

Review

Mechanisms of change within motivational interviewing in relation to health behaviors outcomes: A systematic review



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ABSTRACT

Objective: Motivational interviewing (MI) has been identified as an effective treatment for health behaviors. Understanding the mechanisms of MI could have practical implications for MI delivery. This review is the first to examine mechanisms within MI that affect health behavior outcomes and summarizes and evaluates the evidence.

Methods: A systematic literature search was conducted in PSYCHINFO, MEDLINE and EMBASE to identify studies that delivered individual MI in the context of health behaviors, excluding addictions, and investigated mechanisms of MI. Effect sizes were calculated.

Results: 291 studies were identified and 37 met the inclusion criteria. Few of the 37 studies included, conducted mediation analyses. MI spirit and motivation were the most promising mechanisms of MI. Although self-efficacy was the most researched, it was not identified as a mechanism of MI. Study quality was generally poor.

Conclusion: Although this review has indicated possible mechanisms by which MI could influence health behavior outcomes, it also highlights that more high quality research is needed, looking at other possible mechanisms or causal pathways within health behavior outcomes.

Practice implications: MI spirit possibly plays an important role within MI and may potentially be used to evoke change talk which links to outcomes.

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1. Introduction

Leading causes of death have changed dramatically in the last few decades, shifting from infectious diseases to non-communicable causes [1]. Changing unhealthy lifestyle behaviors is an important issue. A key barrier to behavior change is a lack of motivation [2]. Motivational interviewing (MI) is a counseling approach designed to promote behavior change. It aims to strengthen personal motivation for, and commitment to a specific goal by eliciting and exploring the person's own reasons for change within an atmosphere of acceptance and compassion [3]. There is a lack of evidence for specific mechanisms that may account for its efficacy within health behaviors [4,5] such as exercise or adhering to a medical regime. Looking at mechanisms of change (mediators) means attempting to understand what it is that brings about change. Understanding how MI works could lead to improvements in practice and efficacy, focus research efforts and further enhance our understanding of behavior change processes [6].

There have been at least 12 reviews that have found statistically significant effects of MI in relation to health outcomes [5,7–17]. However, these reviews do not examine the mechanisms of MI. Potential mechanisms relate to counselors' skills such as empathy [18,19], while others relate to client behavior such as change talk [20–22]. There are potential mediators 'within the individual' for example self-efficacy and readiness to change which have also been linked to outcomes within MI (see Section 2 for full list of mechanisms). Few systematic reviews explore mechanisms of MI. One review examining mechanisms of MI and substance abuse found the most consistent evidence pointed to change talk, clients' experience of discrepancy and therapist MI-inconsistent behaviors as being important [4]. The review however, investigates substance abuse outcomes and not health behaviors. Health behavior outcomes are "behavior patterns, actions and habits that relate to health maintenance, to health restoration and to health improvement" [23]. This includes behaviors such as exercise, diet, weight loss, managing bulimia or anorexia or adhering to a medical regime. These health behaviors may involve different mechanisms [15,24] as they require the modification or addition of a behavior rather than the termination of a behavior as for addictions [10,15]. Therefore mechanisms found to be important previously in the addictions field [4] may be different from those found to predict behavior change in these health behaviors. To date there has not been a systematic review looking at health behaviors and mechanisms within MI.

The aim of this review is to systematically review studies identifying possible mechanisms underlying the effectiveness of

MI in relation to health behaviors. It will look at mechanisms identified in the MI literature (addictions and health behaviors) to assess if the mechanisms of change in relation to health behaviors are the same or different from those in the addictions field. The review will look at the extent to which MI is associated with a particular mechanism and whether this mechanism is related to health outcomes.

2. Method

2.1. Study eligibility criteria

The papers included within this review must examine all three of these aspects: MI, a mechanism of MI and a health outcome otherwise they will not be included.

Selected studies met the following inclusion criteria:

- Articles published from 1980 to the present.
- Participants received MI or an intervention referred to as motivational enhancement therapy (MET), motivational enhancement or brief motivational intervention. These interventions all incorporate the techniques of MI [5]. Throughout this review the term MI incorporates these variations.
- Health behavior outcomes for example:
 - Weight
 - BMI
 - Diet
 - Physical activity
 - Fruit and vegetable intake
 - Self-care index
 - Glycemic control
 - Medication adherence (self-reports or pill counts)
- Qualitative or quantitative data
- MI sessions delivered to individuals and not groups
- The intervention was not delivered via the Internet.
- Articles published in English only.

Studies were excluded if: the therapeutic intervention was to treat alcohol problems, gambling, use of illegal substances and smoking as previous review [4] has examined mechanisms in addictions already. For the full list of search terms and search strategy see Appendix A.

2.2. Information sources

Research articles were identified from PSYCHINFO, MEDLINE and EMBASE. They were also identified from references of included

papers and by emailing authors (identified by database searches and/or references of included papers) requesting any unpublished studies. The search included 1980 until May 2014.

2.3. Search strategy

The following keywords were used: motivational interviewing, motivational Enhancement Therapy, brief motivational intervention, mediator, therapist behavior, empathy, client change talk, motivation, change process, obesity, diet, heart disease and hypertension (for details of the full search strategy see Appendix A). The search terms are in three categories 1) MI, 2) mechanisms and 3) health outcomes which were combined in the databases. The search strategy started off with broad expansion terms e.g. *health* and became more specific e.g. *fruit*, to maximize the sensitivity of the review.

2.4. Data collection

Identified studies were assessed by four researchers and independently checked for eligibility of the abstract and title of the records retrieved according to the inclusion and exclusion criteria. Assessment of studies was split between three researchers, and the first researcher checked all the studies. Studies that met the criteria were obtained in full text and again checked for eligibility by four researchers in the same manner and according to the criteria.

