,186) = 9.27$, $p < .01$, $\eta^2_p = .05$. The high attendees also showed a significant increase in family social support ($M = 4.49$, $SE = 0.92$) compared to low attendees ($M = 2.08$, $SE = 0.76$), $F = 3.95$, $p < .05$, $\eta^2_p = 0.02$. High attendees also reduced external behavioural regulation

($M = -0.11$, $SE = 0.10$) compared to low attendees ($M = 0.16$, $SE = 0.06$), $F = 3.65$, $p = .06$, $\eta^2_p = 0.02$. The effect of the SES status covariate was not significant in any of the analyses.

A one-way ANOVA was used to further explore the effect of MI dose (1-6 sessions) on total PA change. A significant dose-response relationship was found ($F(5, 194) = 4.74$, $p < .001$, $\eta^2_p = 0.11$) such that the higher the number of MI consultations, the greater the increase in PA (see Table 4). The greatest increases in PA were found amongst those attending four or five MI consultations. Post hoc least significant difference tests (LSD) were conducted to identify the location of the differences. Table 5 displays the difference scores for mean change in total PA (MET-minutes) for groups defined by number MI consultations attended. The main trends indicate that differences lie between the lower sessions (1 and 2) and higher sessions (4 and 5). There were no significant differences found between 1 and 2 sessions or between 1 or 2 and 3 sessions. Furthermore, there were generally no significant differences in total PA change for those attending 6 sessions compared to those attending 2, 3, 4, or 5 sessions. Therefore, the data suggests that the optimal number of MI consultations to increase total PA appears to be four or five sessions.

INSERT TABLES 4 AND 5 ABOUT HERE

Finally, hierarchical regression analyses were conducted to explore the predictors of change in PA between baseline and six-month follow-up. Specifically, the design of the regression was such that demographic and non-psychological variables (gender, age estimation, SES, number of MI consultations) were entered in the first step, change in psychological variables from the TPB and TTM and social support variables were entered in the second step, and finally, change in SDT variables were

included in the final step. This regression model was used in each analysis predicting the four domains of PA (total PA, vigorous PA, moderate PA, and walking).

Focusing first on the model with total PA as the dependent variable, results indicated that the overall model predicted 31.3% of the variance in total PA ($R^2 = .32$, $F(15,185) = 5.17$, $p < .001$). The only predictor in the first step was number of MI consultations ($\beta = 0.31$, $p < .001$). In the second step, change in SOC was a significant predictor ($\beta = 0.38$, $p < .001$) along with number of MI consultations ($\beta = 0.20$, $p < .01$). In the final step, number of sessions ($\beta = 0.20$, $p < .01$), change in SOC ($\beta = 0.36$, $p < .001$), and change in identified regulation ($\beta = -0.26$, $p < .01$) significantly predicted change in total PA.

For vigorous PA, the overall model predicted 21.7% of the variance in PA changes ($R^2 = 0.21$, $F(15,173) = 3.00$, $p < .001$). The number of sessions was the only significant predictor in the first step ($\beta = 0.18$, $p < .05$). Change in attitudes ($\beta = 0.29$, $p < .001$), PBC ($\beta = 0.19$, $p < .05$), social support (friends) ($\beta = 0.23$, $p < .01$), and age ($\beta = -0.18$, $p < .05$) along with number of MI consultations ($\beta = 0.18$, $p < .05$) significantly predicted vigorous PA change in step two. In the final step, change in PBC ($\beta = 0.20$, $p < .05$), attitudes ($\beta = 0.35$, $p < .001$), social support (friend) ($\beta = 0.26$, $p < .01$), intrinsic motivation ($\beta = 0.26$, $p < .01$), and number of sessions ($\beta = 0.19$, $p < .05$) significantly predicted vigorous PA change. Change in amotivation was borderline significant in the final step ($\beta = -0.14$, $p = .06$).

The overall model predicted 11% of the variance in moderate PA and the overall equation was not significant ($R^2 = 0.11$, $F(15,173) = 1.39$, $p = .16$). There were no predictors except for change in SOC at steps two and three (final $\beta = 0.18$, $p < .05$), but this effect was negligible.

