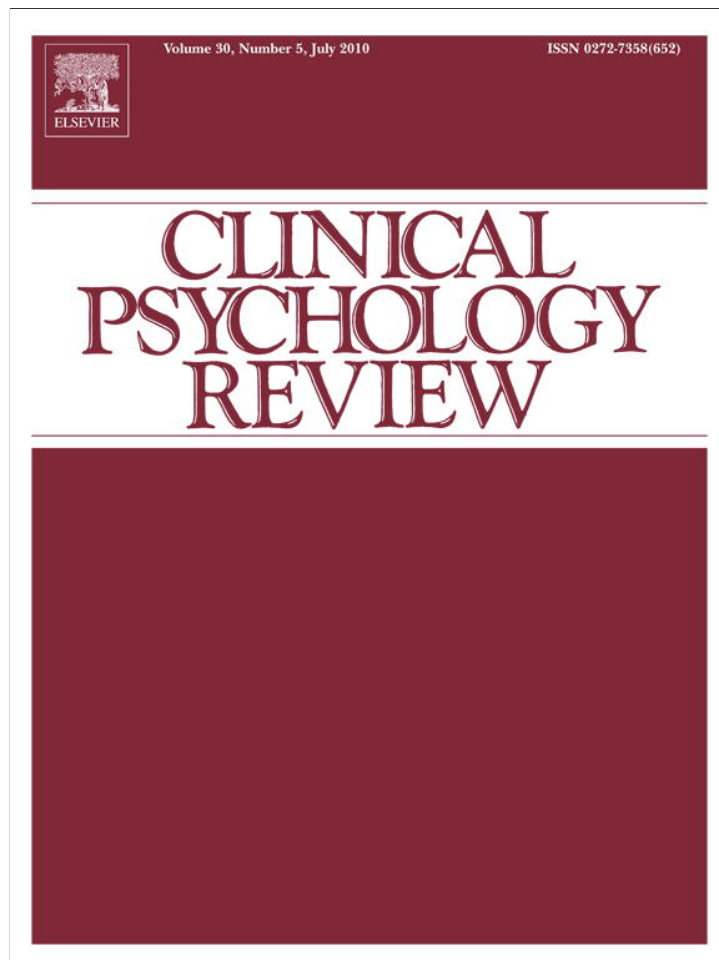


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A critical review of assessment strategies to measure the behavioral activation model of depression

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ABSTRACT

Behavioral activation (BA) treatments for depression are based on a model of psychopathology indicating that losses of, reductions in, or chronically low levels of positive reinforcement produce behavioral and emotional changes in depression. The corresponding mechanism theory is that using BA techniques to increase activation will lead to a subsequent increase in positive reinforcement, which will decrease depressive symptoms. We attempt to review BA literature relevant to its psychopathology and mechanism models, paying particular attention to attempts to measure activation as conceptualized within BA treatments and attempts to measure reinforcement. Suggestions on ways in which to improve these measurements in order to better evaluate the psychopathology and mechanism models are provided.

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1. Attempts to measure activation as conceptualized within behavioral activation treatments

Behavioral activation (BA) as a treatment for depression has a long history. Several past (Fuchs & Rehm, 1977; Gallagher & Thompson, 1981; McLean, 1976; Zeiss, Lewinsohn, & Muñoz, 1979) and current (Lejuez, Hopko, & Hopko, 2002; Martell, Addis & Jacobson, 2001) variants of BA have been developed and demonstrated efficacy compared to both no-treatment control groups and other active treatments (Cuijpers, van Straten, & Warmerdam, 2007; Ekers, Richards, & Gilbody, 2008). In fact, a comprehensive meta-analysis of BA treatments and analysis of findings in terms of the standards of the American Psychological Association's Division 12 Task Force on Promotion and Dissemination of Psychological Procedures (Chambless et al., 1998; Task Force on Promotion and Dissemination of Psychological Procedures, 1995) concluded that the collective evidence for BA satisfies the Task Force's criteria for designating BA as a "well-established empirically validated treatment" (Mazzucchelli, Kane & Rees, 2009). Furthermore, although this remains an untested assertion, several authors (Hollon, 2000; Kanter, Busch, & Rusch, 2009; Mazzucchelli et al., 2009; Sturmey, 2009) assert that BA's simplicity, ease of training and dissemination, and suitability for a broad range of populations may give it an advantage over other empirically validated treatments for depression in terms of overall reach and public health significance.

How BA works, however, is much less clear. Identifying BA's mechanism of action is important for developing strategies for treatment nonresponders specifically and improving the intervention broadly, as well as for improving training and dissemination efforts (Mazzucchelli et al., 2009). Underlying efforts to identify BA's mechanism of action are prerequisite efforts to clearly articulate BA's related theories of the *psychopathology* of depression and its hypothesized treatment *mechanism* and the development of measures that assess the key constructs in these models reliably and validly. Identifying, describing and evaluating existing measures in terms of BA's theories of psychopathology and mechanism will be the emphasis of this article.

This article first will review the history of BA treatments that have been developed and evaluated in clinical trials. Because extensive reviews (Kanter et al., 2009; Martell et al., 2001; Mazzucchelli et al., 2009) and meta-analyses of BA efficacy are available elsewhere (Cuijpers et al., 2007; Ekers et al., 2008; Mazzucchelli et al., 2009), this review will be brief and focus on the models of psychopathology and mechanism proposed by BA variants over the years. Next, these models of psychopathology and mechanism will be summarized. This will be followed by a review of measures relevant to the key processes of behavioral activation in the context of both psychopathology and treatment mechanism. Research implications and future directions are then discussed.

1.1. A brief history of behavioral activation

Behavioral theories often focus on reinforcement contingencies that shape and maintain dysfunctional behavior. In the case of depression, early writers emphasized the removal of reinforcement and the resulting reductions in behavior (Ferster, 1973; Skinner, 1953). Lewinsohn's (1974) early reinforcement deprivation psychopathology model suggested that negative affect and behavioral reductions seen in depression are produced by losses of, reductions in or chronically low levels of response-contingent positive reinforcement (RCPR). Lewinsohn suggested that RCPR was a function of three factors: (1) differences in what is reinforcing to different individuals, (2) the availability in the environment of what is reinforcing to a particular individual, and (3) the individual's level of skill necessary to obtain and maintain contact with that reinforcement. Essentially the theory was that reduced RCPR produces the behavioral reductions seen in depression through operant extinction schedules. Less emphasized, but also important, was that reduced RCPR produces depressed mood through respondent reactions; i.e., the depressed mood is automatically elicited in response to the reduced RCPR. This theory led Lewinsohn and his colleagues (e.g., Lewinsohn & Libet, 1972; Zeiss et al., 1979) to develop a treatment based on pleasant events scheduling to increase contact with RCPR. Lewinsohn's early approaches also included skills training to increase skill at obtaining and maintaining reinforcement (Lewinsohn, Biglan, & Zeiss, 1976; Lewinsohn, Weinstein, & Alper, 1970).

In the 1970s and 1980s a variety of treatments were developed that were based on variants of this reinforcement deprivation model and included activity scheduling and additional techniques (Gallagher & Thompson, 1981; Graf, 1977; Lewinsohn et al., 1970, 1976; McLean, 1976; Zeiss et al., 1979). The mechanism models of these approaches vary but generally are consistent with the notion that increases in overall activity related to pleasant events will increase contact with RCPR which will reduce depressive mood and other depressive symptoms.

