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Targeting cultural changes supportive of the healthiest lifestyle patterns. A biosocial evidence-base for prevention of obesity

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Abstract

This paper argues that the rise in obesity can be slowed only by universal education based on a type of evidence that does not yet exist. On top of literacy and numeracy, people need the ability to preempt the fattening effect of a decrease in habitual physical activity by altering familiar patterns of eating, drinking and exercise in ways that are both maintainable within the individual's social and physical environment and also effective at decreasing weight to the asymptote for each sustained change. Hence the prevention of obesity requires locally valid evidence on which changes to specific customary habits actually do avoid unhealthy fattening. Interventions need to focus on antecedents to individuals' common lapses from the healthy changes in these customs. Yet no research has been funded into the public's descriptions of feasible changes that cause a step down in weight, let alone into the environmental conditions for individuals' maintenance of those changes. As a result, public health policies on obesity lack scientific basis. When will a start be made on systematic identification of cultural supports to readily executed patterns of lifestyle behaviour which improve health to extents that have been directly measured?

Keywords. Weight control. Prevention of obesity. Evidence-based policy. Lifestyle behaviour research. Intervention-tracking trials.

Evidence needed to prevent unhealthy fatness

We lack the basic evidence for any population as to which aspects of their social and technological culture would support health-promoting patterns of behaviour. Useful data can come only from systematic measurements of the impact that specific customary activities currently have on disease or on epidemiologically established risk factors. This gap could be filled by an automated system for research and services on maintainable changes on locally recognised patterns of habitual action shown to be effective in that environment at providing the desired improvement in health, wealth or happiness (Booth & Booth, 2003).

This paper focuses slowing the rise of obesity and reducing its prevalence. Obesity should be defined as having a degree of fatness over sufficient time to risk physical disease and consequent deterioration in quality of life – not as a body mass index, waistline or body fat content at one point in time. So the scientific investigation of reduction in obesity needs to gain evidence on the effects on individuals' fatness of indefinitely maintainable alterations in their self-described patterns of eating, drinking and movement. This approach identifies in the local populace's own terms those particular aspects of lifestyle and environment that help to avoid unhealthy fatness, and most crucially the contexts that support the maintenance of the actually preventative changes in everyday habits.

This paper first contrasts the theoretical presuppositions of this approach to prevention of obesity with less realistic approaches to research and services. Then the rest of the paper outlines the theoretical logic of each step of this biomedically, socio-culturally and psychologically integrated methodology.

The enABLEr/s approach to obesity-preventative lifestyles

The theory and method of this biosocial approach to weight control have been refined over several decades. A lack of evidence on which particular customary activities keep weight off best was pointed out in the heyday of behaviour modification for obesity (Mahoney, 1975; Booth, Toates & Platt, 1976). The need for such basic scientific data was reiterated to the obesity research community of the time (Booth, 1978, 1980; Booth, Fuller & Lewis, 1981). After refusal of medical research support, work to identify successful and workable customs was started on funds from a health education provider then allowed to attend to its base in experimental science (Lewis & Booth, 1986; Booth, 1988b). After that support ended, a major observational study was spun off food research funds for work then in fashion on rationalisations about eating (Blair *et al*., 1989; Booth, 1996; Booth *et al*., 2004).

These first successes still did not attract medical, social or biological research support nationally and so the approach was formulated for international collaboration under the acronym for a computational internet system, enABLE*r/s* (Booth, 2002) -- evidence-networking Application of Better-Living Education, research and services (Figure 1). However, European proposals along these lines were blocked by political considerations. Subsequent medical research proposals have been declined because of the erroneous presupposition that the design to be implemented in enABLE*r* must fit conventional public health research procedures and that clinical qualifications are needed to gather evidence on self-care activities in daily life (Booth *et al.*, 2007). Most recently, the medically reviewed National Prevention Research Initiative in the U.K. took the extraordinary view that such "research will not add greatly to the existing knowledge base." This view has again been comprehensively refuted since in international research on obesity (Baranowski, 2010) and in the dietetics of weight control (Aphramor, 2010).

Clearly there is a longstanding and continuing problem of deficient education in the relevant sciences. This has produced the monstrously unrealistic experimental design of randomised controlled trials (RCTs) of selected outcomes in the everyday lives of members of the public from interventions in the clinic or through other professionally controlled power bases. The mistake of comparing before/after mean differences between groups is not addressed by subgrouping according to patients' preferences or by adding conceptual speculations based on interviews. The simplistic RCT bears no resemblance to the science done on other sorts of system, such as genomics, individual development, the natural environment, engineering or the minds of human beings or laboratory animals. This irrelevance of RCTs to improvements in medical or other service systems has led to the notion of 'complex interventions,' giving up on effective scientific investigation.

The RCT fails to address two key scientific issues. First, the design does not depend on measurements of what each patient does as a result of the delivery of each component of the treatment package (what in psychological science are called "manipulation checks"). Secondly, the processes within the individual's life -- from induced changes in behaviour, physiology or culture, working through to outcomes in medical, social or psychological wellbeing -- are not monitored at the times they actually occur within the period between baseline and final follow-up. Measurements of these causal pathways from culture to wellbeing are the core of the approach that could be implemented in the enABLE research facility.

So far only two studies with substantial similarities in design to Blair *et al.* (1989) have been reported. Both have the key weakness that they tracked behaviour-related measures for only a part of the time between weight baseline and outcome, invalidating causal inferences (S. French, Jeffrey & Murray, 1999; Westenhoefer *et al*., 2003).

Such tracking after prescription of common psychiatric medications has repeatedly shown that improvement is mediated by the drugs' autonomic side-effects, not their modulation of central neurotransmission (Thomson, 1962; Greenberg *et al*., 1994). An analogous fallacy afflicts the supposition that cognitive behaviour modification (CBM) is a treatment of obesity. It is not. The only effective treatment is communication of evidence in the public's words for widely achieved customs which actually do deliver a step reduction in weight. Without this usable knowledge, CBM can do nothing. The role of CBM would be to help a minority to avoid disruption of their evidence-based changes in lifestyle, as follows.

An open trial of group administration of an early form of the enABLE service added CBM for those overweight clients who had emotional problems about their shape and/or their eating habits (Lewis *et al*., 1992). These problems reduce self-esteem in general and self-efficacy at weight control in particular (Blair *et al.*, 1990). When just the leaflets handed out to the groups for enABLE plus CBM were mailed to volunteers with stratified randomisation, the desire to overeat emotionally, actual emotional eating and dietary restraint were all reduced, and weight-control self-efficacy improved (Blair *et al*., 1992). Indeed, that written therapy was no more effective on body weight than just reading and answering the questions on frequencies of 27 patterns of healthy behaviour that were used to monitor both the group who were sent leaflets and the group who received none.

The group who met in classes had the unprecedented outcome of losing further weight after the end of intervention (Lewis *et al*., 1992). The key difference from previous therapy was that they were informed of the causal evidence from the early enABLE research by Blair *et al*. (1989) in their locality with people like them as to which feasible changes in self-described habits did most to reduce weight. As well as implementing more of the evidence after the classes ended, that sort of education enabled members of the group to become 'flexible dieters' (Westenhoefer *et al*., 1999): they could experiment on themselves to find further patterns of behaviour that were feasible to change indefinitely and yielded another step loss in weight.

