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Abstract

Two recent commentaries published in this journal argued against the usefulness of memory-based dietary assessment methods (M-BMs) [1,2]. A pair of responding commentaries disputed those negative claims regarding M-BMs, and defended the usefulness of M-BMs [3,4]. This article is intended to clarify the claims made in the four commentaries cited above, identify the manner in which those claims have been supported, and suggest possible ways forward. In service of the goals of this article, I have identified the main arguments found in each of the four commentaries cited above. I then partitioned each argument into two principle components: data and claim. I then identified the type of data used to support each claim. Finally, I have identified some of the potential reasons for the disagreements between the two parties and have suggested potential opportunities for progress on the issues at the heart of the controversy.

Key words
Diet
Nutrition
Memory-based dietary assessment methods
Food frequency questionnaires
Conflict of interest
Memory-based measures
Scientific measurement
Measurement

Introduction

In 2018, The Journal of Clinical Epidemiology published four articles on the topic of the appropriateness of the use memory-based methods (M-BM) in nutrition research (Archer, Marlow & Lavie, 2018a; 2018b; Martin-Calvo & Martinez-González, 2018a; 2018b). Two articles argued against the usefulness of M-BMs, while the other pair of articles disputed the negative claims regarding M-BMs, and defended their usefulness. Rather than arguing for or against the claims presented in the earlier four commentaries, the goal of the present commentary is twofold: 1) to identify, deconstruct, and label arguments used by members of each side of the issue and 2) to offer some commentary on the debate in the service of providing clarity. To the degree that I am successful, this commentary should clarify the claims made by both parties, the manner in which those claims have been supported, and suggest possible ways forward.

The present commentary comprises two distinct sections. In the first section, I identify the main arguments found in each of the four commentaries. I then partition each argument into two principle components: data and claim. I then identify the type of data used to support each claim. In the second section, I identify some of the potential reasons for the disagreements between the two parties, and suggest potential opportunities for progress on the issues at the heart of the controversy.

Section 1: Identifying arguments and labeling their elements

Tables 1 through 4 contain a list of the major arguments found in the four "Controversy and Debate" documents. Table 1 contains a list of the major arguments for the first article in the series, Table 2 contains a list of the major arguments in the second article in the series, and so on. The arguments presented in the tables are paraphrased, and each argument is divided into two elements: data and claim. My choice to divide the arguments into data and claim was influenced

by Toulmin's (1958) approach to informal reasoning. The arguments generated by both sides all appeared to fall under the umbrella of informal reasoning as described by Toulmin (1958). For those interested in a more specific label for the arguments, I suggest that most arguments presented on both sides of the debate could be described as defeasible. That is, the arguments were compelling (to greater or lesser degrees) but not deductively valid, and could potentially be nullified by presentation of additional evidence or argument (Pollock, 1987). Toulmin (1958) claimed to have created a scheme that he felt was able to describe most or all informal arguments. He claimed that, minimally, an argument requires both a claim and data. Data might include anything that could lend some support to the claim (e.g. empirical evidence/folk reasoning/facts/appeal to authority, etc.).

The first column in each of Tables 1 through 4 contains unique alphanumeric identifiers for each argument. The number before the first underscore identifies the document the argument came from, the letters after the first underscore (AML or MCMG) identify the authors who created each argument, and the final characters uniquely identify the argument within each document. Each table also contains a column labeled "Argument/claim addressed". The contents of this column identifies (when applicable) the argument or claim that is addressed by each argument. Each table also contains a column that identifies the type of data used in each argument. It is my hope that, by clearly identifying the type of data used for a particular claim, that the type of counterargument that would be an appropriate respond to each claim will be made clear.

Each table also contains both a data column and a claim column. As mentioned above, the contents of these columns are paraphrased from the original article, and are not direct quotes. Within the data column, I have sometimes included phrases such as "Several citations showing

that...” or “A chain of reasoning that indicates that…” These should not be taken to indicate that I feel that an author has successfully provided evidence of anything. I hope to provide clarification, not take sides, on the primary issue and all supporting arguments. So each time that a phrase such as “several citations show that…” appears in the data column of one of the tables, the reader should assume that the meaning I intend to convey is that “several citations purportedly show that…” or that “the author of the argument feels that these several citations show that…”.