Despite substantial empirical support for these behavioral techniques (Cuijpers et al., 2007; Ekers et al., 2008; Mazzucchelli et al., 2009), Lewinsohn (e.g., Lewinsohn, Muñoz, Youngren, & Zeiss, 1978) and others moved away from a strict behavioral conceptualization of depression as the cognitive revolution took hold in the 1970s and 1980s. Activity scheduling was incorporated into cognitive therapy (Beck, Rush, Shaw, & Emery, 1979) and subsumed into a cognitive model in which behavioral techniques were employed in the service of cognitive change (e.g., behavioral experiments to challenge dysfunctional thoughts), typically at the beginning of treatment.

Interest in BA models of psychopathology and mechanism was renewed by the component analysis of CT by Jacobson and colleagues that found that the strictly behavioral techniques of CT, when used

throughout treatment without additional cognitive interventions, performed equivalently to the whole CT package at post-treatment (Jacobson et al., 1996) and at two year follow-up (Gortner, Gollan, Dobson, & Jacobson; 1998). In response to these findings, two treatments based on BA strategies were developed: BA by Martell et al. (2001) and Behavioral Activation Treatment for Depression (BATD; Lejuez et al., 2002).

Similar to earlier behavioral interventions, Martell et al.'s (2001) BA is based on the psychopathology model that losses of or chronically low levels of positive reinforcement produce some depressive symptoms. To address this, and consistent with how behavioral techniques were employed in CT, the scheduling of activities to increase contact with reinforcement is the primary goal of treatment. Therapists work toward this goal using strategies such as daily activity monitoring, activity scheduling, and a variety of strategies designed to increase the likelihood of successful activation including cognitive rehearsal of assigned behavior, stimulus control procedures, contingency management, role playing and skills training (Martell et al.; Kanter, Busch et al., 2009; Kanter, Rusch, et al., 2009). Unlike earlier behavioral treatments, however, BA emphasizes an idiographic, functional approach in which activation assignments are tailored to the client, based on individual functional analyses and client goals, and there is less emphasis on activities that are simply pleasant.

Also unlike earlier behavioral treatments and CT, BA adds to the psychopathology model increased attention to the role of negative reinforcement in depression. Specifically, BA emphasizes that the depressed environment is characterized by excessive aversive stimuli (punishers and negative reinforcers) as well as decreased positively reinforcing stimuli. BA characterizes depression as a cycle in which these aversives, as well as the negative affect resulting from decreased positive reinforcers, result in repeated, excessive attempts to avoid and escape the aversives and negative affect. Avoidance leads to short-term relief, thus strengthening the behavior, but the individual moves no closer to solving the problems that may have led to the depression and may create new ones. Thus, a cycle is created in which individuals continue to engage in avoidance with an ever-increasing likelihood of experiencing additional negative events.

In response to this new model, Martell et al.'s (2001) BA incorporates strategies to assess avoidance and tailored techniques to activate in the presence of competing avoidance contingencies, and increase problem solving and tolerance of negative affect. Specifically, clients are taught how to identify avoidance patterns and alternate coping behaviors (adaptive ways of responding when they would usually engage in an avoidance behavior) as they occur. Emphasis is

placed on monitoring events and affective responses that precede avoidance behaviors so that these events and responses can be used as prompts for coping strategies. BA, therefore, attempts to extinguish avoidance behaviors and shape alternate behaviors that will be more likely to lead to positive reinforcement.

BATD (Lejuez et al., 2002) employs a psychopathology model that starts with Lewinsohn's original notion as well but expands it based on matching theory (Hernstein, 1970; McDowell, 1982), which, when applied to depression, emphasizes that positive and negative reinforcement for both depressed and non-depressed behavior must be taken into account. Specifically, matching theory suggests that the frequency of depressed behaviors compared to non-depressed behaviors is proportional to the reinforcement value of depressed versus non-depressed behavior (Lejuez, Hopko, LePage, Hopko, & McNeil, 2001; Lejuez et al., 2002). Therefore, BATD aims to decrease the value and availability of reinforcers for depressed behavior and increase the value and availability of reinforcers for non-depressed behavior (Lejuez et al., 2002). In order to accomplish this, BATD adds to traditional activity scheduling an emphasis on behavioral contracting with the client's friends and family to decrease access to positive reinforcement (e.g., attention) and negative reinforcement (e.g., escape from household tasks) for depressed behavior and increase reinforcement for non-depressed behavior. In BATD, activity scheduling is based on monitoring daily activities and an assessment of client values. The formal assessment of client values occurs early in BATD and is another distinction with BA by Martell et al. (2001; see Hopko, Lejuez, Ruggiero, & Eifert, 2003, for a full comparison of BA and BATD).

2. BA's models of psychopathology and mechanism

BA's models of psychopathology and mechanism are summarized in Fig. 1. The psychopathology model describes relations between reinforcement, mood, behavior, and depression. As per behavioral tradition, the model starts with changes in Reinforcement contingencies. Specifically, decreased positive reinforcement (symbolized as "R+") for healthy behavior leads to depressed mood and decreased activation behavior. "↑ negative reinforcement" (R-) is added to highlight the process emphasized by Martell et al. (2001) and "↑ R+ for depressed behavior" is added to highlight the matching law considerations of Lejuez et al. (2001). Both are added in parentheses to maintain the primacy of reduced positive reinforcement to the model. The model assumes that the functional environmental processes (subsumed under Reinforcement) have an immediate effect on mood and together these

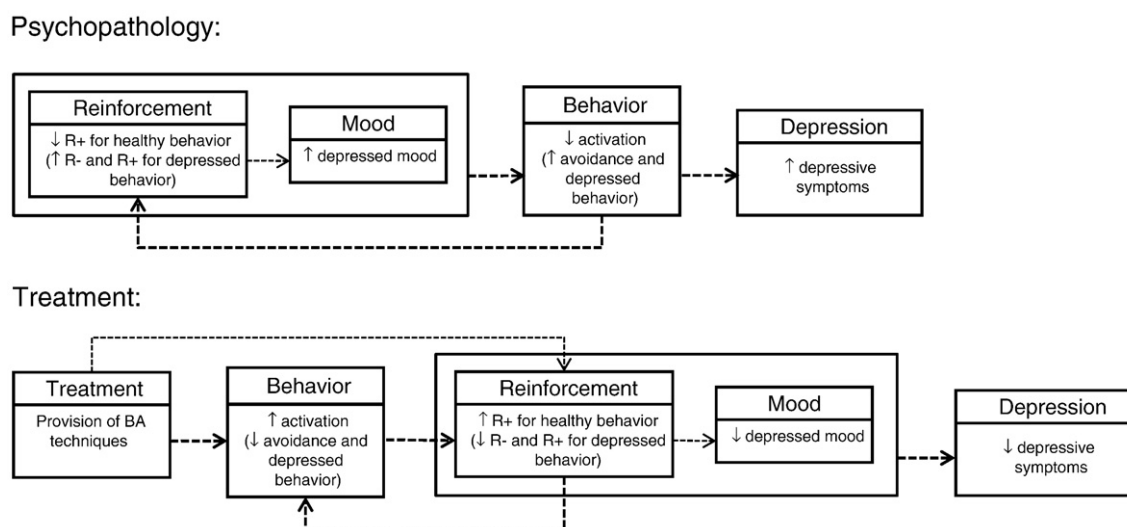


Fig. 1. BA's psychopathology and mechanism models.

environmental and mood changes extinguish healthy behavior previously maintained by the lost reinforcers, evoke depressed behavior maintained by new positive reinforcers, and evoke avoidance behavior maintained by negative reinforcers. Avoidance behavior includes covert behavior such as rumination as per Martell et al. (2001).