Failure to prevent re-gain after treatment

The best trial thus far of effects of lifestyle counselling on weight control provided no more evidence than its predecessors of impact on the risks of disease from obesity (Diabetes Prevention, 2002). There is no known effect on long-term incidence of morbidity from the observed transient reduction in weight on its own. For many participants, such a trial could be the start, or even just the continuation, of a lifetime of cycles of reduction in weight and failure to keep the weight off ('yo-yo dieting'), potentially damaging to health (Aphramor, 2010).

This trial had a crucial merit of tracking weight in the months before final follow-up. The group's mean weight was still being re-gained in the last months of the two years of the trial. As emphasised in consultation but not reported (NHS Centre, 1997), such continued increase in weight predicts zero average impact of the intervention and possibly an eventual group mean weight above baseline.

The continued regain also proved that earlier changes in energy intake and expenditure were not being maintained. Dietary assessment was not reported and in any case is incapable of measuring eating customs. So it is unknown if any food choices reduced weight but were not maintained (Knauper *et al*., 2005). Generic scores for physical activity were decreasing as weight was being regained and so that aspect of the trial's lifestyle counselling was unsustainable in the trialists' culture.

This all illustrates why education in weight control can succeed only after feasible changes expressed in the general public's terms have been shown to reduce weight. Attempts to prevent regain of weight by medication, food products or exercise facilities cannot defeat ignorance of what changes in habits both reduce weight and also can be maintained indefinitely in that person's current environment (Booth & Nouwen, 2010).

Individuals' avoidance of unhealthy weight gain in their own environments is a single issue spanning clinical management and public health (Booth, 1980). The mechanisms for re-gain of weight after it has been reduced in treatment are the same as those for prevention of initial fattening into the overweight or obese ranges. The same choices provided by the same environment risk both regain of lost weight and gain from the healthy range to overweight and into obesity of increasing severity, and hence also risk the incidence or recurrence of the obesity-related disease and distress. Hence, as for any disease to which behaviour contributes, policies for environmental change to reduce incidence and prevalence should not be separated from clinical advocacy of healthy lifestyle. Individuals' maintenance of changes in habitual activities requires support from locally accessible environments, whatever their medical status.

Multiple causal networks in a person's life

The enABLE approach is based on an inclusive view of a human being as a biosocial cognitive-affective-conative unity generated by interactions between genomics and culture (Booth, 1988a, 2008; Booth, Lewis & Blair, 1990; cp. the biosocial thought experiments by Wittgenstein, 1953). Rather than being "reductive" or "over-individualised", as has been said in public health circles, enABLE is realistic simultaneously about the social, biological and mental systems that have developed together in each fat or thin person's life. Either brain-centred research or society-centred models focus on the wrong causal system for investigating the exchanges of energy between a person's body and physical environment. The real issues are what action-organising mental processes are informed by the processes in the society and represented by the processes in the brain of that person. As a consequence, the past succession of interactions between genetic expression and cultural inculcation can only be investigated effectively when we understand how each grown individual operates in everyday life.

The long-term embodied and acculturated processes of weight control in everyday life do not begin to be addressed by laboratory tests of eating or exercising (Booth, 2009) or by scores from questionnaires worded by the investigators (cp. Goodchild *et al*., 2008). The research has to start with culturally consensual descriptions of customary eating or exercising patterns. These qualitative foundations of the enABLE approach run into trouble with deconstructionist scholars of politics or postmodernist social theorists who refuse to recognise that objective uses can be made of such fully subjective narrative data. Yet qualitative research by itself yields at best only stories that alert the theoretically driven research or objectives-driven services of the personal realities with which they are dealing: causal hypotheses remain to be formulated and tested.

Research into situated realities also has to recognise that the individual operates on the basis of what has been learned from previous experience of such circumstances. On the energy intake side of obesity, work on palatability and satiety as well as research into social influences on eating has been seriously flawed by failure to recognise that orosensory and bodily factors have norms just as cultural factors do (Booth, 2008; Kissileff *et al*., 2008; Conner *et al*., 1988). Such misconceptions are addressed later in this review while considering the hypotheses that should be tested.

Finally, each person does something different within a particular environment. If it were not so, the politically favoured concepts of personal choice and rational decision-making would be totally vacuous. It follows that a group mean is meaningless. Worse, treating the variance as error throws away the very data that could tell us what is actually going on in the members of the group: as Hume pointed out in the 18th century, the only evidence for causation is covariation between the observations that are hypothesised to be at each end of the particular causal pathway. Therefore the genuinely scientific approach to healthy lifestyle is not the RCT's contrast between a group on a clinically specified treatment package and some sort of control group, let alone the abandonment of science to researchers' own construing of conversations with patients or members of the general public, coupled with professional brainstorming around aggregated survey statistics. The application of experimental science to lifestyle behaviour requires measurement of the effect of individuals' varied responses to each culturally objectified communication when presented disconfounded from other recognisable messages. The effect of each component of an intervention has to be measured in an individually tailored way across a group large enough to give a reliable estimate of the ratio of changes in behaviour and weight, with randomisation achieved by a 'multiple-baseline' design (Barlow, Nock & Hersen, 2008).

Contrast with mainstream theory of behaviour change

The above theory of behaviour preventing obesity contrasts sharply with dominant psychological approaches to changing behaviour in order to improve health. Currently leading theories invoke 'will power,' self-control (or 'behavioural regulation') and self-efficacy. There is not the space here for a critical review from the holistic mechanistic viewpoint and so single-sentence alternative formulations of these concepts will have to suffice. Self-control is an external influence operating relative to the norm for self. Will power is exerted when a person's own reasons determine action. Motivation is the way a person acts, not something that a therapist can 'inject.' In short, such notions are phenomenological froth on the actual mental processing of decisions to eat, drink and move around or not (or to carry out any other sort of habit).

In fact the widely recognised requirements for promoting healthy changes in lifestyle behaviour are exactly met by the approach reviewed here. For example, the phrases underlined below are quoted from the priority on "Behavior Change" highlighted by the US National Institutes of Health at the start of their Transformative research programme (NIH OBSSR, 2009). The multi-level causal approach illustrated in this review builds upon direct evidence of <u>maintenance</u> of <u>sustained</u> change in behaviour <u>common to multiple health conditions</u>, helping to <u>unify disease-specific efforts</u>, and <u>developing innovative intervention</u> that <u>scales well</u> in <u>the broader context in which individuals live</u>. The paradigm requires innovatory <u>interdisciplinary teams</u> to deliver a new <u>transdisciplinary approach</u> to hitherto unmeasured <u>basic mechanisms</u> of <u>interaction between</u> <u>biological</u> <u>and social factors</u>.

The longstanding problem with theories of behaviour change is that they have been focused on persuading people to adopt new habits without knowing which changes work best or how to prevent lapses among those who do change their behaviour as prescribed. Even those theories that address relapse to the old habits treat it as a secondary problem. This review treats occasions that could presage weight gain as the primary issue. Only when an effective and maintainable change has been identified in a person's own terms should that item be included in a package of lifestyle change or its environmental support in a public health policy. Anything less is a betrayal of the professional standards of evidence-based practice. Indeed, it has been argued that it is unethical to invite participants to join a trial requiring unsustainable changes in behaviour and weight (Alphamor, 2010).