The types of data appearing in the table include empirical, reasoning, and semantics. The label reasoning can include folk reasoning, defeasible reasoning (Pollock, 1987), abductive reasoning (Walton, 2004), etc. Reasoning, as used here, does not refer to the type of empirical datum that scientists regularly use to settle questions about the natural world (although it is true that most appeals to empirical evidence also include explicit or implicit reasoning that establishes *why* a particular piece of empirical data counts as evidence for a particular claim). The label semantics always involves reasoning, but in the tables, I use the term semantics to identify arguments that involve the issue of the manner in which a particular term ought to be defined. In the four articles of interest, all semantics arguments involve reasoning, but not all arguments involving reasoning focus on the definition of terms. Empirical data, as used in the tables, refers to a straightforward appeal to the type of empirical datum that scientists regularly use to settle questions about the natural world. Like the other categories, the boundaries for empirical cannot be precisely defined and are somewhat fuzzy. In argumentum ad populum, for instance, an individual makes the case that claim X is true because the majority of people believe it to be so. While it is true that a person could use a survey to generate empirical data regarding how many people believe X to be true, I would not label such data as empirical. Instead, I would

label that data as an example of reasoning. For arguments in which the data in support of the claim involve more than one type of data, all the relevant types are included in the table. For arguments in which the nature of the data was unclear, a "?" was placed in the column for data type.

Finally, I must include some information regarding abbreviations and acronyms found in Tables 1 through 4. AML refers to Archer, Marlow and Lavie, while MCMG refers to Martin-Calvo and Martinez-González. M-BMs are memory-based assessment methods, while NHANES refers to the National Health and Nutrition Examination Survey.

Section 2: Additional Comments

The major arguments presented in AML's first paper can be found in Table 1 and fit into two categories. The first group of arguments (1_AML_1, 1_AML_3, 1_AML_4) address the issue of the definition of proper science and/or the definition of proper measurement. The second group of arguments (1_AML_2, 1_AML_5) are more narrow in scope, and speak specifically to the issue of the degree to which M-BMs are valid measures of nutritional/caloric intake. The first group of arguments deal with whether-or-not certain measures are permissible in science, and those arguments deal with that issue in a dichotomous manner (e.g. permissible vs. not permissible). The second group of arguments deal with validity, which is generally approached as a continuum rather than as a dichotomy (Kaplan, 1998).

It should be noted that if anyone grants the truth of any single argument in the first group of arguments (1_AML_1, 1_AML_3, 1_AML_4), the conclusion, "M-BMs have fatal flaws" follows, and there is no need to consider additional arguments. Many scientists and philosophers of science have weighed in on the issue of the nature of proper science and proper measurement. Percy Bridgman (1959) promoted a view of measurement known as operationism. While some

operationist ideas continue to be influential in certain fields, there are many who reject that approach to measurement (Carnap, 1936-1937/1953; Frank, 1961; Hempel, 1952; Leahey, 1980). Some scholars (e.g. Kuhn, 1962; Duhem, 1954; Quine, 1953) have promoted a theory-laden understandings of measurement. Some views on measurement are grounded in both empiricism and positivism, but one does not have to subscribe to either of those isms in order to be a scientist. Some alternative isms include realism (Bhaskar, 1975), constructionism (Gergen, 1985), and intentionalism (Leahey, 1983), and each of these isms will impact the measures a researcher feels are/aren't permissible. However, it does not appear that the views on measurement offered by any of the authors cited in this paragraph would rule out the use of M-BMs on a priori grounds. That is not to say that the claims contained in 1_AML_1, 1_AML_3 and 1_AML_4 are false. I am merely pointing out that it appears that AML have the burden of proof in regards to those claims.