2.5. Data extraction

Data extraction sheets were created based on templates from the critical Appraisals Skills Program (CASP) checklists [25]. The data extraction sheets were piloted and amended before a standard data extraction sheet was finalized (Appendix B). 50% of the data extraction sheets were verified for interrater

consistency. The quality of the papers was rated by the first researcher using checklists appropriate for the study design. Randomized control trials (RCT) (Appendix C) and non-controlled studies (Appendix D) were checked using a checklist from the health evidence bulletins-Wales [26]. Observational and qualitative studies were rated on quality using the CASP [26] (Appendix E) and National Institute for Health and Care Excellence (NICE) [27] (Appendix F) checklists. Fidelity of the MI interventions was also investigated. This is important as if high quality MI is not delivered then this may impact the effectiveness of the mechanisms. Effect sizes were calculated for the different studies using follow up means and standard deviations (SD). If follow-up SDs were unavailable then baseline SDs were used. Where these were unavailable Cohen's *d* or odds ratio were calculated.

2.6. Data synthesis

Each study was summarized descriptively in terms of results, intervention type, strengths and weaknesses of the research type of MI, intensity of MI training, whether a fidelity assessment was included, number of MI sessions delivered, the mechanism examined and the link between MI, the mechanism and the health outcome (see Appendix G). A list of all mechanism included within the review and their definition is presented in Table 1. A diagram was used to depict these links, based on a diagram devised by Apodaca and Longabaugh [4]. The mechanisms within Fig. 1 were all mechanisms identified from the MI literature and behavior change theory. We were not prescriptive in terms of the mechanisms investigated instead all mechanisms reported were included. All studies that looked at one of these links were included within this review. These relational links are potential causal pathways through which MI could work (see Fig. 1). Due to the heterogeneity of the papers included in the review, it was not

Table 1
Mechanisms definitions.

Mechanisms	Definition
Therapist behaviors ^a	
Empathy	Empathy involves seeing the world through the client's eyes and showing that you understand them from their perspective.
MI spirit	MI spirit is based on three key elements: collaboration, evoking the client's ideas about change and autonomy.
Reflections	To repeat or rephrase what the client has said allowing deeper meaning to the communication.
Open questions	Open ended questions facilitate a client's response to questions from his or her own perspective and from the area(s) that are deemed important or relevant.
MI consistent	MI consistent is defined as incorporating the following behaviors: advise with permission; affirm; emphasize control; open question; simple reflection; complex reflection; reframe; and support.
MI inconsistent	MI inconsistent is defined as incorporating the following behaviors: advise without permission; confront; direct; raise concern without permission, and warn. ^b If MI is delivered well there should be a low occurrence of MI inconsistent behaviors and these should be inversely related to outcome.
Client behavior ^a	
Change talk	Change talk is defined as statements by the client revealing consideration of, motivation for, or commitment to change. There are different categories of change and sustain talk: ability, desire, reason, need, commitment, activation and taking steps.
Sustain talk	Sustain talk is any statements made by the client in favor of the status quo.
Self-efficacy	People's beliefs about their capabilities to change aspects of their lives. Self-efficacy includes both having the skills but also the confidence. Someone may perceive that they have the ability but not have the confidence to carry out that behavior.
Self-monitoring	Monitoring one's behavior e.g. via charts, diaries or self-weighing etc.
Stage of change	Health behavior involves six stages of change: precontemplation, contemplation, preparation, action, maintenance, and termination. ^c The change process unfolds over time, with progress through the six stages, although frequently not in a linear manner. ^d
Motivation	The process that initiates, guides, and maintains goal-oriented behaviors.
Planning	Ideas of how the client can change their behavior, these may include how, when and where.
Therapeutic alliance	Therapeutic alliance is the relationship between the client and the therapist.
Commitment strength	Commitment strength is how committed an individual is to changing their behavior.
Perceived behavior of control	Perceived behavior of control is defined as a person's perceptions of their ability to perform a certain behavior.

^a Moyers et al. [67].

^b Vader et al. [21].

^c Prochaska and Velicer [68].

^d Prochaska [69].