Prevention of obesity by personal changes in specific activities

The theory behind use of enABLE to prevent obesity follows from a basic fact of life. The amount of fat in the abdominal region will increase if an individual takes less and less exercise without cutting back more and more in energy intake to a corresponding extent. Clearly, additional exercise -- perhaps of a different kind from that dropped -- would require less reduction in food intake. However, the time demands alone of enough extra exercise may be impracticable, or at least too difficult for most people to keep up. So, even if decline in physical activity is the main cause of overweight, prevention of weight gain into the unhealthy range and further upwards must rely mainly on each person finding sustainable habits of eating and drinking that involve a lower long-term average rate of energy intake.

Weight change is asymptotic while behaviour change is maintained

It is vital to recognise that this fundamental 'fat physics' requires a succession of these permanent changes in expenditure and intake of energy by each individual. Even some professional advocates of action on obesity still commit the thermodynamic fallacy of adding up over a lifetime the energy in, say, an extra pat of butter or an hour's less exercise each day, in order to estimate the impact on weight of adding that piece of food to the diet or leaving it out. Alert dieters know that eating less of something does not work like that. The principle is also apparent in the deceleration in the group-average decline in weight during an intervention to reduce weight, even if compliance remains good.

The physiological fact is that there are diminishing returns to any change in intake or expenditure of energy. This is because a loss or gain of fat stored in the body is accompanied by a drop or rise also in the lean body mass that spends energy even while we are asleep and have assimilated all our food (Garrow, 1974, 1987). Hence this basal metabolic rate decreases or increases in parallel to the fall or rise in body fat content. Thus energy intake and total energy expenditure come into balance again, if there is no other change in eating or exercising. In consequence, the lowering or raising of weight as the result of a persisting change in a habit slows down and reaches an asymptote.

Edholm *et al*. (1955) provided evidence that it took about 3 weeks for a shift in energy exchange to re-balance. That is, the impact on weight of any one maintained pattern of behaviour that changes the rate of energy intake or expenditure is likely to be finished in less than a month. Furthermore, all that sustains that change in weight in the long term is the continuation in full of that change in habitual eating or exercise. Since the weight change is asymptotic after a persisting change in behaviour, another long-term slowing in energy intake or speeding of energy expenditure needs to be identified and implemented in order to lose further weight or to prevent a gain that would otherwise occur because of other changes in behaviour or metabolism.

Another widely neglected fact of physiology is that the initial loss of weight or prevention of weight gain from eating less is mainly water: deposits of glycogen in the liver are depleted by the sudden decrease in the supply of glucogenic substrates, and hepatic glycogen holds three times its weight of water. Ignorant or unscrupulous advocates of rapid weight loss exploit this fact to keep people in an ineffective treatment or to sell a product that is falsely alleged to slim fast, not at best to reduce weight temporarily, even mainly as water. Further change in weight after the first several days, however, is in the body’s contents of fat, along with some lean mass.

This step-by-step approach is recognised by those who have abandoned the notion that an initially rapid loss of weight is ultimately helpful in slimming. However there is little appreciation of its relevance also to basic research into weight control. Almost 50 years have passed since the first demonstration that behaviour modification can reduce weight, at least while the behaviour change persisted (Ferster, Nurnberger & Levitt, 1962). It is astounding therefore that there is still no systematic research into the asymptotic weight change following a maintained change in a particular pattern of eating, drinking, movement or stillness as described by the public. This paper presents once again the required methodology and exposes fundamental misconceptions that have blocked its implementation.

Antecedents of occasions of fattening eating, not of eating generally

Research into influences on eating and exercise has not been focused enough to provide a scientific basis for prevention of obesity. The reality that needs to be investigated is lapsing from weight-reducing changes in habitual actions that have been shown to influence energy flows into and/or out of the body, averaged over weeks.

Lapsing is a key part of the theory of stages of change in problematic behaviour such as misuse of drugs. Yet proportionally very little research has focused on this stage in sequences or cycles of behaviour change. Application of stage theory to healthy eating has centred on people’s preparedness to change this whole part of their lifestyle or even just awareness of a need to do so. Such research suffers from lack of behavioural specificity compared to lighting up a cigarette, an injection of heroin or even going out to get drunk. A high-fat diet, for example, is a biochemical characterisation of a large and variable set of particular eating activities having little in common except the consumption of a substantial amount of a fat-rich food, to which there may or may not be a customary alternative available to adopt, let alone to lapse from. Since the public are not given hard evidence in their own terms on how to keep lost weight off, those who are currently trying to reduce weight lose no more weight than those who are not even concerned about their obesity (Jeffrey, French & Rothman, 1999).

Hence, what needs research is the immediate antecedents of individuals' lapses from a change in a habit that reduces weight but otherwise is usually maintained indefinitely in that physical and social culture. The environmental conditions of lapsing are the ultimate focus of enABLE*r*.

Hard data on prevention of obesity

The distinctive parts of enABLE research and services apply to real life some innovative combinations of straightforward methods of basic science – in this context, to avoid unhealthy fattening in any member of the public. The early formulation in the late 1970s has been refined with ideas and procedures from classic and recent cultural anthropology, human physiology and cognitive behavioural psychology. Since the evidence comes directly from members of a local culture, it could not be more firm or precise.

Participants in enABLE are asked to cooperate in research that will help people in similar circumstances to their own. The first step is to obtain descriptions of specific habitual patterns, such as dietary or exercising performance, that are agreed among individuals within each distinguishable subculture and lifestyle (Booth & Booth, 2003). The second phase measures how much change in an outcome such as weight is produced by a feasible change in frequency of each culturally recognised pattern that might be relevant, such as customs of eating, drinking and moving about. The third phase identifies what in the environment does most to help individuals not to reverse such changes. These phases of an enABLE research programme are outlined for weight control in the next sections.

Variants of each phase were first implemented in the 1980s using face-to-face or telephone interviews or questionnaires on paper, with analysis of data in generic statistical packages and manual post-processing for interpretation. Each of these procedures has now been specified algorithmically in its simplest form, and data are collected online. Hence a whole system of enABLE research and services can be automated.

In enABLE services, the system's users are advised to change habits one or two at a time on the basis of evidence about people like them, starting with what their own reports show to be the options that are most feasible in their culture and then continuing in accord with changes in behaviour and outcome seen in later reports. Those service users who consent to their reports being used to refine and widen the database on their culture can contribute to enABLE research, closing the loop in the networking of evidence (Figure 1).

The mature suite of methods can be divided into three phases of the gathering of data. First, the customs that might affect weight have to be identified. Then the effects on weight of individuals' changes in frequency of one such custom are measured. Thirdly, antecedents of lapses from change are characterised, for estimates of their relative influence and their interactions within the individual's mind.

enABLE*r *Phase 1: collecting the hard evidence on culture

The first phase in enABLE research in an uninvestigated culture is to make a record of a modest number of local citizens' descriptions in their own words of habitual practices and desired outcomes relevant to the target of the research – in this case, particular patterns of eating, drinking and movement. To begin to characterise potential antecedents to an occasion when an activity was carried out (for Phase 3), the specifics of any uses of commercial or public services or products may also be elicited open-endedly.

From such narrative text, a subsample of local informants then assign each practice and its context to a much smaller number of categories and provide a name for each major category of habitual behaviour or expected outcome. This consensus on the wordings of classifications objectifies such customs in the (sub)culture sampled, ready for immediate use in an evidence-based service and also in fully realistic research investigation, either built into the service or carried out in other ways.