In regard to the first group of arguments presented by AML (1_AML_1, 1_AML_3, 1_AML_4), it must be noted that, if AML are correct, then the implications would go far beyond the issue on M-BMs. For instance, if one accepts the truth of those three arguments, then a wide range of measures commonly used by scientists across many fields would have to be rejected as inappropriate. Political scientists use dependent measures such as intention to vote or memory of past voting behavior to indicate actual voting behavior (Campbell et al. 1960). Going back to the 19th century, researchers in the field of psychophysics have used subjective reports (mental concepts) to develop precise mathematical relations between perceptual experience and physical stimuli (Fechner, 1860/1966). The famous Kinsey reports (Kinsey, Pomeroy & Martin, 1948; Kinsey et al., 1953) used self-report of sexual behavior as a measure of actual sexual behavior. By AML's reasoning, these types of measures (and hundreds, if not thousands, of other

commonly used measures) would not be permissible in science. While that may be the case, AML failed to address some of the far-reaching implications of their first group of arguments. The first set of arguments presented by AML stray into some difficult philosophical areas upon which many thousands of pages have already been written. Regardless of whether AML are right or wrong, they may be required to more thoroughly address the extensive literature on the nature of good measurement and good science in order to persuade their intended audience.

AML's second group of arguments (1_AML_2, 1_AML_5) work within a commonly accepted scientific framework, and are more likely to be successfully addressed by appeal to empirical data. 1_AML_2 and 1_AML_5 challenge the validity of M-BM based measures. Such validity challenges are part of the day-to-day workings of science, and this particular validity challenge has implications that are far more restricted than those of the AML's first set of arguments. For these reasons, progress on these arguments seems more likely than progress on the first group of arguments.

In MCMG's first commentary they directly, but briefly, address AML's first five arguments (see top two rows of Table 2). MCMG address 1_AML_1 thru 1_AML_5 by presenting a series of citations. For this reason, the details of their counter-arguments are found in those additional documents rather than in the text of their commentary. MCMG then briefly respond to one of AML's philosophical objections (1_AML_1) by pointing out that AML's position is nominalist and that their position is not consistent with the views of most scientists. Essentially, they are claiming that AML has the burden of proof regarding those deep philosophical issues and that they do not feel that AML has met that burden of proof. The next seven arguments presented by MCMG do not directly rebut specific AML *arguments*, but instead they rebut the primary *claim* of AML (i.e. that M-BMs have fatal flaws). MCMG do this by

presenting empirical data that M-BM based measures have had practical value in science (see 2_MCMG_3 thru 2_MCMG_9). 2_MCMG_10 thru 2_MCMG_13 are intended to rebut AML's claim that M-BM measures are not plausible and are therefore invalid (1_AML_5).

AML begin their second commentary in the series by discussing the philosophical metaphor of swans. The claim that "all swans are white" is falsified if a single black swan is found (regardless of how many white swans can be produced). AML claim that they have presented MCMG with black swans and that MCMG have ignored their black swans while presenting additional white swans. I believe that AML may be misapplying the swan metaphor. If a person makes a universal claim (e.g. all swans are white) then a black swan can falsify that claim. If, however, a person makes a more modest claim (e.g. some swans are white), the presence of a black swan does not falsify the claim. It is AML who have made a universal claim (all M-BMs have fatal flaws) while MCMG have only claimed that AML's universal claim is not true. Note that the claim "not all M-BMs have fatal flaws" is not the same as the claim "all M-BMs are flawless". Though MCMG have not stated it explicitly, one might assume that they understand that ALL measures used by scientists (including those based on M-BMs) are imperfect and subject to measurement error. AML have made the universal and more extreme claim, and they have placed themselves a position that is more difficult to defend. Essentially, AML's main claim can be falsified by the presence of a black swan, while the main claim of MCMG cannot be falsified by the presence of a black swan. It is perhaps, for this reason that MCMG spent so much time listing evidence of successes of M-BMs in their first commentary. No doubt MCMG would consider each piece of evidence in 2_MCMG_3 thru 2_MCMG_9 to be black swans that could falsify the main claim of AML.

After the discussion of swans, AML go on to argue (3_AML_2 thru 3_ AML_7) that MCMG failed to address most of AML's arguments from the first commentary. Technically this is not true, as MCMG did list several citations that they felt addressed most of the arguments presented by AML. The present commentary has as its focus the content of the four commentaries by AML and MCMG and, for that reason, I will not weigh in on the arguments or evidence found in articles that were cited by either AML or MCMG. As can be seen in Table 2, MCMG used several arguments to directly address 1_AML_5. Table 3 reveals that AML present several of their own arguments (3_AML_10 thru 3_AML_13) in order to address the arguments proposed by MCMG.