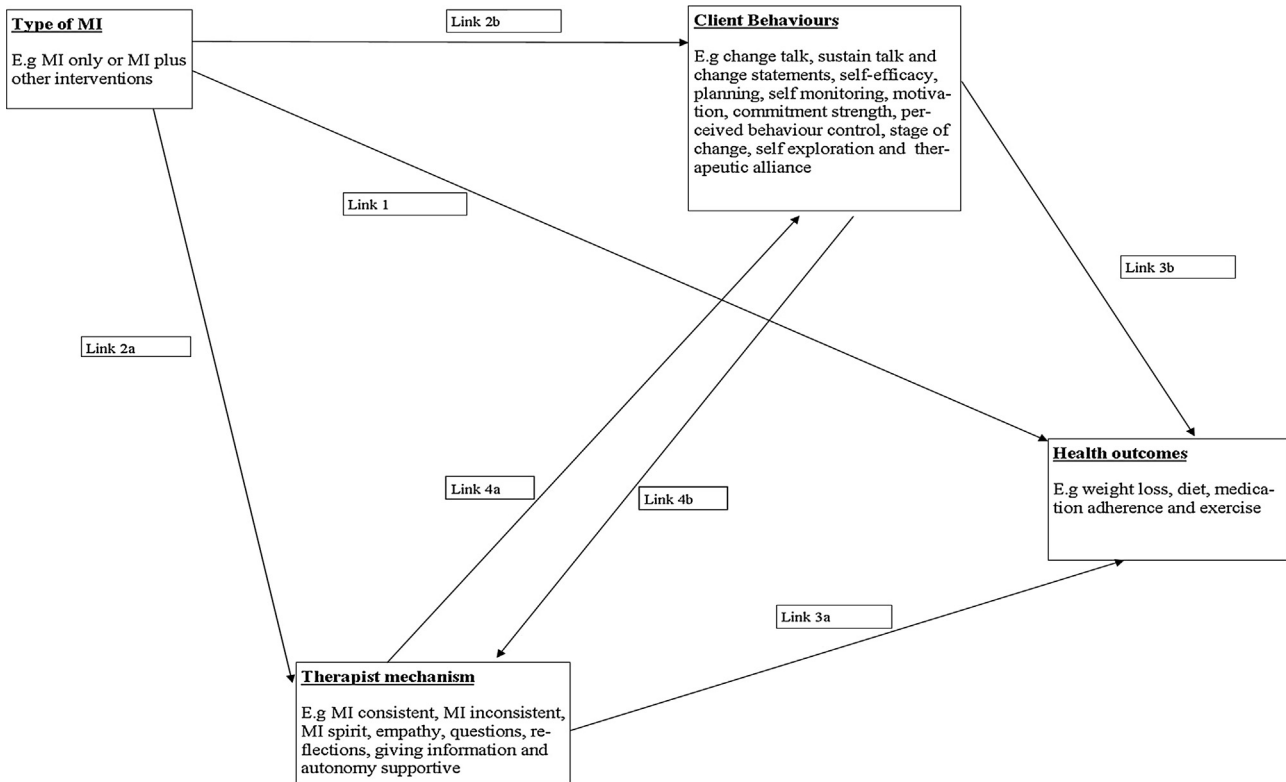


Fig. 1. Diagram of potential causal links within MI. Diagram is adapted from Apodaca (2009) diagram [4].

possible to carry out a meta-analysis and a narrative synthesis was performed instead. The narrative synthesis involved summarizing the results according to the links in Fig. 1. The quality of the studies was also measured and taken into account.

Mechanisms that had many low quality papers led to potentially weak links in Fig. 2. The strength of the evidence was based upon the mediation triangle and which link the paper examined (see Section 3, Tables 2 and 3).

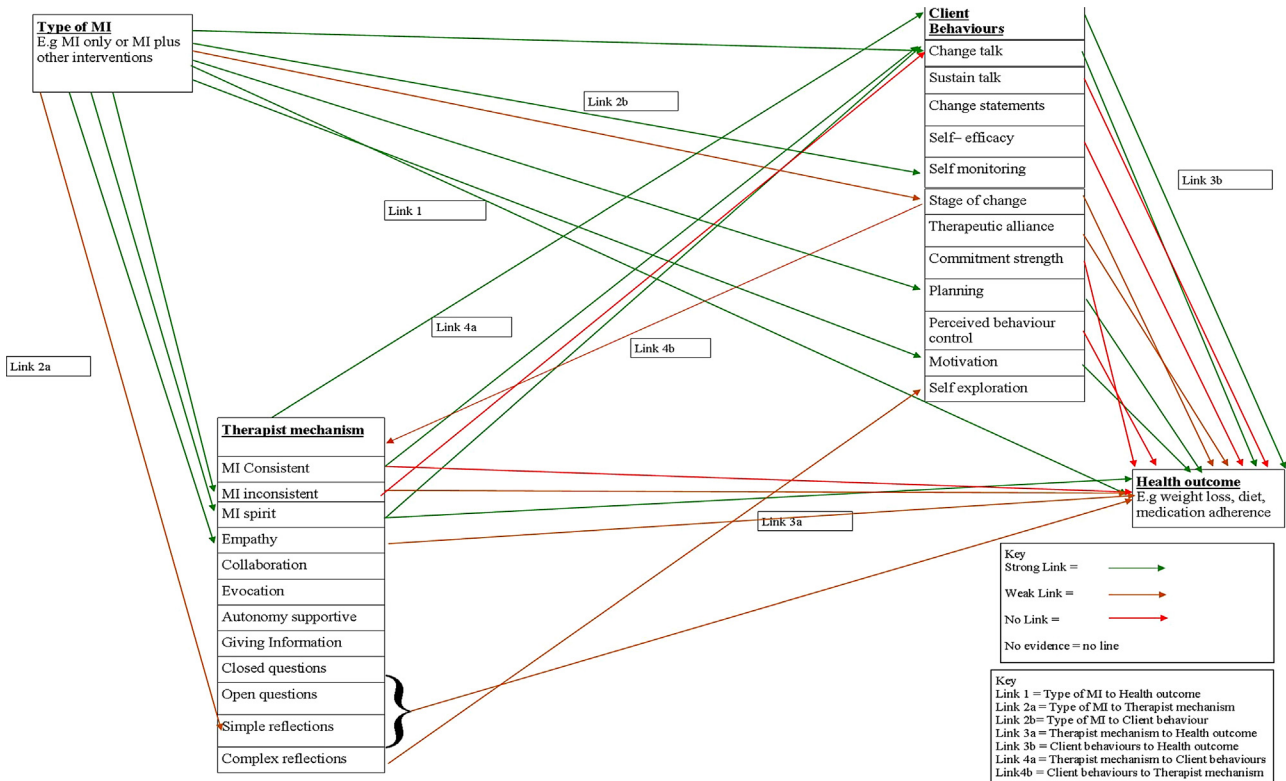


Fig. 2. Results of causal links within MI.

Table 2
Quality of articles.

Study	Quality score
Austin [53]	4/8
Bennett et al. [33]	10/11
Bennett et al. [46]	10/11
Britt [49]	6/11
Brug et al. [44]	7/11
Campbell et al. [43]	9/11
Channon et al. [38]	8/11
Chin [50]	4/8
Cox [54]	6/9
Ernst [52]	5/8
Feld et al. [41]	6/8
Gillham and Endacott [39]	8/11
Hardcastle et al. [37]	7/8
Hardcastle and Hagger [60]	10/10
Jansink et al. [51]	7/11
Latimer-Cheung et al. [59]	6/8
McDoniel et al. [35]	9/11
Neame [58]	5/8
Newnham-Kanas et al. [34]	4/8
Noordman et al. [64]	7/8
Olson et al. [57]	6/11
Perry and Butterworth [63]	4/8
Perry et al. [48]	10/11
Pirlott et al. [22]	5/8
Pollak et al. [56]	7/9
Pollak et al. [55]	5/9
Pollak et al. [18]	6/9
Pollak et al. [19]	6/9
Resnicow et al. [31]	7/11
Riegel et al. [29]	4/8
Riekert et al. [47]	5/8
Seid et al. [32]	9/11
Shaikh et al. [30]	8/11
Smith et al. [40]	5/11
Treasure et al. [36]	7/11
West et al. [45]	10/11
Ziegelmann et al. [65]	7/11

3. Results

3.1. Study characteristics

The search identified 291 papers, after duplicates were excluded and search limits applied. After screening abstracts using the inclusion and exclusion criteria, 87 papers were obtained in full text. The final number of included studies which includes unpublished studies, and studies obtained from reference lists was 37 (see Fig. 3).