Blair *et al*. (1989) omitted the classification by informants and themselves merged the elicited wordings into 27 descriptions of eating, drinking, exercise and slimming group attendance. Bowman *et al*. (2004) used focus groups to elucidate ambiguities in individuals' diaries about recurrent tiredness and discomfort. We are currently using two methods for developing investigator-independent categories from cultural consensus. The more economical approach is for representatives of the culture to sort elicited descriptions into preexisting categories (A. Laguna-Comacho & D.A. Booth, unpublished data). The other approach is the classic technique of cluster analysis on pairwise dissimilarity ratings between the elicited descriptions of common habitual activities (L. Shepherd & D.A. Booth, in preparation).

Self-description in culturally agreed terms cannot be dismissed as 'soft' data. Such a characterisation reflects the fundamental error of assuming that what people say that they are doing is less valid than observations of what they are doing (Booth, 2009). We have to deal with what people do, not with how the jaw or legs are moving, the chemical composition of a food or other merely material facts. This confusion of movement with action can still occur in psychology itself (van Dantzig, Pecher & Zwaan, 2008). Worse if possible, that view is blind to the problem that is faced by both research and services of communicating accurately about what a person has been or should be doing. The finest detail of audiovisual recording or of electronic traces from a food-weighing scale or an oxygen-consumption meter will not enable the scientist to report what the intended activity was, nor the practitioner to recommend what activity to carry out (Booth, 2009). What people do is nothing more or less that what they regard themselves as doing. Any exceptions such as verbal deceit, unintended consequences or unconscious motivation, all trade logically on the intention with which a person acts (Anscombe, 1957).

Hence the UK NPRI totally missed the point about the evidence-base and educational delivery needed for prevention when they commented that "self reported behaviours are open to mis-reporting and some validation is required" and "it will be hard to discern whether weight outcomes relate to natural habits or the act of reporting behaviours" It is scientifically impossible to discern a natural habit as complex as a pattern of eating or exercise without the act that was carried out repeatedly being described in language agreed within the agent's culture. Weights of food consumed say nothing about how those choices were made in the terms in which eaters communicate objectively. In any case, having to weigh food greatly distorts what is consumed, whereas reporting after the event cannot alter what happened.

enABLE*r *Phase 2: direct measurement of the causal pathways

The second phase of enABLE research uses the culturally recognised categories of common local patterns of eating and exercise from the first phase to generate evidence on their impact on weight and on the persistence of each change in a pattern.

The long-established scientific method for measuring the outcome from each of a set of manipulations is a version for groups of participants of the "multiple-baseline" design developed by behaviorists for single-case research (Hersen & Barlow, 1973; Barlow, Nock & Hersen, 2008). Experimental control is achieved within the group by randomising across the participants all the possible sequences of the set of habits to be tested for effects on weight. This is a powerful fundamental design for identifying which customs that prevent weight gain. Yet Phase 2 is as close as Phase 1 to enABLE services. Testing one habit at a time maps exactly onto the strategy increasingly recognised as best for an individual to reduce obesity -- slow but steady weight loss by permanently changing one habit at a time.

Repeated readings of weight scales, not one-off report. Local citizens are recruited who are willing to report the timings of their most recent execution of each category of behaviour pattern at weekly intervals for at least a few months, together with the current state of the desired outcome being tracked -- in this case, body weight, read each week from the same scales at the same time of day. Repeated weighing encourages weight loss (Linde *et al*., 2005; VanWormer *et al*., 2008) but this does not undermine measurement of differences between patterns. Indeed, enABLE can detect which eating and/or exercise patterns are changing to produce the loss of weight provoked by the self-monitoring of weight.

Once-reported weighings are highly valid on measured weights but that is not relevant to enABLE. The method uses reporting of repeated weighings to monitor only changes in weight. Actual weight is important only in secondary analyses -- and then in relation to height in BMI, if not replaced altogether by waist circumference.

"*When did you last …?", not "How often …?"* The frequency of an action is commonly assessed by asking how often it is done. Experimental psychologists have shown that such direct questioning is fundamentally flawed (Sedlmeier & Betsch, 2002). Instead, we exploit the power of episodic memory by asking when the last two occasions were of each action. The reciprocal of the time interval between those times is the exact frequency over the period back to the first of the two.

This weekly estimate of current frequency is the primary independent variable -- not the requested change in a habit but the actual change, and how long it persists. If a participant does not comply, or even is countersuggestible, this is an important fact about the requesting, but it is irrelevant to the indirectly estimated behavioural change and its impact on weight.

Unrequested changes in habits. A key commitment by participants in multiple-baseline research is to keep current habits stable until asked to change the frequency of one of them (within the range of most others like them). Nevertheless, any changes in frequency of other habits are picked up by the weekly monitoring of the full range of customary patterns of eating and exercise.

Parallel changes should not be treated as confounders to be removed by multiple regression (S. French *et al*., 1999) or combined into scores of behaviour and motivation (Westenhoefer *et al*., 2003). Rather, they should be tested for evidence if one or more underlying common factors coordinate the observed changes, e.g. by principal components analysis (Booth *et al.*, 2004). Correlations between habits' changes of frequency can also identify replacements of one habit by another, e.g. packet foods between meals by pieces of fruit.

Causation from time-lagged correlations. Evidence for a specific pattern of behaviour (or a set of covarying patterns) that prevents obesity comes from the dependence across participants of the extents of change in weight on the degree of change in the habit tested. That is, enABLE research measures which patterns of eating or exercise are most effective, not just which have statistically reliable effects.

The fundamental parameter for statistical effect size is the correlation coefficient (r), also calculated as the regression β-value. On the other hand, the scientific measure of the impact on weight of change in a habit's frequency comes from the slope of the regression (B), e.g. the change in number of times per week for loss of 1 kg. This is an objective 'dose-response' value for a single culturally recognised custom (not for an arbitrary score on a questionnaire; cp. S. French *et al*., 1999).

A positive slope of frequency change per weight change associates that habit with fattening, and a negative slope with weight reduction. In the case of an eating habit, a negative slope demonstrates an uncompensated decrease in the average rate of intake of energy while the average frequency of that pattern of eating increased. For movement habits, the negative slope measures how much net increase in rate of expenditure of energy is achieved by a given increase in average frequency of that form of exercise.

However, slopes from changes in behaviour and weight over the same period of time ('concurrent' or zero-lagged correlations) do not establish the direction(s) of causation. A reliable correlation is definite evidence for the existence of a causal connection but it does not distinguish among an effect of behaviour change on weight, noticed weight change affecting behaviour, and some third change influencing both behaviour and weight. Evidence on the direction of causation can be obtained from time-lagged correlations. The start of weight change is measured with a lag of one week behind the start of behaviour change; this also avoids confounding of change of fatness by initial changes in body water content**.** A change in one variable that is followed by a change in another variable is evidence that the first variable measures an influence on what is measured by the second variable. Hence a difference between the r-values for the crossed time-lags identifies one direction of causation as dominant.

Where the cross-lagged pair of correlations have the same sign, then a larger absolute r-value for weight change starting after behaviour change shows that a concurrent correlation of the same sign includes an effect of behaviour on weight. However, if the crossed r-values differ in sign, a totally different mechanism is implied: the habit is believed to affect weight by the people sampled (whether it actually does so or not) and so, when they notice a change in weight that they do not want, they change the frequency of that habit in the direction opposite to that they believe changed their weight.