In Fig. 1, a cycle is represented in which the behavioral changes lead to more changes in reinforcement contingencies, which in turn increases depressed mood and the likelihood that the behavior will continue, creating a vicious cycle into deeper and deeper depression. For example, a woman loses her job (\downarrow positive reinforcement) and experiences increased depressed mood (arrow from *Reinforcement* to *Mood*). In response to this, she stops socializing (arrow from *Reinforcement/Mood* to *Behavior*) which has the unfortunate effect of decreasing positive social reinforcement further (arrow from *Behavior* back to *Reinforcement*) and increasing her depressed mood (arrow from *Reinforcement* to *Mood*). Both Martell et al. (2001) and Lejuez et al. (2001) emphasize this vicious cycle.

This cyclical sequence essentially completes the psychopathological model of depression according to BA and it is important to note that this cycle is what leads to *Depression*. The depressive syndrome includes the mood and behavior changes established earlier in the cycle but also includes additional emotional, behavioral, somatic and cognitive symptoms (e.g., maladaptive thought patterns). The full syndromal response is distinguished from single episodes of reinforcement loss that lead to transient responses of sad or depressed mood (the arrow from the *Reinforcement* to *Mood*), which, independent of the cycle of depression, are seen as normal and not pathological (Kanter, Busch, Weeks, & Landes, 2008).

The treatment model starts with provision of BA techniques (*Treatment*), the immediate goal of which is to increase activation behavior while decreasing avoidant and depressed behavior (*Behavior*) and restore an environment characterized by diverse and stable sources of positive reinforcement (*Reinforcement*). Although most BA techniques target behavior directly, some techniques target the environment directly (e.g., contracting with family members), represented by a smaller arrow from *Treatment* to *Reinforcement*. BA techniques are less likely to target the mood directly but it is expected that mood changes will occur following behavior that elicits positive reinforcement. As healthy behavior produces changes in reinforcement contingencies, these reinforcement processes feedback to increase the behaviors that produced them, reversing the cycle of depression. This is an important component of the model in terms of relapse prevention. While single episodes of improved behavior may improve mood relatively quickly, according to the model the environmental reinforcement processes for healthy behavior must be stable and in place to prevent relapse.

Several additional comments about this model are needed. First, the *Reinforcement* box in the Psychopathology diagram is a simplification and does not address the myriad influences on what is perceived and experienced as reinforcing. *Reinforcement* represents in functional terms a diverse topography of environmental events related to depression, such as negative life events (Billings & Moos, 1984a; Kessler, 1997; Mazure, 1998; Monroe & Depue, 1991; Paykel, 2003; Paykel & Hollyman, 1984), decreases in marital satisfaction (e.g., Whisman, 2001), chronic life strains (Billings & Moos, 1984b; Brown & Harris, 1978), and poor social support networks (e.g., Billings, Cronkite, & Moos, 1983; Brown & Harris, 1978; Costello, 1982), to name just a few.

The important assertion of BA is not that these myriad factors are relevant to depression—that they are is undisputed—but that a reduction in positive reinforcement is the theoretical mechanism of interest characterizing how these events result in clinical depression. Thus BA characterizes these events in functional terms. In fact, the model suggests that many functional environmental processes can result in reduced positive reinforcement and the current depiction is not an attempt to model this complexity. In addition to increased negative reinforcement, which is highlighted, these processes include in-

creased punishment, satiation, reinforcement erosion, skills deficits, and a lack of or excessive rule governance (Kanter, Cautelli, Busch, & Baruch, 2005). Lewinsohn's three factors that influence RCPR are also relevant here. Essentially, adding any or all of these factors to the model would involve tracing the causal chain back into the history of the individual and looking at the idiographic factors (including cognitive, biological and genetic factors) that resulted in the current state of reduced positive reinforcement. According to BA, each individual's history here will be different and the process will not be easy to describe in model form.

Second, *Reinforcement* and *Mood* are grouped together within a larger box to denote that these two processes will co-occur temporally and be difficult to disentangle in measurement attempts. Simply put, when reinforcers are lost, individuals feel bad. Technically, the mood reaction is seen as a respondent byproduct of the change in contingencies (Kanter, Busch, et al., 2008; Kanter, Busch et al., 2009; Lewinsohn, 1974). Including mood as part of the model is important, especially to Martell et al. (2001), who suggest that often the behavior of the depressed individual is in the service of escaping from or avoiding emotional reactions (*Mood*) to the change in contingencies rather than to addressing the contingencies themselves (*Reinforcement*). It is also important because, as will be discussed below, some attempts to measure reinforcement processes have relied on measuring changes in mood as proxy indicators in the absence of feasible strategies for measuring reinforcement directly. The behavioral response to the change in contingencies, unlike the emotional response, is not automatic and may be temporally distinct, thus it is not included in the box with *Reinforcement* and *Mood*.

3. Attempts to measure activation

The *depression* and *treatment* components of the models are outside the scope of this review. Many options for measuring depression exist and may be consulted for an overview (e.g., Cusin, Yang, Yeung, & Fava, 2010; Hopko, Lejuez, Armento, & Bare, 2004; Nezu, Ronan, Meadows, & McClure, 2000). Likewise, measuring the provision of treatment techniques in BA is an interesting and important area and guidelines for doing so have been published (Moncher & Prinz, 1991) including discussion in the context of BA treatments (Waltz, Addis, Koerner, & Jacobson, 1993). Here we focus on measuring the relations between behavior, mood and reinforcement which are presumed to be affected by treatment techniques and underlie the experience of depression. In this context, a key question that researchers have wrestled with is whether frequency of behavior, experience of reinforcement or both should be incorporated into measurement attempts. Choosing to focus on either of these aspects of the activation process raises several issues reviewed below.

If one chooses to focus on the frequency of behavior, what is the nature of the behavior that should be measured? Is it important to obtain a measure of general overall activity level or breadth of behavior, or should more specific, targeted behaviors be the focus? It may also be important to capture activation attempts that occur in situations when normally they would not (e.g., "Despite feeling tired, down, and wanting to stay in bed, I got up and went to work."). Most current BA researchers agree that it is important to describe the behavior functionally (e.g., is the behavior actually functioning to produce contact with positive reinforcement or is it functioning as avoidance of a more important or meaningful task?) rather than topographically (e.g., going to the movies; Hopko, Lejuez, Ruggiero, & Eifert, 2003; Martell et al., 2001), but this produces a host of measurement complications as it precludes the use of simple lists of activities and confounds the measurement of behavior with the measurement of contact with reinforcers. Furthermore, some have suggested that it is important to consider behavior that is consistent with the client's values or goals (Gaynor & Harris, 2008; Lejuez et al., 2002). As will be seen below, most attempts to measure behavior in

BA research have focused on activation behavior to be increased rather than avoidance behavior or depressed behavior to be decreased.