The total numbers of participants included in this systematic review are: RCTs = 4946; non-randomized controlled studies = 316; non-controlled studies = 478; observational studies = 1541 and qualitative studies = 14.

3.2. Mechanism results

Results in Sections 4.1–4.4 of this review are presented in ascending order of strength of evidence for a mechanism of MI. This is in line with the mediation triangle [28] that in order to show a mediating effect a link must be demonstrated between the intervention and the outcome (link 1), the intervention and the mechanism (link 2) and the mechanism and the outcomes (link 3). For explanation of links refer to Fig. 1. Therefore this review initially examines link 1. In Sections 4.2–4.4, links 2, 3 and 4 are examined. Link 2 is the weakest link as there is no link to health outcomes, link 4 is stronger as it investigates client behavior outcomes, link 3 is stronger still as it examines outcomes, and finally studies looking at links 4 and 3 have the strongest level of evidence as they conduct mediation analysis.

Quality of included studies was assessed using the relevant scales according to study type. The RCTs and the qualitative study were of high quality. The non-controlled and observational studies were medium quality. A number of studies had potential issues with reliability of results, having made multiple comparisons, increasing the likelihood of type I errors.

The fidelity of the MI interventions delivered was also examined within this review. 35% of studies stated they measured MI fidelity. Seven out of thirteen studies did not report their fidelity findings, one reported proficiency and five reported findings suggesting non-proficiency. Therefore from the studies that reported their fidelity findings the majority were not delivering effective MI according to the proficiency measures, however for the majority of the studies the quality of the MI delivered is unknown.

3.3. MI and health behavior outcomes (link 1)

When investigating mechanisms it is important to first identify whether MI affects the health behavior outcome/s before going on to examine the mechanism [28]. Twenty three studies investigated link 1; therefore the 14 did not investigate link 1 but did investigate other links and are therefore unable to validate the mediation effect. Eleven studies reported statistically significant findings [29–39]. Six studies [40–45] reported mixed support for MI affecting health outcomes. Six papers [46–51] demonstrated that MI had no effect on link 1.

3.4. Therapist behaviors

3.4.1. Empathy

Three studies suggest a link (2a) between empathy and MI ($P \leq .001$ [52] and $P = 0.01$ [44]) [44,52,53]. The association between empathy and health outcomes (link 3a) has mixed results [18,19,29,54–56]. Two studies [18,19] indicating that empathy is associated with positive health outcomes ($P = 0.02$) [19], yet others [55,56] found no statistically significant relationship (behaviors to reduce fat intake: $d = 0.13$ and moderate or vigorous physical activity: $d = 0.00$ [55], weight change $P = 0.26$ [56]). Empathy was not related to physical activity ($P = 0.67$) or attempted weight loss ($P = 0.19$), but was statistically significantly related to fruit and fiber intake ($P = 0.05$) [54]. Two studies [52,53] examined the association with either change talk or self-exploration ($P = 0.102$ [52]) (link 4a). One study [22] (see links 4a and 3b) indicated that empathy and change talk, work in conjunction to affect outcome. It found a correlation between empathy and client change talk ($r = 0.40$) and between change talk and fruit and vegetable intake (FV) ($r = 0.33$, $P \leq 0.05$). However, mediation analysis was not conducted. Different pathways have been highlighted, with empathy working on its own or with change talk.

3.4.2. MI spirit

MI training statistically significantly improved MI spirit scores ($P = 0.01$) [44]. Link 3a studies [19,55,56] have found a statistically significant relationship between MI spirit and weight ($P = 0.02$ [56], $P = 0.02$ [55], $P = 0.05$ [19]), increased readiness to lose weight $P = 0.005$ and change in exercise patterns $P = 0.04$ [19]). However, statistically non-significant relationships were found between MI spirit and fat and fiber intake ($P = 0.29$), physical activity ($P = 0.39$) and attempted weight loss ($P = 0.20$) [54]. There appears to be no association between MI spirit and self-exploration (link 4a) ($P = 0.310$ [52]) [53]. A mediation analysis [22] (links 4a and 3b) found that spirit increased change talk, and change talk increased FV (C.I. 0.01 and 0.13). It should be noted that some of the studies (see Appendix G) have used the MI Treatment Integrity scale

Table 3

Link 1 study results.