Time-lagged analyses over periods of years have shown that the widely observed association of greater physical activity with lower BMI is not attributable to an effect of energy expenditure on fatness, as generally assumed; rather, the association arises from obesity producing less exercising (Mortensen *et al*., 2006). These results imply that it could be a mistake to conclude that more than moderate exercise is needed to reduce risk of cardiovascular disease -- possibly via its effect on fatness. Rather, the main source of the association is that much fatter people are less likely to take extensive exercise. Also, some people may eat more when they increase exercise, by mechanisms that remain to be investigated.

Step change in weight. Change in one habit at a time generates unique data on the diminishing returns on weight as lean mass changes in parallel to fat mass. Average change in habit frequency can be correlated with change in weight for increasing numbers of weeks to measure the time course of approach to asymptotic weight. The sign of the change in weight for a given change in frequency (the slope of the “dose-response” line; S. French *et al*., 1999) measures the effectiveness of each piece of behaviour. This information is needed in order to prioritise advice in any intervention, after allowing for the persistence of changes in its frequency in that culture.

Maintenance of the changed behaviour. The duration of change in a habit’s frequency could be randomly distributed across participants. The function might be exponential with a time constant that depends on the initial frequency and a number of other factors in the person (such as weight loss achieved), the environment (such as incidence of temptations to lapse) and the behaviour’s impact on weight. Data on the minimum persistence of change in each individual are also the first step to identifying the context of any relapses that occur (Phase 3). If lapses fit a linear survival (logarithmic Poisson) function, then effects of advice, cognitive-behavioural therapy or environmental change on the slope (exponent) can be investigated in subsequent work.

The longer that the tracking of frequency of that pattern of behaviour is continued (adequately at longer intervals, such as 3 months), the stronger can be the evidence that the change in habit is maintained indefinitely. A new frequency that is unattenuated for 12 months can reasonably be presumed to survive seasonal changes and common vicissitudes of everyday life in the environment of the study. However a finite incidence of relapse is likely and so evidence on its causes is needed.

enABLE Phase 3: hard data on preemption of lapses

When a requested change reverses sharply, the participant can be asked first for details of the observable context of the first occasion at the lapsing frequency (without explicitly identifying it as such). Then a description can be elicited of any differences in context for a similar incident at nearer the older frequency. This questioning about the environment can then be pursued into the participant’s intentions, eliciting perceived influences on the lapse. When such open-ended responses begin to show common themes across participants, consensus of description can be sought (by methods such as in Phase 1).

That is, what people think of items on the menu in a fast food outlet or of the public transport at the time to leave home for work are objectively determinable facts, just like the patterns of activity required in Phase 1. Individuals' described viewpoints on the facilities available for eating, drinking and moving around are key parts of the intentions they have while carrying out their habitual activities. These intents are not captured by the highly generic and investigator-constructed phrasings of questionnaires about attitudes to foods or exercise or styles of life such as dietary restraint, emotional eating, watching video or being in a sports club.

There is some indirect evidence that behaviour that reduces exposure to environmental disruptors of weight-reducing behaviour can be important in long-term weight loss. People are aware of these factors as "temptations" to sit instead of walking or to eat instead of drinking an energy-free beverage. Susceptibility to temptation to eat has been scaled psychometrically as "disinhibition" and decreased scores are associated with weight loss after a year's pharmacological treatment for obesity (Hainer *et al*., 2005) and after 6 years of conventional dieting to lose weight (Savage, Hoffman & Birch, 2009).

When we have the evidence for an effective and maintained custom and these perceptions of features in the environment that disrupt shifts toward adoption of it, then effective public intervention requires basic knowledge of the specifics of the actual antecedents in the body, the food or the social or physical environment. After the relevant details have been elicited, action-related descriptions can be translated into weights of foods eaten, amounts of energy expended, products' prices and information on nutrient contents, distances to and visibility of stairs and elevators, and so on. Note that these are not the total amounts of nutrients consumed (such as a high-fat diet), facilities used (TV, fast-food outlets, automobile), money spent (on a healthy food basket, parking), etc. What matters are the controllable environmental aspects available for evidence-based intervention by health education or by food marketing.

Once that evidence was obtained, major issues could be addressed about environmental support for weight-gain avoidance behaviour. Which antecedents of relapse are the most important to reduce as a matter of public policy? Do different antecedents interact in their influences on the individual's maintenance of a particular obesity-preventative habit? The strengths of influence of different perceived factors and their cognitive interactions in generating an occasion of relapse can be measured as normed multiple discriminations (Booth & Freeman, 1993; Freeman & Booth, 2010). The pattern of eating, drinking or exercise is made more likely when there are factors in the situation to which that action is sensitive. Two factors may act in the same way or independently of each other, and they may be conceptualised or not, or described or processed in still deeper ways (cp. Booth, Kendal-Reed & Freeman, 2010). The contribution of a factor to the overall explanation of the lapse is a measure of its importance to the individual's weight control. The cognitive integration of factors is the causal mechanism by which they interact to determine the frequency of the habit.

Other outcomes. In Phases 1 and/or 3, the same techniques of open-ended description and extraction of consensus can be used to specify other individually expected outcomes of change in behaviour, good or bad for physical health or other aspects of wellbeing. These other perceived consequences can also be translated into social, economic and material impact for aggregation across samples containing the relevant demographic quotas.

What cultural changes might help reduce and prevent obesity?

In contrast to the decades of research into relapse from cessation of smoking, heavy drinking or use of a particular type of drug, there has been almost no investigation of the specific situations in which an individual relapses from any particular weight-reducing pattern of eating or exercise. Hence, at present, suggestions for cultural support against obesity can do little more than avoid theoretical incoherence or common impracticalities. The best that can be done is to formulate enABLE*r*-testable hypotheses about the most fattening habits that have been indicated by less precise methodology.

The zero-calorie drink break

Consideration of the slowing of gastric emptying over the hours following a meal led to the proposal that "zero-calorie drink breaks" (ZCDBs) between mealtimes are the first line of defence against becoming overweight (Booth, 1988c). The first clear evidence that the timing of energy intake, and not just the amount, affected its fattening power came from a prospective observational study in England using an early form of enABLE methodology with an opportunity sample of the general public in England who were interested in healthy eating (Blair *et al.*, 1989; Booth *et al.*, 2004). This study showed that one of the two most fattening habits measured was the consumption of "calories between meals." Shortly afterwards, some retrospective evidence was obtained from members of weight-control classes in California that what they called "snacking" was the worst cause of regaining lost weight (Kayman, Bruvold & Stern, 1990). The term 'snack' (or snackfood) should not be used, in the UK at least, because it can refer to a light meal (Chamontin, Pretzer & Booth, 2003) and moderate intake at mealtimes could be an important part of a successful weight control strategy.

In addition, professed cessation of "eating between meals" was associated with weight loss, while the general populace gained weight (Coakley *et al*., 1998). Providing people with 'snackfoods' for 8 weeks was observed recently to have no reliable effect of weight, whether eaten between or with meals or having high or lower energy content (Viskaal-vanDongen, Kok & de Graaf, 2010). However the participants already ate considerable amounts between meals. Also they consumed less in total when given high-energy foods to eat between meals, at least in part by substituting them for the foods that they had been eating then. Hence no conclusion can be drawn from these data about the ZCDB.

Energy intake away from regular meals is a major example of the advantages of the scientific method of enABLE over dietary assessment procedures. The effect of calories between meals is totally missed by dividing weighed intakes into 'snacks' and 'meals' around a threshold set by the investigator, rather than by timing relative to the individual's and the culture's mealtimes. Crucially for intervention, investigators' views on which eating is between meals can diverge from eaters' understanding of their own behaviour.