Finally, the overall model predicted 23.3% of the variance in walking change. ($R^2 = 0.23$, $F(5,173) = 3.51$, $p < .001$). In step one, number of MI sessions was a significant predictor ($\beta = 0.29$, $p < .001$). Number of sessions ($\beta = 0.20$, $p < .01$), change in SOC ($\beta = 0.28$, $p < .001$), and social support (friends) ($\beta = 0.17$, $p < .05$) were significant predictors at step two. In the final step, change in SOC ($\beta = 0.29$, $p < .001$), social support (friends) ($\beta = 0.18$, $p < .05$), identified regulation ($\beta = -0.20$, $p < .05$), and number of MI sessions ($\beta = 0.19$, $p < .01$) significantly predicted changes in walking.

Discussion

The three aims of the study were (1) to investigate the effectiveness of using MI within the primary care setting to increase PA amongst lower SES groups, (2) to examine the degree of support needed to facilitate PA, and (3) to explore the psychosocial predictors of PA behavioural change. In summary, there were significant increases in total PA, walking, vigorous PA, SOC, and SS from baseline to follow-up. High attendees significantly increased total PA, walking, SOC and family SS and reduced external regulation compared to low attendees. The psychosocial predictors of change in total PA were SOC, number of MI consultations and identified regulation. Predictors for walking were change in SOC, SS friends and identified regulation, and number of MI consultations. The predictors of change in vigorous PA included change in attitudes, PBC, SS, intrinsic motivation and number of MI consultations.

In relation to the first aim, the significant increase in PA at six-months found in the present research is supported by a number of studies (Pinto et al., 2001; de Blok et al., 2006; Benbassat et al., 2008; Carels et al., 2007; Bennett et al., 2007; Jackson et al., 2007; Hardcastle et al., 2008) that have found an MI intervention to lead to significant increases in PA compared to standard treatments or controls, and is supported by a

number of systematic reviews (Rubak et al., 2005; Martins and McNeil 2009).

However, compared to previous research, current findings are rather more favourable.

For example, Hardcastle et al.'s (2008) MI study within primary care reported a significant increase in PA at six-months and a 17% reduction in those classified as inactive in the intervention arm (compared to a reduction of 4% in controls), compared to a 28% reduction in the current study. Our findings are also in contrast to those of Whittemore et al.'s (2009) and Groeneveld et al.'s (2010) studies adopting intensive MI interventions (3-6 sessions) which failed to demonstrate significant differences compared to standard care.

Differences in MI training and experience between the present research and those highlighted could account for the particularly favourable outcomes reported in the current study. Prior to data collection, LCF's received a total of six days MI training compared to the maximum of three days cited by Groeneveld et al., (2010). However, although MI practitioners in both the present and previous research could access support through an MI specialist or monthly supervision; documentation of the practitioner's actual "experience" of delivering MI was rarely described in the aforementioned studies. This is a limitation of the previous research. In the Groeneveld et al. (2010) study, MI practitioners underwent a six-week pilot in which to practice MI; however for the present research, LCF's had been implementing MI as part of their daily role for over 6 months prior to data collection. Subsequently, results spell out the possible influence of MI experience in that its contribution may have enabled the present study to achieve the greater observed changes in PA relative to other studies using less intensive MI intervention protocols. Our findings suggest that MI is effective in facilitating PA behaviour change in lower SES groups and is in contrast to previous research (Ferguson et al., 2005; Yancey et al., 2006; Dutton et al., 2007; Keyseling et

al., 2008) to suggest that interventions to increase PA in low SES groups are less effective or ineffective. Although the sample was recruited from areas with overall high social deprivation, we went to some effort to ensure that our participants could be characterised as members of a 'lower' SES group; the majority (69%) of the sample were classified into this group based on our primary criterion of household income, followed by employment status and education. We used this classification to control for the effect of variations in SES in all analyses. However, the sample as a whole could be considered representative of lower SES. Indeed, the UK national household income has been calculated to be between £32,000 and £36,000 (Oguz & Knight, 2010) and, in the current study, 76% of participants declared a household income of less than £30,000². This is unsurprising given that Hastings (the recruitment area) ranks amongst the 10% most deprived areas in the country (East Sussex County Council, 2010).

In relation to the second aim, the current findings support previous findings that have identified a dose-response relationship for MI within health research (Burke et al., 2003; Rubak et al., 2005). For example, in a meta-analysis of adapted MI in treating problem behaviours, Burke et al. (2003) found high-dose studies to yield larger effect sizes. A meta-analysis by Rubak et al., (2005) also found a significant effect in 40% of studies with just one counselling session, but in 87% of studies where individuals received more than five MI encounters. However despite such research, several authors (e.g., Bennett et al., 2008; Greaves et al., 2008) have been unable to replicate this relationship. For example, although Hardcastle et al., (2008) found high attendees (3 to 5 MI sessions) to increase their vigorous PA, walking, and overall PA compared to low attendees (2 or less MI sessions), no significant dose response relationship was identified. Another study (Harland et al., 1999) including four intensity-related

²This is a conservative estimate given that 34 participants did not report their income and returned a 'prefer not to say' response. Taking the latter into consideration, it is likely that the percentage classified with an income would be higher.

intervention groups or control, also found no significant effect as a result of attending more than one MI interview.