Study	Study design	Outcome	Results	Effect size
Statistically significant Shaikh et al. [30]	RCT	Fruit and vegetable consumption	$P \leq 0.01$	$d = 0.11$
Riegel et al. [29]	Mixed methods pre- and post-test design and qualitative interviews.	Heart failure self-care	12 out of 15 participants improved their self-care behavior	0.8 C.I. (0.55–0.93)
Treasure et al. [36]	RCT with an active control of CBT	Binge eating vomiting Laxative abuse	$P \leq 0.001$ $P \leq 0.001$ $P \leq 0.05$	Odds ratio 0.54 C.I. (0.2–1.5) 1.6 C.I. (0.6–4.2) 2.4 C.I. (0.6–9.2)
Seid et al. [32]	RCT	PedsQL asthma symptoms	$d = 0.93$	–0.37
Resnicow et al. [31]	RCT	Fruit and vegetable intake	$P < 0.01$	–0.22
Bennett et al. [33]	RCT	Physical activity	$P < 0.05$	0.55
Newnham-Kanas et al. [34]	Quasi experimental design	Physical activity	$d = 0.6$	$d = 0.6$
		Fruit and vegetable	$d = 1.06$	$d = 1.06$
		Protein	$d = 1.30$	$d = 1.30$
		Large decrease in sodium	$d = -1.53$	$d = -1.53$
		Total calories	$d = -1.50$	$d = -1.50$
		Saturated fat	$d = -1.08$	$d = -1.08$
		Fiber	$d = -0.51$	$d = -0.51$
		Total fat	$d = -0.52$	$d = -0.52$
		Cholesterol	$d = -0.39$	$d = -0.39$
		Carbohydrates	$d = -0.04$	$d = -0.04$
McDoniel et al. [35]	RCT	Bodyweight	$P \leq 0.05$	–0.12
Hardcastle et al. [37]	Pre- and post-test trial	Physical activity	$P < .001$	–0.19
Channon et al. [38]	RCT	A1C concentrations	$P = 0.003$	–0.12
Gillham and Endacott [39]	RCT	Exercise	$P = 0.007$	0.14
		Fruit and vegetable consumption	$P = 0.033$	0.14
Mixed results West et al. [45]	RCT	Weight loss A1C	$P = 0.04$ $P \geq 0.05$	0.82 Data not reported in paper to calculate effect size
Smith et al. [40]	RCT	Glycemic control Exercise levels Calorie intake	$P = 0.05$ $P = 0.07$ $P = 0.07$	0.21 –0.42 –0.46
Feld et al. [41]	Pre- and post-test trial	Weight Depression Self esteem Eating disorder symptomology	$P < 0.0001$ $P = 0.01$ $P = 0.0001$ $P \geq 0.05$	–0.16 0.56 0.80 Data not reported in paper to calculate effect size
Olson et al. [57]	Pre- and post-test control trial	Physical activity Fruit and vegetables Sweetened beverages Screen time	$P = 0.006$ $P = 0.386$ $P = 0.059$ $P = 0.414$	$d = 0.4$ $d = 0.13$ $d = -0.28$ $d = 0.11$
Campbell et al. [43]	RCT	Block food frequency question (FFQ) 35 item measure Block food frequency question (FFQ) 2 item measure	$P \leq 0.01$ $P \geq 0.05$ $P \geq 0.05$	0.02 0.22 Data not reported in paper to calculate effect size
Brug et al. [44]	RCT	Physical activity Saturated fat score Vegetable intake Fruit intake BMI Waist circumference HBA1C	$P = 0.00$ $P = 0.46$ $P = 0.03$ $P = 0.00$ $P = 0.00$ $P = 0.00$	–0.24 0.05 0.04 0.09 –0.04 0.10
Statistically non-significant Bennett et al. [46]	RCT	Physical activity	$P = .572$	0.16
Riekert et al. [47]	Pre- and post-test trial	Asthma medication adherence caregiver Asthma medication adherence teen	$P = 0.14$ $P = 0.96$	0.03 –0.18
Perry et al. [53]	RCT	Physical Activity	$P = 0.057$	0.21
Britt [49]	Two quasi-experimental designs. MET vs. usual care but patients not randomized	HB1AC	$P \geq 0.05$	$d = 1.0$
Chin [50]	Mixed methods. Classic experimental design and content analysis	Physical activity	$P \geq 0.05$	0.36

Table 3 (Continued)

Study	Study design	Outcome	Results	Effect size
Jansink et al. [51]	RCT	Hb1Ac	$P=0.221$	-0.058
		Fat	$P=0.708$	-0.026
		Vegetables	$P=0.518$	0
		Fruit	$P=0.884$	0.043
		Physical activity	$P=0.839$	0.030
		BMI	$P=0.198$	-0.035

2.0 measurement which has a different definition of MI spirit compared to version 3.0.

3.4.3. Open questions and reflections

Link 2a studies, that trained people in MI [44,57] found mixed results for therapist behaviors: simple reflections ($P=0.01$) and

total reflections ($P=0.01$) [44] and open questions and total reflections (statistically significant at 0.05 level [49]). However statistically non-significant improvement for open ($P=0.79$) and closed questions ($P=0.86$) and complex reflections ($P=0.06$) was found [44]. Two link 3a studies [54,55] found no statistically significant link between reflections and open questions and various