MCMG's second, and final, commentary in the series criticizes AML for using philosophical and rhetorical language. MCMG then present several arguments (4_MCMG_2 thru 4_MCMG_4) that address one of AML's validity-related arguments (1_AML_2). MCMG end their final commentary by accusing AML of conflicts of interest (COI) and suggest that, for this reason, AML's arguments ought not to be trusted. Out of all five parties concerned, I do not know which individuals (if any) have conflicts of interest. I was, however, asked by one of the authors of the commentaries to specifically address the issue of conflicts of interest and ad hominem attacks. Up until the 21st century, those studying argumentation generally included ad hominem attacks among examples of illegitimate or fallacious arguments. Recently, however, most of those working in the fields of argumentation science and informal reasoning have accepted the idea that ad hominem attacks may be legitimate rather than fallacious (Hitchcock, 2007; Aberdein, 2010, 2014; Bondy, 2015). Van Eemeren, Garssen, and Meuffels (2012) distinguish among three types of ad hominem attacks: 1) abusive, in which an individual is attacked as bad or stupid 2) tu quoque, in which an individual is attacked for being hypocritical

and 3) circumstantial, in which an individual is attacked by casting suspicion on that person's motives. The COI accusation leveled by MCMG is an example of a circumstantial ad hominem attack. Most of those working in argumentation science and informal reasoning would agree that circumstantial ad hominem attacks are sometimes legitimate, and van Eemern, Garssen, and Meuffels (2012) presented empirical evidence that lay persons find circumstantial attacks to be more reasonable than abusive attacks.

Appropriate scientific behavior during any particular era is generally determined by the views and the behaviors of the majority of scientists. So what is the consensus in the scientific community in regards to accusations of conflicts of interest? At present, there are many views on this issue, and views on the appropriate response to conflicts of interest are evolving rapidly. COI policies at journals are constantly evolving and are not consistent across journals (Ancker & Flanagan, 2007). Recently the entire editorial board of the International Journal of Occupational and Environmental Health resigned in protest at the appointment of a new editor with links to industry (Iacobucci, 2017). The FDA Safety and Innovation Act (FDASIA) was signed into law in 2012 and it changed some of the regulations regarding COI reporting that had been set in 2007 with the FDA Amendments Act (FDAAA) (Wood & Mador, 2013). Krimsky (2001) suggests that COIs can lead to three potential problems: 1) selection of research questions 2) biasing of research outcomes and 3) influence on public perception of science. Others are concerned that messages from those with COIs are being silenced (Ungar & Bray, 2005). Some (Bero, Oostvogel, Bacchetti & Lee, 2007) believe that trials funded by researchers with COIs may be more positive than trials by researchers without COIs. Many feel that the problems of COIs can be reduced or eliminated via requirements of disclosure. Alternatively, Cain, Loewenstein and Moore (2005) found that disclosure of COI may give those with a COI more license to

misbehave, and that might increase harm to those who depend on scientists who have COIs. It therefore seems that ad hominem attacks referring to COIs should not be considered to be either reasonable or unreasonable a priori. Such attacks may be made, but those that are the targets of the attacks should be able to respond to those attacks. The community of scientists can then decide which attacks are reasonable and which are not.

The way forward

It seems to me that if both sides could agree on standards for quantifying the validity of measures based on M-BMs, then some headway could be made in regards to the issue of the validity of M-BM based measures. The issue of whether M-BM based measures are permissible or not, however, seems to provide less opportunity for progress in the short term. That aspect of the discussion is related to deep-seated semantic and philosophical disagreements related to the nature of "good" science and "good" measurement. MCMG and AML do not see eye-to-eye on the degree to which their dispute might be settled by pragmatic factors. MCMG feel that, if the use of a particular measure benefits science and moves it forward, then that measure is a good one. AML are less interested in pragmatic issues, and place more importance on a number of philosophical considerations.