We are currently testing the hypothesis in the enABLE design that an individual will lose weight in proportion to the extent that s/he moves from calorific to zero-calorie drinks between meals, e.g. plain (black unsweetened, maybe weaker) coffee or tea and, more importantly, replaces cookie, chocolate or candy by fruit or salad (and apple rather than banana) and will keep the weight off if the changes is maintained. It is vital that medical advisors, food labelling regulators and health educators take such results as a whole. Allowing sodas to be marketed as "diet" brands merely excuses extra nibbles containing more energy than the sugar sodas. The reduced-fat biscuit is a snare and delusion. The issue is how to get non-caloric drinks and fruit or salad finger foods to be marketed as vigorously as packet foods and countlines, in the contexts where enABLE*r*'s testing of lapses confirms that impulse buying for consumption of such products in fattening patterns is indeed a major problem.

In addition, there are gaps in the physiological calculations on which the theory of the ZCDB is based. The proposal was that the energy ingested at a break for a drink mixes with the energy still in the stomach from the previous meal before gastric emptying slows appreciably (Booth, 1988c). This rapid phase of gastric emptying can go right back to the meal itself, in which case the especially fattening calories between meals might include 'afters' like cream or chocolate with coffee, and might even include rich desserts. On the other hand, energy ingested sufficiently soon before a meal suppresses intake in that meal, in some circumstances generating complete compensation. Therefore more data are needed on the amount of weight lost on reducing the energy content of drinkbreaks at different times after a meal and before the next. A gap of more than an hour or so between the previous meal and the 'snack' could miss the crucial period of rapid emptying (Viskaal-vanDongen *et al*., 2010).

Three meals a day?

The term 'between meals' in the theory of the ZCDB invokes a culturally objective concept but this presupposes the concept of a 'meal.' In fact, ZCDBs are not just between meals on the same day: they include energy intake after an evening meal, more than needed to avoid hunger before bed (Booth, 1988c). So prior questions arise, such as when conventionally labelled 'meals' are eaten (at 'mealtimes' or according to personal habit?) and which particular 'meal[time]' followed by more eating is least or most fattening, independently of amount usually eaten**.** Also, do the answers to such questions vary with individual lifestyle, societal norms or climate, for example?

Considerable attention has been paid in nutritional epidemiology to the easily stated parameter, number of meals per day. However this number is causally meaningless. To measure the long-term effects of a maintainable change in the usual number of meals (or eating occasions of any sort or size), the effects of omission or addition of each particular meal in an existing pattens need to be investigated. Far from fattening, more frequent smaller meals might provide tighter control of daily energy intake than do three larger meals (Drummond, Crombie & Kirk, 1996).

In fact a mechanistic theory of eating and exercise in energy balance addressed this issue long ago. Timings and sizes of bouts of eating were calculated from flows of energy into and out of lean and fat masses in an adult human body at constant weight and with common sleeping and physical activity patterns (Booth & Mather, 1978; Booth, 1988a). This simulation gave discrete intakes of similar amounts of energy soon after waking, around 1pm and at about 6pm, with no fourth meal nor waking to eat if activity declined sufficiently before midnight. This theoretical result was interpreted to suggest that the culture of three meals a day -- breakfast, lunch and supper -- is well adapted to the average physiology among largely sedentary adults in a temperate climate. Nevertheless, a 4-meal pattern – before work, late morning, late afternoon ('high tea') and mid-evening ('dinner') -- could also be regulatory of adipose tissue fat contents.

As with packages of treatment for obesity, the simplistic research questions need turning around into a search for evidence about the impact on weight of changes in each discrete component of behaviour involved, as perceived by the eaters themselves in a consensual description. The term 'breakfast' is self-defining. 'Lunch' or perhaps 'midday meal or snack' seems relatively unproblematic. A 'meal' (or two) between 4 or 5pm and bedtime, however, can be difficult to pin down.

Weight-controlling breakfasts? Cross-sectional data associate omitting breakfast with higher BMI (though it could be that fat people tend not to feel like eating breakfast, e.g. from ketosis, sleeping poorly or lower mobility). Evidence is direly needed on the effects on weight of changes in the composition, size and timing of the initial meal of the day. Is it any worse for the waistline to eat first just before work, rather than shortly after waking? Is there a least fattening size of breakfast, independently of composition, i.e. can it be too small (though well above zero calories) as well as too large (even when low in fat)? Energy at breakfast, at least while being absorbed, also appears to help good performance during the morning.

When does a midday meal do most for weight? Some lunch, especially if breakfast has been skipped, has been advised for weight control and for good performance through the afternoon. Tracking lunches in the enABLE*r* design could provide a definitive answer.

Is energy intake in the late evening particularly fattening? Within the simulations of Booth and Mather (1978), intake at or after supper which is more than enough to keep hunger suppressed until falling asleep for the night is an avoidable fattener. This hypothesis has yet to be tested by enABLE*r* or less direct methods.

Protein contents of meals

Substantial amounts of protein in a meal, combined with some fat, attenuate the rise of hunger before the next meal (Booth *et al*., 1970; J. French *et al*., 1992). Hence protein might help to prevent fattening from a calorific drink break habitually before the next meal. Evidence from field experiments indicates that this mechanism underlies better compliance with reduced-energy diets when they are low in carbohydrate and therefore high in protein (and fat) from meat and dairy products (Skov *et al*., 1999; Bravata *et al*., 2003). Even rats can learn eat extra protein in order to postpone the development of hunger (Thibault & Booth, 2006; Jarvandi, Booth & Thibault, 2007). Hence, people may be able to adapt more easily to this technique of managing hunger than to dietary strategies that make heavier demands on effortful decisions.

It should be added that the early satiating effects of protein have little if any mechanistic relevance to weight control. There is no point in deepening a state of satiety which is already sufficient to stop all eating. What needs strengthening is resistance to temptation to eat when hunger returns before next meal.

For the same reason, the broader notion of a 'satiety extenders' for an hour or two after a meal is misguided (Booth & Nouwen, 2010). It has arisen from the illusion that only carbohydrate is strongly satiating and fat is weakly satiating. With respect to weight control, the reverse is true.

The original implementation of the idea of extending the satiating effect of a meal was for fibre and slow-release starch. Variations in rate of digestion of different physical forms of grain starch (“Gi”) have turned out to be minor and of negligible relevance to obesity. An experiment purporting to show that starch and not fat has postingestional satiating effects gave a much greater mean effect of fat while it was being metabolised (Sepple & Read, 1990), at risk of type 2 statistical error (Blundell *et al*., 1993; Cotton *et al*., 1994). There is no such thing as time-independent satiety (or hunger) -- only the inhibition (or facilitation) of eating at a particular time on the physiological or social clock and calendar (Booth, 1972, 2008).

There is no evidence that sugar is any more fattening than starch (BNF, 1987). DiMeglio and Mattes (2000) proposed that liquids are more fattening than solids but any epidemiological evidence for that could be accounted for by the contribution to energy intake between meals of sugar sodas (Tordoff & Alleva, 1990) and, ironically, of carbohydrate-rich drinks marketed to boost mental and physical 'energy.' In short, short-term satiety tests are irrelevant to energy balance (Booth, 1996; Booth & Nouwen, 2010).