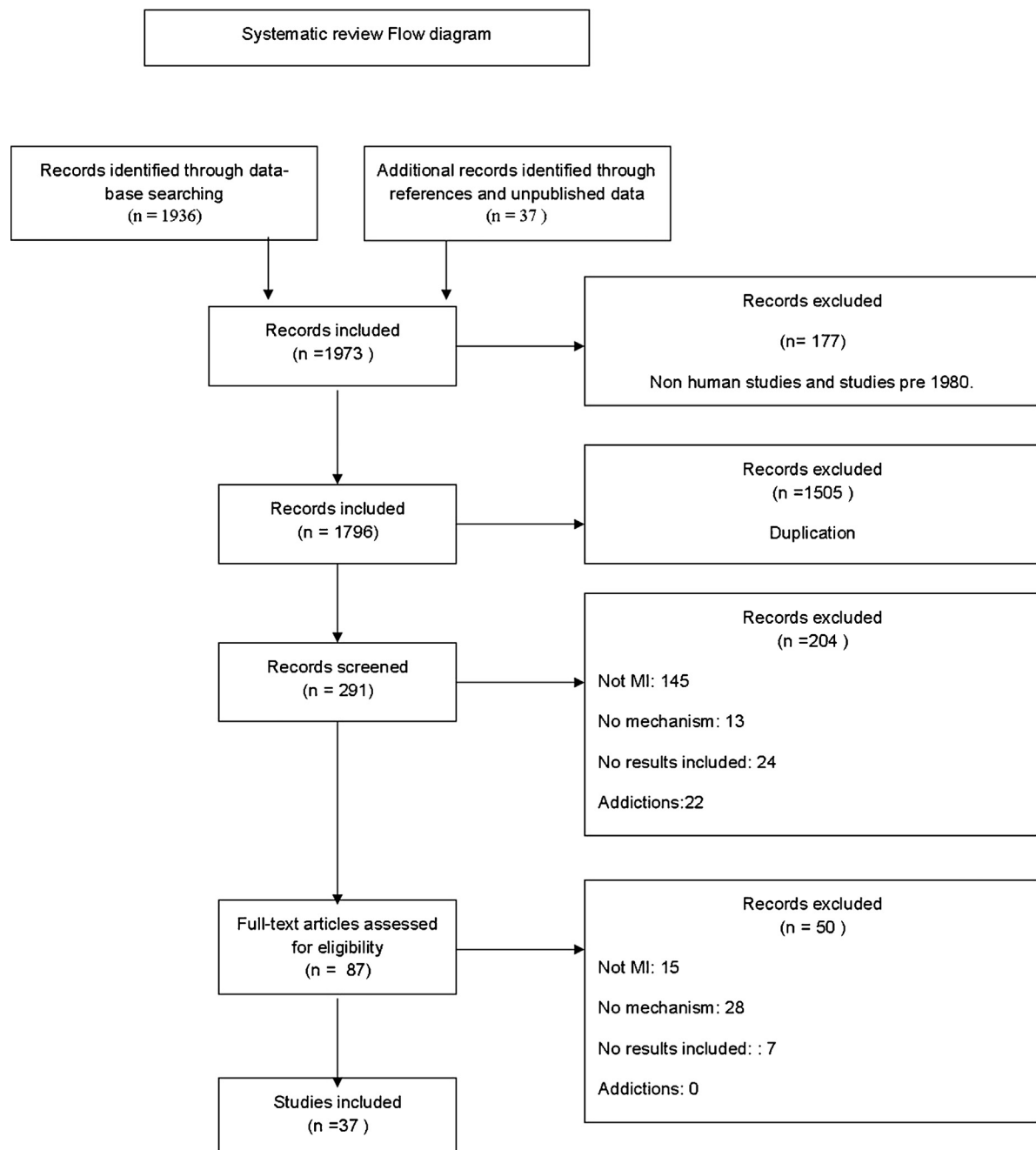


Fig. 3. Flow diagram of study selection strategy.

health outcomes; physical activity (open question $P=0.72$, reflections $P=0.86$ [54], $P=0.17$ [55]), fat and fiber intake (open question $P=0.37$, reflections $P=0.34$ [54], $P=0.05$ [55]) and screen time ($P=0.41$ [55]). However, there was an association with physicians use of reflections and weight loss ($P=0.03$) [56]. Two link 4a studies examined complex reflections [18,52] both of which found a relationship between complex reflections and autonomy support [18] ($P=0.006$) or self-exploration [52] ($P=0.003$).

3.4.4. MI consistent

MI delivered by trained dieticians, did not demonstrate more MI consistent behavior/s than control dieticians [44] ($P=0.75$) (link 2a). Three studies investigating link 3a found statistically non-significant results: physical activity ($P=0.6$) [55], attempt to lose weight ($P=0.08$) [19] and weight loss [56]. Cox et al. [54] found mixed results as both fat and fiber ($P=0.52$) and attempted weight loss ($P=0.86$) proved to be statistically non-significant, however there was an increase in physical activity ($P=0.03$). Ernst [52] found that MI consistent behavior, did not lead to an increase in self-exploration ($P=0.728$).

There is however some evidence that MI consistent behaviors might mediate outcomes along with change talk. Link 4a suggested that high levels of MI consistent behaviors, led to more change talk [53]. A study [22] exploring links 4a and 3b found the effect of MI consistent behavior on FV is mediated through change talk (C.I. 0.02 and 0.12).

3.4.5. MI inconsistent

A link 2a study [44] demonstrated that participants in the MI intervention group received less MI inconsistent behaviors than those in the control group ($P=0.01$). With link 3a one study found participants gained 0.3 kg (not statistically significant) when physicians only used MI inconsistent behaviors [55]. Examining the association between MI inconsistent behaviors and self-exploration or sustain talk, there is little evidence to support this (self-exploration $P=0.235$ [52] and no difference in sustain talk between high MI consistent groups compared to high MI inconsistent groups [53]). Investigating both links 4a and 3b [22] no statistically significant links between either mechanism (MI inconsistent and sustain talk $d=0.03$, MI inconsistent and FV $d=0.28$) and the FV outcome were found.

3.5. Client behavior

3.5.1. Change talk and sustain talk

As previously mentioned change talk does appear to mediate the link between therapist behaviors and outcome [22]. When investigating sustain talk in links 4a and 3b there is little evidence of mediation [22,53]. Instances of change talk as a mechanism on its own has been investigated in two studies ($P=0.01$) [44,52]. Exploring link 3b, one study [58] found participants who changed their behavior engaged in a greater frequency of commitment talk ($P\leq 0.05$). There was no difference between any of the other talk categories which may indicate that only one element of change talk is related to outcome.

3.5.2. Self-efficacy

Thirteen studies [30,31,33–35,37,38,43,46–48,19,59] examining self-efficacy were identified. Two [34,46] found self-efficacy was improved by a MI intervention ($P=0.019$) [49]. One study [59] demonstrated mixed evidence for link 2b as they found a medium to large effect size increase in goal setting self-efficacy ($d=0.72$). However they also found decreased scheduling self-efficacy ($d=-0.23$) and barrier self-efficacy ($d=-0.13$). A study [33]

investigating link 3b also found that it statistically significantly affected physical activity ($P=0.05$).