To our knowledge, the current study is the first to demonstrate a clear dose-response effect within PA research using multiple MI intervention sessions. The optimum number of sessions would appear to be 4 or 5 hours/sessions of MI. High attendees also reported significantly increased SOC and perceived family social support and decreased external behavioural regulation compared to low attendees. The latter finding supports SDT (Deci & Ryan, 2002), in that decreased external regulation is associated with higher self-determined motivation and consequently increased PA participation (Vlachopoulos & Michailidou, 2006).

A lack of research on the active ingredients of MI (Burke et al., 2003) has made it difficult to draw firm conclusions regarding how MI facilitates behaviour change. In relation to the final aim, the current study sought to explore the predictors of PA behaviour change, and, in particular, the degree to which change in motivational regulations from SDT, change in attitudes and PBC from the TPB, change in self-efficacy and social support (SCT) and change in motivational readiness (TTM) predicted change in PA. The main psycho-social predictors of PA change were number of sessions, change in SOC, and change in identified regulation. The finding that change in SOC predicted PA change (both for total PA and walking) is consistent with a central purpose of MI; that is, to increase client readiness to change (Miller & Rollnick, 2002).

The decreased levels of identified regulation predicting PA change and walking change is somewhat difficult to explain but it has been suggested that MI may promote more controlling forms of regulation via its key principle of developing discrepancy (Markland et al., 2005). Recent work has also identified client change talk and client

experience of discrepancy to be key mechanisms of MI in influencing outcomes (Apodaca & Longabough, 2009). It may also be the case that quality of motivation is less important than quantity of motivation (SOC) and other factors (e.g., social support) in lifestyle PA behaviour change, a point we will return to later. Certainly, findings here reinforce the notion that different types of PA may be guided by different forms of behavioural regulation (Edmunds et al., 2006). Our research is also consistent with previous investigations (e.g., Wilson et al., 2002; Edmunds et al., 2006) in that intrinsic motivation only predicted change in vigorous PA rather than less intense forms of PA (i.e., moderate intensity activities and walking). It may be that motivational regulations within SDT are more relevant in predicting structured, and/or more intense exercise rather than lifestyle related/less intense forms of PA. The borderline significant result for amotivation as a predictor of vigorous PA reinforces this notion further, in that perceptions of competence may only affect motivation and thus behaviour in more vigorous and structured forms of PA.

The predictors of vigorous PA change were increased intrinsic motivation, PBC, social support from friends, and attitudes. These findings support previous research that PBC is a significant predictor of PA behaviour change (Lorentzen et al., 2007; Kamphuis et al., 2009). Meta-analyses of the TPB applied to multiple behavioural outcomes (Armitage & Conner, 2001) and specific to PA (Hagger et al., 2002; Hagger & Chatzisarantis, 2009) have shown PBC to have a medium to large effect size with attitudes and PBC to be significantly correlated with intention. The finding that increased social support from friends predicted change in both vigorous PA and walking is consistent with recent research pointing to the significance of social support in both decreasing saturated fat intake and increasing time spent in PA (Burke et al.,

2008) and to research suggesting that social support is a key predictor of self-regulation of PA in older adults (Umstadtd et al., 2006).

Strengths and Limitations

The present study has numerous strengths including the adoption of MI; a theory-based client-centred intervention technique known to be effective in changing behaviour, the inclusion of a gamete of theory-based psychosocial mediators of known to be related to physical activity behaviour change (Dombrowski et al., 2011), and the adoption of an intention-to-treat analyses. In addition, the present study also included comprehensive training of the practitioners delivering the intervention. The MI counsellors completed both basic and advanced training from a MINT-accredited trainer and received ongoing supervision and feedback on their MI skills. They also had six-months practice to refine their MI skills prior to the start of data collection. Furthermore, there were five LCF's, collecting data across 15 practices which helps to rule out issues of research bias both in terms of practitioner and 'type' of patient. In addition, the research took place within primary care, and involved GP referral (rather than self-referral); actively recruiting those patients deemed to be insufficiently physically active. Finally, the intervention was conducted in a participant group from a low SES community which is a difficult to reach and insufficiently studied group and was such that it could be easily integrated into routine practice to demonstrate good translational efficacy (Dunn 2009). Together these unique features demonstrate the importance of the current research in contributing to knowledge and understanding of interventions to promote behaviour change in physical activity in this often neglected population.