If one chooses to measure reinforcement (positive or negative), and loss thereof, it raises a host of tricky issues. Reinforcement is defined as a process: Traditional functional analysis measures positive reinforcement as the change in rate of behavior over time contingent upon the presentation of certain stimuli; if the behavior changes then one can say that the stimuli presented have been identified as positive reinforcers. This logic is sound, but impossible to apply to the current situation as it requires a relevant measure of behavior (see paragraph above), control over the subject's environment, and long periods of observation. Instead, most measures have either not tried to measure the process of reinforcement at all, or tried to measure it by measuring variables hypothesized to be indicators or proxies of the process. These variables include pleasant events and mood changes associated with these events. There are strengths and weaknesses associated with each of these attempts, which will be discussed.

In order to find relevant measures of key BA processes, a literature search using PsychInfo was conducted using the search terms "Behavioral Activation", "Activity Scheduling AND Depression", "Pleasant Events", and "Lewinsohn." When searching, articles were examined for scales that were used in studies of behavioral approaches to depression treatment in order to assess the process of change in activation/avoidance or changes in reinforcement. This search identified all measures presented below. Specific measures were then entered as search terms to identify studies that incorporated those measures. In the following sections, each measurement attempt will be discussed in terms of the nature of the behavior being measured, how the scale addresses reinforcement processes, and research findings relevant to BA's psychopathology of depression and treatment mechanism models. See Table 1 for a review of the main measurement attempts discussed below.

3.1. Activity monitoring, activity schedules, and home observations

In early BA research, attempts to measure activation were integrated with the treatment itself in the form of daily diaries (Lewinsohn & Atwood, 1969), activity schedules (Lewinsohn & Libet, 1972), and home observations (Lewinsohn & Atwood, 1969; Lewinsohn & Shaffer, 1971). Daily diaries consisted of daily schedules on which participants recorded and rated activities engaged in and people with whom time was spent (Lewinsohn & Atwood, 1969). Early forms of activity schedules consisted of having clients mark the occurrence of specific pleasant events each day for several months (e.g., Lewinsohn & Libet, 1972). The specific events chosen were often those rated most pleasant by the client on the Pleasant Events Schedule (MacPhillamy & Lewinsohn, 1982). With both diaries and schedules, clients were often asked to provide mood ratings (e.g., Lewinsohn & Atwood, 1969; Lewinsohn & Libet, 1972) or more specific ratings of experiences of mastery (or, similarly, reward value) and pleasure while engaging in the activity (e.g., Armento & Hopko, 2007; Beck et al., 1979). Home observation methods (e.g., Lewinsohn & Atwood, 1969; Lewinsohn & Shaffer, 1971; McLean, 1976) included observing the client in his or her home and coding for the occurrence of specific interpersonal actions emitted by the client and reactions from others elicited by the client.

3.1.1. Nature of behavior measured and measurement of reinforcement

These strategies allowed for measurement of both specific events presumed to be reinforcing and specific behaviors leading to contact with reinforcing events, depending on the instructions given to participants (and coders) and how the results were interpreted. In fact, the two variables (behavior and reinforcing event) often are somewhat confounded, an issue with the Pleasant Events Schedule (PES) as well, discussed next. For example, a behavior that could be

listed on an activity schedule or daily diary (and one represented on the PES), "playing with grandchildren," also directly refers to the potential reinforcers (feedback from and interaction with the grandchildren while playing with them). The dual, confounded purposes of these strategies were noted early by Lewinsohn and Libet (1972):

We have become increasingly impressed with the clinical utility of activity schedules as a technique for (a) assessing what events or activities are potentially reinforcing for the patient, (b) focusing for the patient his low rate of emitting the behaviors which are positively reinforcing for him, (c) defining an increase in such activities as an explicit goal for treatment; and (d) objectively measuring behavior change (p. 291).

In most research using these strategies, the focus was on interpreting the data as indicative of reinforcement rather than behavior. In the case of home observations, an observer in theory could evaluate later instances of behavior and assess reinforcement in the more traditional, behavior analytic manner; however, more often reported were immediate reactions to client behavior by family members that were assumed to be reinforcing or punishing (e.g., Lewinsohn & Shaffer, 1971).

As indicators of reinforcing events, these strategies were quite specific and idiographic, strengths in terms of capturing the rich experience of the individual but weaknesses in terms of comparing data across participants. The strategies provided detailed information on specific activities engaged in by the client although some (particularly activity schedules based on specific activities from the PES) did limit the types of activities that could be reported. More recent versions of activity schedules have the advantage that they allow for any activities engaged in to be reported without limiting the client to specific options. Home observations provided a much more detailed account of activities in a short time period, whereas activity monitoring usually provided hour-by-hour accounts of general activity across longer time periods. As indicators of behavior, schedules and diaries allow clients to record all behaviors, topographically defined, over a specified time period or to record specific behaviors of interest tied to a case conceptualization (e.g., sleeping, completing schoolwork, and gardening).

Mood, mastery and pleasure ratings have been used in conjunction with behavioral records such as diaries or schedules to increase the validity of these strategies as indicators of reinforcement in lieu of more detailed, functional analyses of reinforcement following specific activities. This was a key strategy of the PES, discussed next, but also applies to daily diaries and schedules in many cases. In all of these cases, from the perspective of Fig. 1 the assessment of reinforcement is further confounded with the assessment of mood.

The traditional concern with activity monitoring and activity scheduling as assessment strategies is that they result in data that are not easily comparable across individuals and therefore are not as useful when conducting nomothetic research that seeks to characterize the behavior of groups of individuals rather than individuals. Nonetheless, they continue to function as clinical tools for the BA clinician and are incorporated into most variants of BA (Gaynor & Harris, 2008; Kanter, Busch et al., 2009; Lejuez et al., 2002; Martell et al., 2001). Home observations approached the single-subject methodology ideal, in that the data were produced by trained, reliable observers, rather than self-report. However, this method required a significant time commitment by the client, therapist and the treatment team and did not produce a large body of research.

3.1.2. Research findings

Most research investigating the links between activity levels and depression has not incorporated these early strategies, although some of the early research utilizing home observations examined these relationships more intricately. Lewinsohn and Atwood (1969)

Table 1
Description of primary measures with pros and cons.