Ten studies found no statistically significant effect for self-efficacy in relation to outcome. Three studies [38,47,19] (link 2b) found no statistically significant improvement in self-efficacy (manage asthma attacks: $P=0.09$ and prevent asthma attacks: $P=0.24$ [47] and manage diabetes $P=0.43$ [38]). Four studies [31,35,37,48] (link 3b) found no statistically significant relationship ($d=0.13$ [37], $P=0.68$ [35], $P=0.81$ [48]). These studies indicate that self-efficacy is unlikely to be a mechanism by which MI works. This conclusion is strengthened by other studies [30,31,43,46] that have examined self-efficacy as a mediator using mediation analysis. These studies all compared MI to a control and found self-efficacy did not mediate MI when looking at health outcomes ($P=0.953$ [46]).

3.5.3. Self-monitoring

This review identified only four papers looking at this all of which examined self-monitoring in link 2b, therefore, it is hard to conclude whether it works as a mechanism of MI (submission of diaries at 6,12 and 18 months $P=0.003$, $P=0.003$, $P=0.005$ [45] and self-monitoring of blood glucose $P=0.05$ [40]). One qualitative study [60] reported that participants said they found monitoring to be useful when losing weight. A final paper [49] provides mixed support for self-monitoring as MET appeared to have contributed to increased self-monitoring of blood glucose, however, it was not generally maintained beyond the 3-month follow-up.

3.5.4. Stage of change

Studies have shown that the stage of change model can explain behavior change within health outcomes [61]. Two studies [49] found MI can increase participants readiness to change ($P=0.03$) [47]. Treasure et al. [36] compared MET to CBT and found that both pre-contemplation ($P\leq 0.08$) and contemplation ($P\leq 0.06$) scores reduced marginally over four weeks with a statistically significant increase in action scores ($P\leq 0.01$). They concluded that mean scores indicate this change was due to CBT and not MET however no statistical analyses are presented to support this. Another RCT [51], however, found that for those receiving MI, there was no statistically significant change for readiness to change various health behaviors (fat $P=0.90$, vegetables $P=0.23$, fruit $P=0.60$ and physical activity $P=0.563$). Three studies found no change from pre to post MI measures of stage of change [19,50] with one study [39] finding a statistically non-significant difference between MI and the control groups ($P=0.083$). Hardcastle et al. [62] found a statistically significant link between stage of change and physical activity 3b ($P=0.05$). However, Perry et al. [63] did not ($P=0.13$). A link 4b study [64] found that the nurse practitioners apply their MI skills on average more when patients are in the preparation stage than in the other stages (95% confidence intervals pre-contemplation $(-0.21$ to $0.17)$, contemplation $(-0.02$ to $0.44)$ and action $(-0.35$ to $0.06)$).

3.5.5. Motivation

A link 2b study [41] found a statistically significant increase in motivation associated with MI ($P=0.0001$). Another paper [32] found a moderate to high effect size of motivation but no statistically significant difference between the MI intervention and control ($r=0.67$). A qualitative link 3b study [60] found participants reported that motivation was important for behavior change. One RCT [30] found that autonomous ($P\leq 0.01$) and controlled motivation ($P\leq 0.01$) was statistically significantly related to an increase in FV. Although no studies identified directly examined motivation as a mediator via mediation analysis, there is some evidence it could potentially be a process by which MI works.

3.5.6. Planning

Planning is a recently added stage to the MI process [3]. Two studies examining planning as a mechanism are included. The first study [59] looked at link 2b and found that MI had a medium sized effect on action planning (when, where, and how [65]) ($d = 0.42$). A further study [65] found an MI intervention led to the generation of more complete action plans than the self-administered planning sheet group. Action planning statistically significantly predicted exercise at T3 (2 weeks follow up) ($d = 0.30, P \leq 0.001$), T4 (4 weeks follow up) ($d = 0.30, P \leq 0.001$), and T5 (6 months follow up) ($d = 0.31, P \leq 0.001$). This is a relatively small correlation but is a larger effect than the authors found for coping planning (a plan to help one successfully cope with situations which could stop one from achieving their goal [65]). Coping planning is comprised of compensation planning and loss based planning. Compensation planning reaches significance at T4 ($d = 0.13, P \leq 0.05$) (T3 $d = -0.06$, T5 $d = 0.05$), loss based planning is initially statistically non-significant (T3 $d = 0.06$) but becomes statistically significant by T4 ($d = 0.10, P \leq 0.05$), and T5 ($d = 0.12, P \leq 0.05$), increasing over time with a correlation of 0.12 at T5. It is feasible that development and implementation of a coping plan could take some time to demonstrate an effect.

3.6. Other mediators

Other client and therapist mediators have been examined including therapeutic alliance, commitment strength and perceived behavioral control. A paper investigating therapeutic alliance [36] at week 4 of a MET or CBT intervention found that task agreement for both the therapist and the client was statistically significantly related to reduced vomiting ($P \leq 0.05$) and binge eating ($P \leq 0.05$). Client rating of goal agreement was also related to reduced vomiting ($P \leq 0.01$) and binge eating ($P \leq 0.05$).

Two studies [35,37] examining perceived behavior control and link 3b both found no relation to outcome ($P = 0.5$ [35], $d = 0.12$ [37]). Finally one study [63] looked at the commitment strength of a participant in relation to physical activity. When looking at a possible relationship to outcome there were no statistically significant findings ($P = 0.49$). Therefore at present there are not enough studies to suggest strength of commitment as a mechanism of MI.

4. Discussion

This review highlights that despite statistically significant evidence that MI positively influences health outcomes [5,7–17], there are few studies looking at the mechanisms of MI. This review shows that there is varying and limited evidence for the different links in the causal chain (Fig. 1). The mechanisms [15,24] may be different from addictions as mentioned earlier [10,15], however from the limited number of studies exploring this issue it is hard to draw conclusions. Despite limited research in this area, there is some emerging evidence that supports a theory of how MI works, in which therapist techniques influence within-client behavior which in turn affects outcome. The findings reported in this systematic review are similar to a review looking at mechanisms of MI in relation to addictions [4].