Considering the empirical arguments presented in the four commentaries, it can be seen that AML have presented only the negative aspects of M-BMs while MCMG have only presented only the positive aspects of M-BMs. This is not terribly surprising for two reasons: confirmation bias is pervasive in human thinking (Nickerson, 1998) and the series of four commentaries were in a format that favors an adversarial approach to reasoning and communication.

Conclusion

The primary goals of the present commentary are to identify and clarify the arguments, and to show where progress may be made. Tables 1 through 4 summarize and paraphrase the arguments found in the four commentaries. The tables also allow readers to quickly determine the types of evidence being used for a given argument (e.g. empirical, reasoning, semantics) and they provide an efficient way for readers to determine if an argument is ignored or addressed by the opposing side. I have also tried to clarify some issues regarding the rules of argumentation (e.g. burden of proof, the validity of ad hominem attacks, black swans, etc.). Finally, I have attempted to identify where agreement between the two sides is likely and unlikely in the short term.

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Table 1. Paraphrase of the data and claim for the major arguments presented in Archer, Marlow, and Lavie (2018a).

Argument Code	Argument/ claim addressed	Data	Type of Data	Claim
1_AML_1	NA	M-BMs are based upon the flaws of category error and reification	Reasoning, semantics	M-BMs have fatal flaws
1_AML_1a	NA	A chain of reasoning that indicates that use of M-BMs involve category error	Reasoning, semantics	M-BMs are plagued by flaw of category error
1_AML_1b	NA	A chain of reasoning that indicates that M-BMs involve reification. That is, actual dietary intake is comprised of concrete substance, while M-BMs are mental in nature.	Reasoning, semantics	M-BMs are plagued by the flaw of reification
1_AML_2	NA	Human memory and recall are not valid instruments for scientific data collection	Empirical, reasoning	M-BMs have fatal flaws
1_AML_2a	NA	Several citations showing empirical evidence that self-report data are often implausible	Empirical	Human memory and recall are not valid instruments for scientific data collection
1_AML_2b	NA	Several citations showing that people often lie about their dietary behavior	Empirical	Human memory and recall are not valid instruments for scientific data collection
1_AML_3	NA	Self-report data have measurement error. This measurement error is non-quantifiable and non-falsifiable	Reasoning, semantics	M-BMs have fatal flaws
1_AML_4	NA	Pseudo-quantification is invalid (and impermissible) and it violates foundational tenets of measurement theory	Reasoning, semantics	M-BMs have fatal flaws
1_AML_4a	NA	M-BMs are based on the logical fallacy "of mistaking the abstract for the concrete"	Reasoning, semantics	Pseud-quantification is invalid (and impermissible)
1_AML_4b	NA	Assigning numeric values to verbal and textual reports is an impermissible transformation that violates the basic tenets of measurement theory	Reasoning, semantics	Pseud-quantification is invalid (and impermissible)

1_AML_4c	NA	Precise standardized ‘reference’ nutrient and energy values do not exist because of biological variability and rapidly changing food environments	Reasoning, semantics, empirical	Pseudo-quantification is invalid (and impermissible)
1_AML_5	NA	Estimates based on self-report are often physiologically implausible and bear little or no relation to nutrient or energy consumption	Empirical, reasoning	M-BMs have fatal flaws
1_AML_5a	NA	Repeated Administration of M-BMs does not solve/exacerbates the physiological implausibility problem	Empirical	Estimates based on self-report are often physiologically implausible
1_AML_6	NA	Thousands of highly cited papers based on M-BMs have been published over the past six decades (the claim that “M-BMs have fatal flaws” is implicitly included here as part of the data for this argument)	Empirical, reasoning, semantics	Misleading publications have contributed to confusion regarding the health effects of dietary sugar, fat, salt, and cholesterol. This confusion has had negative public health consequences

Table 2. Paraphrase of the data and claim for the major arguments presented in Martin-Calvo & Martinez-González (2018a).