Instead, what should be sought to help prevent obesity are 'hunger delayers.' The issue is how to postpone temptations to eat an hour or more before a meal is due -- maybe 3, 4 or even 5 or 6 hours after the previous meal -- and hence to prevent the most fattening timing of energy intake, between meals.

Unfortunately, studies of high-protein diets that have collected ratings of hunger and its sating have not been designed to measure the late suppression of the wish to eat over the period of the trial. In any case, the more direct approach is to run protein-rich meals through an enABLE*r* design. Thus a research priority should be to test larger breakfasts on more than cereal and toast but not high in fat, or a protein-rich breakfast (with inherent fat), perhaps omitting cereal. Maybe existing products are sufficient, such as grilled pieces of frozen fish, portions of pastrami or cold sliced turkey or ham. There may be opportunities to develop ready-to-eat or microwaved portions for individuals. Protein in cereals might not be sufficiently augmentable while retaining crispness. Those who find boiling or poaching an egg too bothersome might be interested in a decently reconstitutable scrambled egg. Kedgeree (smoked fish in rice) might be another possibility. Notice that implementation of evidence-based public health is totally dependent on scientifically tested food product development and testing by commerce (Booth, 1988b).

Cutting back on high-fat foods

Blair and colleagues (1989) found that the choice of high-fat variants of common foods such as cheeses and meats was about as fattening as “calories between meals.” However, the answers to their tracking questions did not distinguish high-fat foods from energy intake between meals (Booth *et al*., 2004). In current work we confine reports of customary choices of high-fat foods to mealtimes, since fat intake between meals will be covered sufficiently by "calories between meals." It is important to track distinct eating customs involving high-fat foods because eaters may not recognise differences in fat content or conceive changes in frequency as raising or lowering of fat intake (Booth & Platts, 2000).

Calorie for calorie, fat is liable to be more fattening because little of it needs to be burnt in order to deposit dietary fat into adipose tissue, whereas a considerable proportion of the energy in carbohydrate and protein has to be spent synthesising long-chain fatty acids before deposition of fat. Nevertheless, there may be patterns of eating in which the intake of a modest amount of fat within a main meal may be less fattening than the equivalent energy in starch or sugar -- for example, by reducing the size of the next meal (Sepple & Read, 1990). This hypothesis can only be tested adequately in properly designed tracking of individuals' weight and frequencies of specific eating practices.

Exercise and fatigue

People suffering from chronic fatigue are 'wiped out' by exercising too vigorously or for too long. Resting after exercise by healthy people is not taken into account in research by experiment or questionnaire on the effects of physical activity on energy expenditure. The issue of 'compensation' is the same as for satiety after eating, and indeed eating after exercise (or before in both cases, in anticipation). Even if a rise in energy expenditure persists after the end of vigorous exercise, it could all be compensatied by extra resting, whether mediated by tiredness, deliberate scheduling or unconscious adjustment.

The enABLE*r* design can measure the long-term net effect on energy exchange of a change in frequency of a particular pattern of physical activity as described, carried out and recommendable in the local culture. Furthermore, when other quality of life indicators are added, the contributions of weight loss and increased fitness can be separated (Ross *et al*., 2009).

Prevention of obesity by enABLE services

Prospects for evidence-based communication

In order to prevent someone from becoming obese or to reduce a person's existing obesity, the same scientifically valid and fully applicable information needs to be inculcated into the individual. The lifelong education required is about practices known in the culture that can be changed permanently in that environment in ways which decrease the average rate of energy intake relative to energy expenditure (Crawford, Jeffrey & French, 2000).

This paper has been about generating that evidence -- a demanding task for the basic social and biological sciences with behavioural leadership. If the universities continue to lack the funds to deliver the requisites, the world faces more decades of rising obesity and its costs because of insufficient evidence for individual members of the public to have learnt from childhood to prevent their own unhealthy fattening in the particular circumstances that they encounter.

After a systematic start had been made on enABLE research into self-care, the approach would readily be disseminated. Uniquely, there is no extra scientific work required to turn the findings into evidence-based communications to individuals in any region that has begun to be investigated and in other areas sufficiently like it. A universally accessible and widely used automated system could collect locally relevant data and extract evidence of the antecedents of weight-altering changes in specific eating patterns (Booth & Booth, 2003; Figure 2).

With such a system accessible through widely used mobile and wearable interfaces, the whole enABLE approach could be implemented by the public themselves by informal local diffusion. Evidence-based 'flexible dieting' and exercising could be developed by an increasingly expert public through dynamic databases of 'what works in [their] circ[umstance]s' (Figure 3).

Fundamental research and community service would synergise, rather than competing. Academic investigation would be empathy, not exploitation. By listening properly, services would provide powerfully personalised help. The universities could return to their original mission of combining scholarly openness with nourishing the community.

Priorities among target groups

The current statistics on detriment to physical health from habits known to be unhealthy indicate that education from childhood (by trained parents and teachers) may be even more important for obesity-preventative habits than for sexual activities, traffic safety and uses of psychoactive drugs including alcohol and nicotine. Nevertheless it is pointless to divert money and effort for research and action from adult obesity into childhood obesity, not just because of the weakness of evidence for causal connections in general between unhealthy fatness within individuals as children and adults but also because of the widespread inter-generational transfer. Poor weight control in a primary carer in early childhood may promote obesity in the youngster at that time, in adolescence or as an adult, who may in turn care for a child, perpetuating the cycle.

Thus, as with smoking, the primary focus for prevention needs to remain on stopping the fattening behaviour in early and middle adulthood. Physical activity is most liable to decline rapidly between the teens and the 30s, particularly in office workers (Viner & Cole, 2006). So the initial prime target of enABLE is a wide sociodemographic range of young adults. Once established in such groups, the approach to research, services and evidence-based educational facilities can be extended both to children and also to later adulthood.

Roles of public and commercial service professionals

The enABLE system's users could permit access to their individual information by a professional developer who is registered to supply advice or material support such as food, medication, domestic or office facilities, transport or office buildings. Professional practitioners could direct their existing support into the requisite locally evidence-based self-educational mode. It is crucial that users of the system own the whole of it, not just their own personal data, with management by independent research teams, not by governmental or commercial health or education services.

From many developments in the market, we know that an evidence-educated public would increase demand for foods that are put to actually healthy uses within a personal mix of eating at home and eating out, facilities for walks and cycling that fit into busy lives, safe and pleasant stairways, and so on. Enterprising commercial providers identify new prospects and design modified or new products to meet a growing beneficial demand, especially if they want a long-term good image for their company and brands. Commercial and public development policies can be informed by anonymised enABLE evidence bases (Figure 3), instead of the decades of ill advised regulations that cultivated misleading and counterproductive claims about fat and sugar content or incentives to slim fast as part of 'calorie-controlled diet' (Booth *et al*., 1981, 1988b) or now even by inducing 'satiety' (Booth & Nouwen, 2010).

Prevention of obesity in chronic disease

In addition to the benefits to those in good health, evidence-based weight control would be a major advance in the medical management and education in self-care of a substantial proportion of those suffering from chronic disease, whether or not obesity was a contributory factor in each case. Examples include type 2 diabetes, where the lack of permanent effect of state-of-the-art advice on diet and exercise has led to removal of weight loss targets from disease management programmes. If locally evidence-based avoidance and reversal of unhealthy weight gain were available, it would be important too in rehabilitation after a heart attack or a stroke and in management of immobilising lower back pain, osteoarthritis or rheumatoid arthritis of the hip or knee, as well as in primary prevention of certain cancers.