| Measure | Description | Pros | Cons |
|--|--|---|--|
| Activity monitoring, activity schedules, and home observations | With activity monitoring and activity schedules, individuals write their activities (usually on an hour-by-hour basis) and sometimes provide ratings of mood, pleasure, mastery or reward value for each activity. With activity schedules, specific activities defined by the case conceptualization may be added. For home observations, specific actions may be recorded and coded later based on the case conceptualization. | <ul style="list-style-type: none"> • Specific and ideographic • Mood, mastery or pleasure ratings increase validity of these methods as indicators of reinforcement • Home observations better for tracking behavior over time • Provides research support for link between types of events and ratings of reward or pleasure associated with those events and depression (psychopathology) • Provides research support for link between changes in behavior and changes in depressive symptoms over the course of treatment (mechanism) | <ul style="list-style-type: none"> • Not easily comparable across individuals • Home observations very time intensive |
| Pleasant Events Schedule (PES) | Developed as a measure of response-contingent positive reinforcement (RCPR). Contains a list of 320 pleasant events that respondents rate in terms of frequency of occurrence in the past month and obtained pleasure over the past month. Also yields a cross-product of these two scores. | <ul style="list-style-type: none"> • Large body of research over several decades • Provides research support for the link between pleasant events and decreased depressive symptoms (psychopathology) • Mostly supportive of mechanism model in that changes in frequency and pleasure associated with pleasant events corresponded with changes in depressive symptoms over the course of treatment (mechanism) | <ul style="list-style-type: none"> • Mood confounded with event occurrence • Assumes that reinforcing events will be experienced as pleasurable • Does not account for negative reinforcement • Time intensive • Very specific items—possible that respondent is engaging in other pleasant activities • Some studies not supportive of mechanism model |
| Unpleasant Events Schedule (UES) | Developed as a measure of response-contingent punishment and negative reinforcement. Contains a list of 320 unpleasant events that respondents rate in terms of frequency of occurrence of the past month and aversiveness over the past month. Also yields a cross-product of these two scores. | <ul style="list-style-type: none"> • Large body of research over several decades • Provides research support for the link between aversive events and depression (psychopathology) • Provides research support for changes in frequency and aversiveness of unpleasant events corresponding with changes in depressive symptoms over the course of treatment (mechanism) | <ul style="list-style-type: none"> • Mood confounded with event occurrence • Difficulty measuring negative reinforcement and punishment distinct from the behaviors required to produce this and the moods elicited by these activities • Time intensive • Very specific items—possible that respondent is engaging in other unpleasant activities |
| Interpersonal Events Schedule (IES) | Developed as a measure of contact with pleasant and aversive interpersonal events. Contains a list of 160 interpersonal events that respondents rate in terms of frequency of occurrence in the past month and how they felt when each event occurred over the past month. Also yields a cross-product of these two scores. | <ul style="list-style-type: none"> • Provides research support for the link between interpersonal events and depression (psychopathology) • Provides research support for changes in IES subscales relating to changes in depressive symptoms over the course of treatment (mechanism) | <ul style="list-style-type: none"> • Mood confounded with event occurrence • Difficulty measuring positive or negative reinforcement and punishment apart from the behaviors required to produce this and the moods elicited by these activities • Time intensive • Very specific items—possible that respondent is engaging in other interpersonal events • Problems with interpretability of negative subscales |
| Behavioral Activation for Depression Scale (BADS) | Developed as a measure of activation and avoidance behaviors relevant to BA treatments. Contains 25 items across four subscales: Activation, Avoidance/Rumination, Work/School Impairment, and Social Impairment. Respondents rate items based on the past week. | <ul style="list-style-type: none"> • Measures frequency of activation, escape, and avoidance behaviors hypothesized to be important for BA mechanism research • Assesses activation generally and therefore is not constrained to specific behaviors • Research supports link between avoidance and depression that is stronger than link between activation and depression (psychopathology) • Support for changes in activation and avoidance corresponding with changes in depression over course of treatment (mechanism) | <ul style="list-style-type: none"> • Some items also include reinforcement or mood components • Limited research thus far |
| Environmental Reward Observation Scale (EROS) and Response Probability Index (RPI) | Developed as measures of extent (EROS) or probability (RPI) of RCPR experienced over the past several months | <ul style="list-style-type: none"> • Does not measure specific activities but more broadly assesses for contact with RCPR • Provides research support for link between RCPR and depression (psychopathology) • Provides some support for link between changes in depression over the course of treatment and changes in RCPR although not assessed weekly (mechanism) | <ul style="list-style-type: none"> • Relies on mood as proxy for experience of RCPR • Reference period makes it difficult to use over the course of treatment • Limited research thus far |

described a case study focused on improving the client's interactions with her husband, improving her social network outside of the home, and increasing meaningful and rewarding activities outside of the home. By the end of treatment, the client evidenced changes on measures of depression and changes were also noted during home observations.

Lewinsohn and Shaffer (1971) used home observations to examine rates of reinforcement in five depressed clients. Interactions between spouses were coded including behaviors emitted by the client and the social consequences of those behaviors. They found that all five clients were characterized by a low rate of positive reinforcement for positive behaviors and that this was tied to the nature, and not amount, of activity.

Hopko and colleagues (Hopko, Armento, Cantu, Chambers, & Lejuez, 2003; Hopko & Mullane, 2008) investigated the psychopathology model through daily diary studies, using mood ratings as a proxy indicator of reinforcement for healthy behavior. Hopko et al. (2003) first compared mildly depressed college students to non-depressed individuals with respect to engagement in behaviors rated as rewarding or pleasurable. They found that self-reported depressive symptoms were related to less engagement in activities rated as rewarding or pleasurable, and that individuals who reported increased depressive symptoms over the course of a week also reported engaging in significantly more activities rated as having low immediate reward value. Hopko and Mullane (2008) also used daily diaries to compare mildly depressed to non-depressed individuals in terms of differences in type of behaviors in which they were engaging. They found that, compared to non-depressed individuals, mildly depressed individuals were engaging less frequently in social, physical, and educational behaviors and more often in activities related to employment.

Gaynor and Harris (2008) provided some evidence for BA's mechanism model, specifically the link between changes in behavior and changes in depression over the course of treatment, in a single-subject design in which activation behaviors were measured weekly over the course of therapy using a diary card format for four teens. Data for two participants was consistent with activation as the active mechanism of action of treatment, with changes in self-reported activity level preceding and predicting changes in depression over time.

3.2. Pleasant Events Schedule (PES)

The PES (MacPhillamy & Lewinsohn, 1974; MacPhillamy & Lewinsohn, 1982), developed as an attempt to measure RCPR, has been the primary strategy for measuring reinforcement in BA over the years. In fact, it has been used for a variety of purposes, including examination of activities engaged in by elderly individuals (McKee, Houston, & Barnes, 2002; Sallis, 1983), including those within nursing homes (Meeks, Shah, & Ramsey, 2009) and those with dementia (LeBlanc, Raetz, Baker, Strobel, & Feeney, 2008; Logsdon & Teri, 1997; Searson, Hendry, Ramachandran, Burns, & Purandare, 2008; Teri & Logsdon, 1991), and examination of activities engaged in or reinforcement experienced by drug abusers (Correia, Carey, & Borsari, 2002; Rogers et al., 2008; van Etten, Higgins, Budney, & Badger, 1998). To facilitate this research, variations of the PES have been created, including a form of the PES for the elderly (Teri & Lewinsohn, 1982), a version for use in nursing homes (Meeks et al., 2009), and a version for patients with Alzheimer's disease (Logsdon & Teri, 1997).

The PES contains a list of 320 pleasurable events (e.g., "Hearing jokes", "Sleeping soundly at night", and "Washing my hair"), identified by having two samples write lists of events they found highly pleasurable and omitting redundant, ambiguous, non-observable, and low-variance items (MacPhillamy & Lewinsohn, 1974, 1982). When completing the PES, respondents rate each item twice, first rating frequency of occurrence in the past month on a 3-point scale (*not*

happened, happened a few times, and happened often) and then rating the subjective enjoyability of that event during the past month on a 3-point scale (*not pleasant, somewhat pleasant, and very pleasant*). The PES, therefore, yields 3 scores: frequency (the mean of all frequency ratings), subjective pleasure (the mean of all enjoyability ratings), and obtained pleasure (obtained by multiplying the frequency and subjective pleasure rating for each item, and then averaging those cross-products). Various subscales of the PES have also been developed that combine subsets of items, and are scored in the same manner. The scales of greatest importance to BA are the G scale (a general tendency to report activities as being enjoyable, consisting of all 320 items) and the MR scale (49 items found to significantly correlate with mood; Lewinsohn & Graf, 1973; MacPhillamy & Lewinsohn, 1982). The PES has demonstrated adequate test-retest reliability (MacPhillamy & Lewinsohn, 1982) and discriminant validity (Lewinsohn & Amenson, 1978; Lewinsohn et al., 1978; MacPhillamy & Lewinsohn, 1974).