Argument Code	Argument/ claim addressed	Data	Type of Data	Claim
2_MCMG_1	1_AML_1 thru 1_AML_5	Several citations pointing to other researchers that have responded to the arguments presented by AML	Empirical, reasoning, semantics	The claim "M-BMs have fatal flaws" is false
2_MCMG_2	1_AML_1	The AML view is based on a nominalist philosophy rather than the current approach to measurement used by most scientists	Reasoning. Semantics	The claim "M-BMs have fatal flaws" is false
2_MCMG_3		Several citations showing that M-BMs are acceptably correlated with relevant biomarkers	Empirical	The claim "M-BMs have fatal flaws" is false
2_MCMG_4		The example of M-BM research on the Mediterranean diet and cardiovascular health	Empirical	The claim "M-BMs have fatal flaws" is false
2_MCMG_5		The example of M-BM data on passive smoking and health outcomes such as lung cancer	Empirical	The claim "M-BMs have fatal flaws" is false
2_MCMG_6		The example of M-BM data on physical activity	Empirical	The claim "M-BMs have fatal flaws" is false
2_MCMG_7		AML have confused problems of random error with problems of systematic error	Reasoning	The claim "M-BMs have fatal flaws" is false
2_MCMG_8		Systematic error wouldn't occur in longitudinal studies using M-BMs because participants fill out questionnaires prior to the outcome being known	Reasoning	The claim "M-BMs have fatal flaws" is false
2_MCMG_9		Several citations showing that nutrition studies based on M-BMs have been useful to	Empirical	The claim "M-BMs have fatal flaws" is false

		scientists and have advanced science/public policy.		
2_MCMG_10	1_AML_5	Researchers can adjust self-report data to adjust for total energy intake	Reasoning	Both the data and the claim of 1_AML_5 are wrong
2_MCMG_11	1_AML_5	Continuous variables derived from M-BMs are often converted to categorical variables (e.g. quantiles) the error is unlikely to be great enough to render the M-BM based measures useless	Empirical	Both the data and the claim of 1_AML_5 are wrong
2_MCMG_12	1_AML_5	We agree that the 24-HR dependent measure used in the NHANES study would not provide a valid measure of usual dietary intake. However, better data could have been collected if measures were taken on multiple days.	Empirical, reasoning	AML's criticism of the dependent measure in the NHANES study does not show a flaw in M-BMs in general, just the use of the 24-HR measure in particular.
2_MCMG_13	1_AML_5	Criticisms of NHANES can be dismissed because those "implausible" results can be true for a single day	Reasoning	Both the data and the claim of 1_AML_5 are wrong

Table 3. Paraphrase of the data and claim for the major arguments presented in Archer, Marlow, and Lavie (2018b)

Argument Code	Argument/ /claim addressed	Data	Type of Data	Claim
3_AML_1		MCMG presented white swans instead of black swans.	Reasoning	MCMG failed to properly address our evidence that M-BMs are invalid measures
3_AML_2		MCMG failed to address the topic of lying that we brought up in 1_AML_2b (people lie, so B-MBs not valid)	Reasoning	Argument 1_AML_2b still stands
3_AML_3		MCMG did not counter claim 1_AML_2a (self-report data are often implausible, so M-BMs not valid)	Reasoning	Argument 1_AML_2a still stands
3_AML_4		MCMG did not counter claim 1_AML_3 (self-report data is non-quantifiable & non-falsifiable, so M-BMs have fatal flaws)	Reasoning	Argument 1_AML_3 still stands
3_AML_5		MCMG did not counter claim 1_AML_4 (pseudo-quantification is invalid and violates tenets of measurement theory, so M-BMs have fatal flaws)	Reasoning	Argument 1_AML_4 still stands
3_AML_6		MCMG did not counter claim 1_AML_4c, 1_AML_5	Reasoning	Arguments 1_AML_4c and 1_AML_5 still stand
3_AML_7		MCMG did not counter claim 1_AML_6 (Thousands of highly cited papers based on M-BMs have been published, so Misleading publications have contributed to confusion regarding the health effects…)	Reasoning	Argument 1_AML_6 still stands
3_AML_8		No valid ways to measure, quantify, or falsify M-BMs exist	Reasoning, and/or	M-BMs have fatal flaws