However, it would be remiss not to mention some of the limitations of the current research including the reliance on self-report measures and absence of a

standard-care comparison group to which participants were randomly allocated next to the intervention group. Due to organisational barriers and resource implications, the research was also unable to access alternative GP practices to form a control arm. Limited resources also prevented the assessment of treatment integrity over the course of the intervention.

Conclusions

The present study adds to the growing literature to support the effectiveness of MI in promoting PA behaviour change, and is one of the first to demonstrate a clear dose-response relationship between MI and PA change. Findings of this research contribute towards both “gaps in the evidence” in relation to brief interventions in primary care and the effect of an intervention across lower socioeconomic groups (NICE 2007; Blaxter 2007), but also to a limited number of physical activity interventions targeting low income groups within the UK (Michie et al., 2009).

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Table 1 Means and Standard Error of Baseline Measures for Total Sample and between Socioeconomic group

Outcome	Total Sample (n=207)	Higher (n=64)	Lower (n=143)	F Ratio	Partial Eta Squared
Total Met Minutes p/wk	1132.28 (125.28)	1072.68 (267.12)	1158.96 (137.03)	0.10	0.00
Walking Met Minutes p/wk	564.75 (51.05)	482.37 (95.61)	601.62 (60.21)	1.17	0.01
Moderate Met Minutes p/wk	374.30 (70.61)	361.56 (127.60)	380.00 (85.07)	0.01	0.00
Vigorous Met Minutes p/wk	193.24 (65.33)	228.75 (111.79)	177.34 (80.48)	0.13	0.00
Stage of Change	3.20 (0.05)	3.05 (0.09)	3.27 (0.07)	3.90*	0.02
Self-efficacy	3.02 (0.07)	3.18 (0.13)	2.95 (0.09)	1.92	0.01
Perceived Behavioural control	5.05 (0.12)	5.58 (0.20)	4.80 (0.15)	9.16**	0.05
Attitude	1.83 (0.05)	1.92 (0.11)	1.78 (0.06)	1.51	0.01
Social Support- Friends	20.64 (0.64)	20.48 (1.13)	20.71 (0.77)	0.06	0.00
Social Support- Family	24.03 (0.69)	24.59 (1.19)	23.76 (0.85)	0.27	0.00
Amotivation	1.23 (0.04)	1.34 (0.08)	1.18 (0.04)	4.49*	0.02
External Regulation	2.16 (0.07)	2.39 (0.14)	2.05 (0.08)	5.22*	0.03
Introjected Regulation	2.25 (0.09)	2.60 (0.15)	2.08 (0.10)	8.74**	0.04
Identified Regulation	3.77 (0.06)	3.76 (0.10)	3.77 (0.07)	0.00	0.00
Intrinsic Motivation	3.61 (0.07)	3.51 (0.14)	3.66 (0.09)	0.75	0.00

* $p < .05$; ** $p < .01$

Outcome	Baseline	six-months	95% CI	F Ratio	Partial Eta Squared
Total Met Minutes p/wk	1132.28 (125.56)	1876.16 (143.56)	-938.98, - 548.77	19.80***	0.09
Walking Met Minutes p/wk	564.75 (51.02)	1033.84 (74.00)	-600.46, - 337.73	15.37***	0.07
Moderate Met Minutes p/wk	374.30 (70.78)	407.54 (58.33)	-128.06, 61.59	1.68	0.01
Vigorous Met Minutes p/wk	193.24 (65.47)	434.78 (86.52)	-344.95, - 138.14	4.96*	0.02
Stage of Change	3.20 (0.05)	3.82 (0.06)	-0.71, -0.52	50.14***	0.20
Self-efficacy	3.02 (0.07)	3.15 (0.07)	-0.25, -0.01	2.12	0.01
Perceived Behavioural control	5.05 (0.12)	5.09 (0.12)	-0.10, 0.32	1.00	0.01
Attitude	1.83 (0.05)	1.80 (0.07)	-0.08, 0.13	0.78	0.00
Social Support- Friends	20.64 (0.64)	23.37 (0.63)	-3.82, -1.66	5.60*	0.03
Social Support- Family	24.05 (0.70)	27.26 (0.68)	-4.41, -2.02	14.47***	0.07
Amotivation	1.23 (0.04)	1.17 (0.04)	-0.00, 0.12	1.34	0.01
External Regulation	2.16 (0.07)	2.16 (0.07)	-0.13, 0.12	0.01	0.00
Introjected Regulation	2.25 (0.09)	2.35 (0.08)	-0.24, 0.04	0.06	0.00
Identified Regulation	3.77 (0.06)	3.81 (0.06)	-0.15, 0.06	0.14	0.00
Intrinsic Motivation	3.61 (0.07)	3.69 (0.07)	-0.18, 0.04	0.06	0.00