3.2.1. Nature of behavior measured and measurement of reinforcement

The primary purpose of the PES was as a measure of reinforcement obtained over time, specifically for tests of the behavioral model of depression. As discussed above, using the PES for this purpose confounds the PES with measures of both mood and behavior. MacPhillamy and Lewinsohn (1974) recognized the difficulties associated with measuring reinforcement and that their solution was confounded with mood:

As this variable [RCPR] would be exceedingly difficult to measure directly (requiring the continuous observation over long periods of time of an individual's behavior and the stimulus events which influence it), a schedule was constructed to measure a closely related but more accessible variable, the amount of pleasure obtained by the individual...The approach was taken that such pleasant events are a major subset of all positive reinforcements and that, therefore, measurement of pleasant events may be used to approximate measurement of positive reinforcement (p. 652).

The PES score specifically intended as an approximation of positive reinforcement (MacPhillamy & Lewinsohn, 1974) or as an assessment of the frequency of reinforcing events (MacPhillamy & Lewinsohn, 1982) is the "obtained pleasure" score which is the cross-product of frequency and pleasure ratings. Research on the PES, however, is not consistent with respect to using this score versus the simple frequency score and several reports suggest that the cross-product score does not improve findings with respect to depression compared to the frequency score (Lewinsohn & Libet, 1972; O'Hara & Rehm, 1979; Rehm, 1978; Sweeney, Shaeffer, & Golin, 1982). In fact, interpreting either score as a measure of reinforcement relies largely on the assumption that positively reinforcing events will be experienced as pleasurable, as the cross-product specifically factors in subjective pleasure but even the simple frequency score is based on items that were rated as pleasurable by participants during the item generation process. The pleasure-reinforcement assumption is consistent with early theoretical writings on reinforcement: "It is sometimes possible to discover what reinforces a person simply by asking him what he likes or how he feels about things" (Skinner, 1974, pp. 53). The two primary problems with this assumption, however, are that (1) not all positively reinforcing events will be experienced as pleasurable (e.g., turning a key is reinforced by the event of a door opening or an engine starting) and (2) positively reinforcing events are not the only events that will be experienced as pleasurable. So too may negatively reinforcing events, which have contrasting implications for BA's theory of psychopathology.

This criticism is well known and a standard example will suffice. The item "Going to the movies" on the PES may be used as an activation assignment in BA, but whether or not it is positively reinforcing depends on the client and the nature of his or her

problems. For example, for an elderly client who has been house-bound, going to the movies may be a positive, reinforcing event that the BA clinician would encourage. For another client, for example a student who is doing poorly at school, going to the movies would perhaps function as avoidance of schoolwork, produce contact with negative reinforcement and represent an activity to be discouraged. In both cases, the client may rate the activity as pleasurable on the PES. This is further complicated by arguments that the distinction between positive and negative reinforcement is not clear enough to allow reliable classification of an event as a positive or negative reinforcer (e.g., Baron & Galizio, 2005; Michael, 1975) and that positive reinforcement can have aversive functions (Perone, 2003).

3.2.2. Research findings

The PES has been employed in many psychopathology studies, which have found that depressed individuals engage in fewer pleasant events compared to non-depressed individuals, including those without psychological disorders (Lewinsohn & Amenson, 1978; Lewinsohn & Graf, 1973; MacPhillamy & Lewinsohn, 1974). As per Fig. 1, these studies offer cross-sectional support for the relation between reinforcing events and depression if the assumption is granted that the pleasant events identified on the PES are valid indicators of reinforcing events. It should be noted, however, that some studies that employ the PES appear primarily interested in the relation between pleasant events and depression without theoretical ties to any behavioral model or reinforcement processes (e.g., Burkhart, Gynther, & Fromuth, 1980). In other words, pleasant events have become the variables of interest in and of themselves, not as proxies for reinforcing events. This loss of the behavioral theory as the lens through which research using the PES may be interpreted may parallel the incorporation of pleasant events scheduling into CT, where the behavioral theoretical reasons for doing so also were cast aside in favor of alternate models consistent with the zeitgeist.

Most research on the PES has shown that high PES frequency ratings are correlated with mood in both nonclinical samples (Lewinsohn & Graf, 1973; Libet & Lewinsohn, 1973; Lewinsohn & Libet, 1972; O'Hara & Rehm, 1979; Rehm, 1978) and clinical samples (Bouman & Luteijn, 1986; Lewinsohn, Sullivan, & Grosscup, 1980; Wierzbicki & Rexford, 1989). We feel these studies provide only limited support for the behavioral model because mood is so confounded with PES items that it is not surprising that such correlations are repeatedly found. In addition, Lewinsohn and Libet (1972) found that the relationship between mood and pleasant activity as per the PES was significantly higher when both were measured on the same day, and Rehm (1978) similarly found that there was no support for a causal link from mood one day to events on the next, or the reverse. This suggests that, the confound aside, as per Fig. 1, the relation between reinforcement and mood is best conceptualized as immediate.

Furthermore, Cunningham (1988) found that inducing an elated mood led to participants reporting significantly greater interest in activities on a shortened version of the PES compared to neutral participants, and participants who received a depression induction reported significantly less interest in social, leisure, or strenuous activities, suggesting that changes in mood may precede changes in engagement in pleasant events. This suggests an arrow from mood to reinforcement which is plausible, not problematic from the BA model's perspective, but not an explicit part of the BA model.

The PES also has been used in mechanism research, with results largely consistent with the mechanism model but no research has fully supported all of its components. However, the methodologies employed do not rule out alternate explanations such as the effects of mediating cognitive variables, the effects do not appear to be specific to BA or similar interventions, and there have been some inconsistent results. Positive results include Fuchs and Rehm (1977) who found that self-control therapy, a variant of BA, led to significant increases in engagement in pleasant events and reductions in depressed mood

compared to a wait list control group. Dobson and Joffe (1986) found that participants instructed to increase engagement in pleasant events actually did so and that they reported having obtained more pleasure as a result of this intervention. Participants who increased engagement in pleasant events and also focused on the event pleasantness demonstrated decreased depressed mood. Turner, Ward, and Turner (1979) found that an intervention designed to increase participation in reinforcing activities led to reports of increased engagement in pleasant events and to decreased depressed mood over a 30-day period, and that this change in depressed mood was significantly greater than improvement for participants in groups not involving increasing pleasant activities.

Mixed results include Zeiss et al. (1979) who found that depressed clients who received pleasant activity scheduling evidenced significant improvement over time in their PES cross-product scores and experienced significant improvement in depressive symptoms. However, clients who received interpersonal skills training and cognitive training also showed significant reductions in depression and increases in cross-product scores. Similar nonspecificity was reported by Jacobson et al. (1996) who found that early increases in pleasant events predicted decreased depression for those in the CT condition but not those in the BA condition.

In a well-known study, Hammen and Glass (1975) compared results of an activity scheduling intervention with expectancy control and self-monitoring control conditions and found that although the activity scheduling group did engage in significantly more pleasant activities than the control conditions, they did not experience improvement in depressed mood. Lewinsohn (1975) noted several methodological flaws with Hammen and Glass (1975), however, such as the failure to demonstrate an initially low level of pleasant activities.