			empirical absence	
3_AML_9		Self-report methods have proven to be useless in terms of informing public health and MCMG did not counter this (instead they provided evidence that self-report methods have been useful in clinical settings)	Empirical, reasoning, ?	M-BMs have fatal flaws
3_AML_10	2_MCMG_12, 2_MCMG_13	2_MCMG_12 & 2_MCMG_13 (Criticisms of NHANES can be dismissed, so data and claim of 1_AML_5 are wrong) is not supported by the data provided by MCMG because they failed to take into account three critical issues	Reasoning, empirical	2_MCMG_12 & 2_MCMG_13 are wrong and/or 1_AML_5 still stands
3_AML_11	2_MCMG_12	Several citations showing that repeated administrations of M-BMs do not improve the accuracy of those measurements	Empirical	MCMGs claim regarding one part of 1_AML_5 (i.e. the part involving repeated administrations of M-BMs) is false.
3_AML_12	2_MCMG_10	Several citations linked to papers whose authors make claims that are inconsistent with 2_MCMG_10 (Researchers can adjust self-report data to adjust for total energy intake, so Both the data and the claim of 1_AML_5 are wrong)	Empirical, reasoning	The claim of 2_MCMG_10 is false
3_AML_13	2_MCMG_11	Several citations showing that M-BM data cannot be used to accurately rank participants in terms of total energy intake.	Empirical, reasoning	The claim of 2_MCMG_11 is false

Table 4. Paraphrase of the data and claim for the major arguments presented in Martin-Calvo & Martinez-González (2018b).

Argument Code	Argument/ /claim addressed	Data	Type of Data	Claim
4_MCMG_1		AML use strategies such as rhetorical language and philosophy	?	AML's goal is to sow doubt in the minds of readers
4_MCMG_2	1_AML_2 & 1_AML_3	When M-BMs are used in longitudinal studies systematic error is unlikely to occur (because of a form of subject blinding)	Reasoning	Therefore AMLs claim that M-BMs are invalid is false
4_MCMG_3	1_AML_2, 1_AML_2a, 1_AML_2b, 1_AML_3	The types of errors that are likely to occur in studies employing M-BMs would be tend to bias the results towards the null and would tend hide true associations from the researcher	Reasoning	Therefore AMLs claim that M-BMs are invalid is false
4_MCMG_4	1_AML_2, 1_AML_2a, 1_AML_2b, 1_AML_3	Sensitivity analyses of classification provide adjustment methods that do not depend on the true exposure prevalence	Reasoning	Therefore AMLs claim that M-BMs are invalid is false
4_MCMG_5	Main claim of AML paper 1	Mainstream science accepts the position that M-BMs can be valid dependent measures	Reasoning	Therefore AMLs claim that M-BMs are invalid is false
4_MCMG_6	M-BM studies are useful	The example that recommendations for reduced saturated and trans fat consumption has had positive consequences and came out of research using M-BMs	Empirical	Therefore AML’s claim that M-BMs are invalid is false
4_MCMG_7	M-BM studies are useful	The example of the banning of smoking in public places has had positive consequences and came out of research using M-BMs	Empirical	Therefore AML’s claim that M-BMs are invalid is false
4_MCMG_8	1_AML_2 & 1_AML_3	The example of John Snow, whose success with cholera was based on imperfect dependent measures	Empirical, reasoning	Error free dependent measures are not required for good science

4_MCMG_9	Main claim of AML paper 1	Two citations providing examples in which observational studies using M-BMs have been confirmed with experimental studies	Empirical	Therefore AMLs claim that M-BMs are invalid is false
4_MCMG_10		AML have conflicts of interest (COI) that drive their rhetoric	?, reasoning	The arguments of AML are not to be trusted
4_MCMG_11		Citations were provided that show that research involving COI tends to report different outcomes than research not involving COI	Empirical	The ad hominem attack on AML regarding conflict of interest is an appropriate criticism
4_MCMG_12		Citations were provided that show that research involving COI tends to report different outcomes than research not involving COI	Empirical	Food industry may be funding researchers to discredit broadly used research methods without suggesting alternatives in order to cripple research programs that the food industry disapproves of