Table 2 Baseline and Six-Month Mean (SEM) Scores for Total Sample

* $p < .05$; ** $p < .01$ *** $p < 0.001$ ^a 95% confidence interval (CI) for the mean difference in changes from baseline.

Table 3 Differences in Mean (SEM) Change Scores from Baseline to Six-Months between Low and High Attendees

Outcome	Low Attendees (n = 92)	High Attendees (n = 112)	95% CI ^a	<i>f</i> Ratio	F
Total Met Minutes p/wk	455.95 (87.90)	923.90 (144.52)	-819, -117	6.83**	S
Walking Met Minutes p/wk	304.53 (66.85)	616.84 (108.14)	-514, -19	4.46 *	
Moderate Met Minutes p/wk	7.17 (62.58)	67.32 (72.68)	-211, 153	0.06	
Vigorous Met Minutes p/wk	121.74 (69.44)	346.43 (77.12)	-371, 16	3.26 ^b	
Stage of Change	0.46 (0.07)	0.74 (0.06)	-0.47, -0.09	9.27**	
Self-efficacy	0.09 (0.07)	0.16 (0.09)	-0.31, 0.17	0.32	
Perceived Behavioural control	0.02 (0.14)	0.03 (0.16)	-0.43, 0.42	0.13	
Attitude	0.02 (0.07)	-0.10 (0.07)	-0.07, 0.32	0.40	
Social Support- Friends	2.40 (0.65)	2.60 (0.81)	-2.30, 1.91	0.36	
Social Support- Family	2.08 (0.76)	4.49 (0.92)	-4.82, 0.01	3.95*	
Amotivation	-0.06 (0.03)	-0.06 (0.05)	0.02, 0.52	0.00	
External Regulation	0.16 (0.06)	-0.11 (0.10)	-0.12, 0.13	3.65 ^b	
Introjected Regulation	0.21 (0.10)	0.02 (0.11)	-0.10, 0.48	1.78	
Identified Regulation	0.09 (0.07)	0.01 (0.08)	-0.15, 0.29	0.39	
Intrinsic Motivation	0.08 (0.06)	0.07 (0.09)	-0.21, 0.23	0.00	

Note. ^a 95% confidence interval (CI) for the mean difference in changes from baseline

* $p < .05$; ** $p < .01$ *** $p < 0.001$

^a95% confidence interval (CI) for the mean difference between the changes within both groups from baseline.

^bBorderline significant

Table 4 Motivational Interviewing Consultation Attendance and Mean (SEM) Change in Physical Activity

No of MI Consultations	Number of Patients	Mean Change Met-minutes (SEM)	95% CI
1	91	456.68 (127.90)	204.90, 78.92
2	47	583.26 (177.99)	232.21, 934.30
3	30	696.25 (222.93)	256.57, 1135.94
4	15	1489.80 (315.13)	868.29, 2111.32
5	10	1968.08 (387.24)	1204.34, 2731.83
6	8	1404.13 (431.43)	553.23, 2255.03

Note. MI = Motivational Interviewing; CI = Confidence intervals.

Table 5 Difference Scores for Mean Change in Total Physical Activity (MET-minutes)

No of MI Consultations	1	2	3	4	5	6
1	-					
2	126.58	-				
3	239.58	112.99	-			
4	1033.13**	906.54*	793.55*	-		
5	1511.41***	1384.83***	1271.83**	478.28	-	
6	947.45*	820.87	707.88	85.67	563.96	-

for Groups Defined by Number MI Consultations Attended

Note. Left-hand column represents the reference group for the mean difference calculations i.e. difference scores calculated as mean change in physical activity for number of MI consultations attended in the left-hand column minus mean change in physical activity for number of MI consultations attended in the upper column.

* $p < .05$; ** $p < .01$ *** $p < 0.001$