3.3. Unpleasant Events Schedule (UES)

To parallel the PES, which was an attempt to measure pleasant events as indicators of contact with positive reinforcers, Lewinsohn and Talkington (1979) developed the UES to measure unpleasant events as indicators of contact with punishers and negative reinforcers. The UES, like the PES, is quite burdensome, containing a list of 320 unpleasant events that is cycled through first for frequency and then for aversiveness. Examples of items include "being alone", "attending funerals", "performing in public", and "being talked down to" (Lewinsohn, Mermelstein, Alexander, & MacPhillamy, 1985). The UES uses the time frame of the past month, and yields a frequency score on a 3-point scale, a subjective aversiveness score on a 3-point scale, and the cross-product that is thought to approximate response-contingent punishment and negative reinforcement experienced by the individual in the past month (Lewinsohn & Amenson, 1978; Lewinsohn & Talkington, 1979). Multiple forms of the UES were developed to improve its psychometric properties (Lewinsohn & Talkington, 1979; Lewinsohn et al., 1985). Factor analytic investigation by Lewinsohn et al. resulted in the following scales: Legal, Sexual–Marital–Friendship, Death Related, Controllable versus Uncontrollable, Life Changes, Self versus Other, and Most Discriminating Items.

3.3.1. Nature of behavior measured and measurement of reinforcement

Like the PES, the UES assesses a topographically varied set of events that are assumed to be indicative of punishment and negative reinforcement as per high cross-product ratings. The same concerns described for the PES exist with respect to the UES, including difficulty measuring negative reinforcement and punishment independent of both the behaviors required to produce contact with them and the moods these processes presumably elicit.

3.3.2. Research findings

Psychopathology research findings on the UES are limited and include Lewinsohn and Talkington (1979) who found that UES scores

discriminated between depressed and non-depressed groups, providing cross-sectional evidence for the relation between negative reinforcement/punishment and depression. As with the PES, this requires the assumption that the UES does validly indicate negative reinforcement and punishment. UES scores also significantly correlated with depressed mood over a 30-day period, providing a small but important longitudinal window of support. However, Sweeney et al. (1982), using cross-lagged panel analysis, found no evidence for a causal relation between unpleasant events or pleasant events measured at Time 1 and depressed mood measured at Time 2 one month later. Interestingly, in both Lewinsohn and Talkington and Sweeney et al., the positive correlations between unpleasant events and depressed mood (r s approximately .50 or above) were stronger than the negative correlations between pleasant events and depressed mood (r s approximately $-.30$ or below), suggesting that it is indeed important, and potentially most important, to include aversives in the BA model as per Martell et al. (2001).

Regarding mechanism, Lewinsohn and Talkington (1979) examined changes in UES scores in relation to changes in depressive symptoms following depression treatment. Individuals in the depressed group exhibited significant decreases in depressive symptoms and UES scores over time, such that most differences in UES scores between the depressed and non-depressed groups failed to meet significance at post-treatment, providing some support for BA's mechanism model.

3.4. Interpersonal Events Schedule (IES)

Duplicating the format of the PES and UES, the IES (Youngren, 1978; Youngren & Lewinsohn, 1980) contains 160 items designed to specifically measure contact with pleasant and aversive interpersonal events. Participants provide a frequency rating for each item on a 3-point scale, using the past 30 days as the relevant time period, and rate how they felt when each event was occurring over the past month on a 5-point scale. As with the PES and UES, cross-product scores are also obtained. The IES contains 8 rationally-derived scales: Social Activity (e.g., "having lunch or a coffee break with friends"), Assertion (e.g., "taking a definite stand on a controversial issue"), Cognition (e.g., "feeling rejected by someone"), Conflict (e.g., "being criticized by my boss"), Give Positive (e.g., giving a compliment), Receive Positive (e.g., receiving a compliment), Give Negative (e.g., giving criticism), and Receive Negative (e.g., receiving criticism). Based on daily monitoring data, two empirically-derived scales were developed: the Dysphoria-Related Scale based on items found to covary with dysphoria for more than 10% of individuals in a depressed sample, and the Positive Mood Related Scale based on items that covaried with positive mood for more than 10% of that same depressed sample (Youngren, 1978).

3.4.1. Nature of behavior measured and measurement of reinforcement

Because of the nature of the IES items, it is somewhat more difficult to contend that the IES purely measures contact with social reinforcers and punishers as intended. The problem is the confound with behavior, which is even more pronounced with the IES than with the PES and UES. For example, items on the "Give Positive" and "Give Negative" subscales clearly represent volitional behaviors distinguished from items on the "Receive Positive" and "Receive Negative" subscales which may be more easily characterized as environmental responses (i.e., reinforcing or punishing events contingent on behavior). Like the PES, another concern with this approach is that by identifying specific events it may not capture idiosyncratic differences in how events function. For example, "turning down a friend's request to borrow money" may function as social avoidance to be decreased for one client but function as assertiveness or effective long term planning to be increased for another. Thus, its face validity as a measure of reinforcement and punishment processes is questionable.

3.4.2. Research findings

Regarding psychopathology, most IES subscale scores discriminated between depressed and non-depressed individuals, including psychiatric controls, but the negative subscales (conflict, give negative, and receive negative) did not (Youngren & Lewinsohn, 1980), suggesting a relation between the frequency of positive interpersonal events and depression but not negative events, which is surprising given a large literature on negative interpersonal events in depression (e.g., Barnett & Gotlib, 1988) and the stronger relations between UES items and depression compared to PES items and depression as discussed above. Regarding mechanism, several IES subscales have been found to be sensitive to changes in depression levels over the course of treatment, including social activity, giving and receiving positive interpersonal responses, and in interpersonal events found to covary with mood (Youngren, 1978). Again, findings highlight potential interpretative problems with this scale, especially the negative subscales, for both psychopathology and mechanism models.

3.5. Behavioral Activation for Depression Scale (BADs)

After the PES, UES, and IES, scale development relevant to BA languished until recently. The BADs (Kanter, Mulick, Busch, Berlin, & Martell, 2006) was the first new scale published since these earlier attempts. The BADs is a 25-item scale created to measure activation and avoidance behaviors relevant to BA. The BADs contains four subscales, Activation, Avoidance/Rumination, Work/School Impairment, and Social Impairment, which have been validated in an undergraduate sample (Kanter et al., 2006) and a community sample with elevated depressive symptoms (Kanter, Rusch, Busch, and Sedivy, 2009). The BADs was designed for weekly administration over the course of therapy with the scale anchors and instructions sensitive to weekly changes in behavior.

3.5.1. Nature of behavior measured and measurement of reinforcement

The BADs measures the frequency of activation, escape and avoidance behaviors hypothesized as important to the BA mechanism and often targeted for activation within BA by Martell et al. (2001) but may be useful in the context of BATD (Lejuez et al., 2001) as well. Unlike the PES and its variants, the BADs did not attempt to capture the full range of behavioral events possible for depressed individuals. Rather, BADs items attempt to represent activation as it generally applies across specific behaviors. For example, items include "There were certain things I needed to do that I didn't do" and "I was an active person and accomplished the goals I set out to do." The BADs is a measure of behavior and does not directly assess reinforcement or mood occurring in response to those behaviors. However, several items in the activation scale somewhat approximate reinforcement, and others include mood components. These include, "I did something that was hard to do but it was worth it," "I am content with the amount and types of things I did," and "I pushed people away with my negativity." Recently, a short 9-item version of the BADs has been developed that more directly measures focused activation, avoidance and general activation that improves on the psychometric properties of the original (Manos, 2009).