The link between MI and outcomes, (link 1) is needed to demonstrate mediation, the review indicates that 74% of the papers support the link through at least one variable. This concurs with a recent systematic review [7], that 63% of the main outcome comparisons showed statistical significance in favor of MI.

Motivation and MI spirit appear to be the most promising mechanisms of MI. There are four studies investigating these; two are well conducted RCTs that have found a positive relationship for

link 1 all support either link 2b or 3b. However studies conducting mediation analyses are needed. When examining MI spirit the majority of studies investigate link 3a and have found there is a statistically significant relationship. It was also found that MI spirit can increase change talk which in turn increases FV [22]. This finding is also supported by studies in the addiction field, that MI spirit increase change talk and this change talk is associated with outcome [20].

The results from the analyses of empathy, open questions, reflections and MI consistent behavior constructs are mixed in terms of link 3a with many being statistically non-significant. However, when examining link 3b and 4 studies the results indicate that one of the possible mechanisms through which MI works is via a causal chain involving therapists' behaviors, client change talk and health outcomes which has also been reported in the addictions field [4].

There is limited evidence to support client change talk behavior as a mechanism. One study found that only commitment talk was related to outcome [58]. This is supported by research in the addictions field which has also found that commitment talk was the only category of change talk predictive of outcome [66]. It is therefore possible that it is not change talk as a whole, but commitment talk that predicts behavior change. This could be a mediator of MI, however more research is needed before any conclusions can be drawn.

When looking at other client behaviors this review found much of the research has focused on self-efficacy, with the majority of studies finding statistically non-significant results. Four studies looking directly at self-efficacy as a mediator have not found a statistically significant relationship: therefore self-efficacy looks potentially unlikely to be a mechanism of MI. This finding is surprising given that self-efficacy has been identified as an important construct in MI [5]. The quality of the measures for self-efficacy was poor which could explain these findings. The majority of papers [33–35,43,46,48,59] used a 5 or 6 point likert scale which can lead to ceiling effect issues for baseline measures.

4.1. Limitations

The main limitations of this review is the lack of studies investigating mechanisms. This is compounded by the fact that there are many different mechanisms by which MI might work, meaning there are only a few studies per mechanism (in this review on average only 5 per potential mechanism). There are also a limited number of studies conducting mediation analyses. Therefore the conclusions that can be drawn about each construct and its role in MI are limited.

The quality of many studies is also poor. Twenty two [19,22,29,31–34,36,38–41,46–50,52,53,55,58,59,63] report a sample size of 60 or less and/or are underpowered, making it difficult to draw accurate conclusions. Many health behavior outcomes are self-reported using measures of dubious quality. Only 43% of included studies were RCTs meaning that conclusions about the association between MI and outcome within this review are weak (see Appendix G). However, the RCTs and the qualitative study were of high quality. The non-controlled and observational studies were medium quality. There are potential issues with the reliability of the results, where studies made multiple comparisons, increasing the likelihood of type I errors. The quality of the measures for self-efficacy is also poor including use of unvalidated or poorly validated measures [33–35,43,46,48,59]. If the measures are assessing the mechanisms poorly or not at all then the results based on these need to be treated with caution.

There is also heterogeneity between studies in terms of delivery of MI. There was a wide variety in the number of sessions received by participants, ranging from 1 to 18 sessions causing a potential

dose-effect. The training that MI therapists received also varied greatly from no reported training to 6 days of training and 6 months experience using MI. This has implications for the quality of MI delivered which is likely to have impacted on outcomes. Only 35% of studies stated they measured MI fidelity to ensure participants were actually receiving MI. Seven out of thirteen studies did not report their fidelity findings, one reported proficiency and five reported findings suggesting non-proficiency. This could have a large impact on findings as statistically non-significant results could be reported due to MI being delivered poorly. The different types of MI included in the review could have an impact on the results if one type of MI yields better results than others. A final limitation relating to the delivery of MI was that some studies only had one MI therapist delivering the intervention therefore it is not known if the effects on outcomes were due to MI or the particular therapist and their skills.

4.2. Future research directions

There is a need for theory testing in this area to explore the different causal pathways. Potential theories need to be rigorously tested through mediation analysis with adequate sample sizes in order to test their predictive validity. Studies should also explicitly test a theoretically-based causal chain within the MI process that has been hypothesized before data is collected. This will reduce the number of associations tested and decrease type 1 error.

As there are many possible mechanisms by which MI could work it may be that there are interaction effects occurring and not just one mechanism acting to change behavior. Therefore future research should investigate the interaction of multiple mechanisms and their effect on behavior.

A more standardized approach would ensure good quality research in this field. Future studies should include a control group, should always test link 1, should assess the fidelity of the MI and therapists should also receive adequate training.

Finally the majority of the studies examining mechanisms were quantitative studies, it is likely that qualitative studies could add further to this research area by adding depth our understanding of mechanisms. Fidelity measurements rely on coding schemes which are somewhat limited, in that they do not capture the wide range of the therapists skills, further research using approaches like discourse analysis may enhance our understanding of the conversational dynamics of MI.

4.3. Practice implications

At the outset we wished to identify the mechanisms of MI which therapists could potentially focus on in order to improve outcomes with their clients. However the quality and lack of research evidence makes it difficult to draw firm practice implications. However MI spirit seems to play an important role within MI and this should be used to evoke change talk which is linked to outcomes. Therefore research needs to be completed to enhance our understanding of the components of MI spirit to improve training and delivery. This review also has implications for researchers, as the quality of studies in this area requires improvement and further studies looking at the interactions of mechanisms are needed.

4.4. Conclusions

This review indicates a possible pathway by which MI could influence health behavior outcomes which is in line with that already outlined in the addictions field [20]. It involves a causal chain whereby therapist behaviors (specifically MI spirit) positively influence client change talk and change talk is linked to

improvements in health outcomes. However this review has highlighted that more high quality research is needed to look at other potential mechanisms, interactions between mechanisms and to test this theory further.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at <http://dx.doi.org/10.1016/j.pec.2014.11.022>.

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