More productive use of professional time and experience than mere disease education would be to guide groups of patients into using their own expertise. A group can be run or can run themselves so that they generate evidence on changes in everyday individual behaviour that ameliorate adverse symptoms and even improve the physical condition. Members of a single group living within the same culture can run a fully effective pilot research project on their own data over a sufficient period of time. Moreover, each group's project can be strengthened by sharing evidence with other groups. If an enABLE service were available over the internet, each stage of this self and group experimentation would be greatly enhanced and could also be volunteered to strengthen the main evidence base.

Indeed, a few data from patients can provide a key basis for research professionals to build stronger assessment instruments (e.g. Goodchild *et al.,* 2008) and evidence-based self-care (cp. a pilot study by Goodchild *et al*., 2004). If service professionals understood the proposed research design, an internet system that permitted the correct ways of sharing of data between groups and using the database would be one of the best ways of building the automated research and intervention system outlined above.

A major opportunity to move in this direction was missed when the concept of "expert patients" was introduced into the UK health services (Department of Health, 2005). Unfortunately research into such groups has focused on the easy task of showing that membership of such a group makes a sufferer feel better empowered and has largely neglected the prior issue of the efficacy of the group by using its own expertise in reducing symptoms, improving functions and slowing or even reversing deterioration of tissues. As a result, health services took the cheap route of setting up groups of patients to be educated in professional expertise concerning their disease and opinions on self-care that have not been shown to improve symptoms or pathogenesis, with RCTs run only on the satisfaction of patients with that addition to the service.

Envoi

Once this integrated approach to research begins to be implemented, all the above options open up. If the approach were implemented in an automated system for research and service communication and education over the internet, its facilities would be driven by usage. The enABLE system need not be constrained by geography or language. No fundable category of user need be excluded – members of the general public, the users of a particular communications network or interface, or practitioners who are given access by their clients, customers or patients.

In short, there is a theoretically global solution to the geographically global problem of obesity.

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Captions to Figures

Figure 1. The creation and distribution of evidence on customs that improve welbeing in the enABLE*r/s* system (Booth, 1988b, 1998, 1999, 2002).

Figure 2. The evidence-generating and evidence-delivering loop in enABLE***r*** that is achievable though computations communicating over the internet (Booth & Booth, 2003). C-ICT: computational information-communication technology ('kicked into Life').

Figure 3. Dynamic evidence-bases from enABLE research delivering services to members of the public and to practitioners who provide to the public (Booth, 2002; Booth & Booth, 2003).

Figure 1

The **enABLE*r/s*** system

evidence-**n**etworking
evidence-*producing* & evidence-*generating*
individual differences secure, anonymised

Application
databases for
research & service

for **B**etter **L**iving
all QoL outcomes

Education
information
personally tailored
in culture's own terms

r*esearch*
universities-
based

s*ervices* *to*
individual members of the public
& professionals in their practice

Figure 2

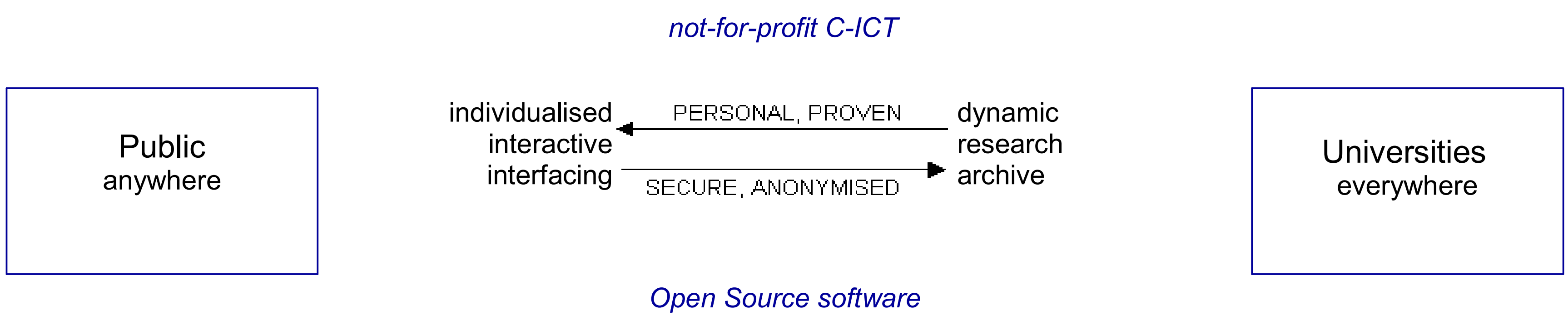
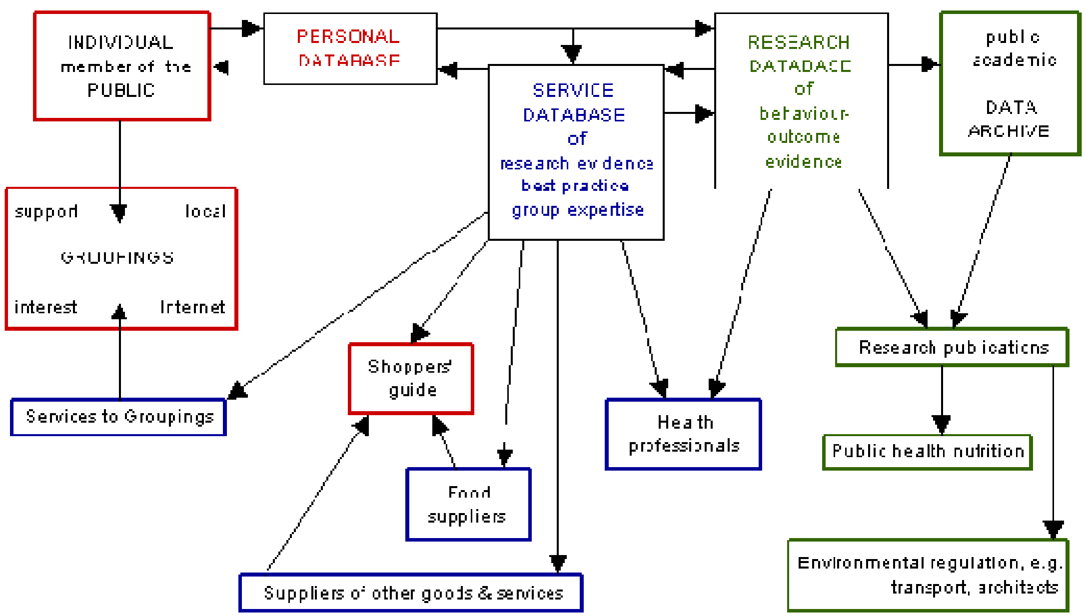

not-for-profit C-ICT
Public
anywhere
individualised
interactive
interfacing
PERSONAL, PROVEN
SECURE, ANONYMISED
dynamic
research
archive
Universities
everywhere
Open Source software

Figure 3


INDIVIDUAL member of the PUBLIC
PERSONAL DATABASE
SERVICE DATABASE of research evidence best practice group expertise
RESEARCH DATABASE of behaviour-outcome evidence
public academic DATA ARCHIVE
support local GROUPINGS interest Internet
Services to Groupings
Shoppers' guide
Food suppliers
Suppliers of other goods & services
Health professionals
Research publications
Public health nutrition
Environmental regulation, e.g. transport, architects