3.5.2. Research findings

The BADs was developed recently, thus research other than the two initial validation studies is limited. In both studies, strong correlations between BADs scores and depression were found. Consistent with previous research on the PES and UES (Lewinsohn et al., 1978; Sweeney et al., 1982), stronger correlations were found between avoidance and depression than between activation and depression. Lending support for the BA conceptualization of rumination as a form of escape or avoidance (e.g., Martell et al., 2001), factor analytic results from both BADs development samples confirmed that

BADS rumination items consistently loaded on the same factor with other avoidance items.

Regarding mechanism research, a study investigating CBT within a partial hospital program and two case studies suggest that the BADS performs as intended over the course of treatment in clinical settings. In Christopher, Jacob, Neuhaus, Neary, and Fiola (2009), improvement in BADS scores from pre- to post-treatment following CBT within a partial hospital setting predicted post-treatment depression scores after controlling for pre-treatment depression scores. In Manos et al. (2009) BADS scores were strongly negatively correlated with depression over the course of successful treatment. This finding was replicated by Kanter, Dieguez-Hurtado, Rusch, Busch, and Santiago-Rivera (2008) who found that a Spanish translation of the BADS was similarly related to depression and that BADS total score increased substantially across the course of the successful treatment of a depressed woman.

3.6. *The Environmental Reward Observation Scale (EROS)*

The second scale published recently for BA research is the EROS (Armento & Hopko, 2007). The EROS was designed to improve on the efficiency of the PES and measure RCPR, defined using Lewinsohn's (1974) definition of three factors that influence RCPR. However, the EROS authors use the term "reward" rather than reinforcement in their scale description, possibly to link better with recent neurobiological research on reward systems. The EROS assesses all three aspects of RCPR over an extended period of time (e.g., several months) with 10 items, including "A lot of activities in my life are pleasurable," "Lately I have found that many experiences make me unhappy" and "The activities I engage in usually have positive consequences." Like the PES, it is a self-report instrument designed to assess contact with reinforcement and thus strategically emphasizes the measurement of mood states as indicators of contact. Unlike the PES, the EROS does not measure the frequency of specific activities; the assumption made by the EROS is not that specific reinforcing activities may be indexed by specific mood during the activity but that general contact over time with reinforcement may be indexed by a general sense of satisfaction, fulfillment and pleasure over time. Thus, it remains a compromise with respect to true functional analysis but possibly less so compared to the PES. Armento and Hopko found evidence for the factor structure, reliability and validity of the EROS with an undergraduate sample, including EROS scores predicting the reward value of overt behavior assessed via daily diaries over a 7-to-10 day period above and beyond the effect of depression.

3.6.1. *Nature of behavior measured and measurement of reinforcement*

While the BADS attempts to measure the activation process at the behavioral level, the EROS seeks to measure it from the level of subjective experience of reinforcement. Ideally individuals who demonstrate higher levels of behavioral activation will score higher on the EROS. However, the reference period used in the EROS of the past few months may make it difficult to assess nuanced changes in the degree to which individuals are experiencing RCPR, would not easily pinpoint changes occurring over depression treatment, and makes direct integration with BADS scores difficult.

3.6.2. *Research findings*

Like the BADS, the EROS is relatively new and empirical findings are limited. The initial validation study (Armento & Hopko, 2007) found that EROS scores significantly correlated with measures of depression, anxiety, behavioral activation/inhibition (BIS/BAS), and pleasant events (PES). Armento and Hopko (2007) also found that EROS scores significantly predicted time spent in low reward and high reward value behaviors above and beyond depression scores. Gawrysiak, Nicholas, and Hopko (2009) found that changes in BDI-II scores over the course of depression treatment were significantly related to changes in EROS scores, and that a modified single-session

BATD intervention led to reductions in depressive symptoms and increases in environmental reward as indicated by the EROS.

Daughters et al. (2008) found that illicit drug users with depression who received a modified BATD intervention in addition to substance use treatment experienced significantly greater improvements in depression severity, anxiety symptoms, and EROS scores compared to those who received substance use treatment but not the BATD intervention.

3.7. *Reward Probability Index (RPI)*

The same research team that developed the EROS recently developed another measure related to activation, the RPI (Carvalho et al., in press) to address criticisms of the EROS including that it does not adequately assess the probability of obtaining RCPR and that it includes items that overlap with symptoms of depression (e.g., "Activities that used to be pleasurable no longer are gratifying" overlaps with anhedonia). Like the EROS, the RPI was developed through a series of three studies that found evidence for the factor structure, reliability and validity of the RPI with undergraduate samples. This resulted in two factors, Reward Probability and Environmental Suppressors, with 20 items such as "I make friends easily", "Changes have happened in my life that have made it hard to find enjoyment", and "I have been very capable in jobs I have had." It is based on a reference period of the past several months.

3.7.1. *Nature of behavior measured and measurement of reinforcement*

While the EROS focuses on the extent to which an individual experiences reward, the RPI purports to measure the probability of experiencing reward. As with the EROS, individuals who demonstrate higher levels of behavioral activation should also score higher on the RPI, however the differences in reference period between the BADS (the past week) and the RPI (the past several months) will make it difficult to assess how changes in activation over the course of therapy relate to changes in RCPR.

3.7.2. *Research findings*

Like the BADS and the EROS, the RPI is relatively new and empirical findings are limited. The initial validation study (Carvalho et al., in press) found that RPI scores significantly correlated with measures of depression, anxiety, perceived social support, environmental reward (EROS), and behavioral activation (BADS). Carvalho and colleagues also found that total RPI scores predicted the reward value of overt behavior assessed via daily diaries over a 7-to-10 day period after controlling for depression at baseline. The RPI total score strongly correlated with the EROS ($r = .81$), however, the RPI accounted for approximately twice the incremental variance in predicting environmental reward using daily diaries compared to the EROS.

3.8. *Other relevant measures*

Several other measures were found that may be of interest to BA researchers, even though to date they either have not been used in BA research or they were not developed for such purposes.

3.8.1. *Behavioral Inhibition System/Behavioral Activation System scales*

The Behavioral Inhibition System/Behavioral Activation System (BIS/BAS; Carver & White, 1994) scales were developed to assess two general motivational systems thought by Gray (1981, 1982) to underlie behavior and affect: the BIS and the BAS. The BIS and BAS have been linked to neural pathways in the brain and are generally thought to either inhibit (BIS) or promote (BAS) activation toward goals (see Carver & White, 1994). Examples from the BIS include, "I worry about making mistakes" and "I have very few fears compared to my friends" and examples from the BAS include "When I get something I want, I feel excited and energized" and "I crave excitement and new sensations."

The BIS/BAS scales attempt to measure dispositional sensitivities of these neural systems and not the types of specific activation and avoidance behaviors expected to change over the course of BA. The BIS/BAS for the most part does not measure consequences of behaviors. The closest the BIS/BAS comes to approximating the occurrence of reinforcement are items such as, “When I get something I want, I feel excited and energized” and “When I’m doing well at something, I love to keep at it” but these items do not indicate the frequency with which these situations occur.

The BIS has repeatedly been found to correlate with depressive symptoms (Alloy et al., 2008; Campbell-Sills, Liverant, & Brown, 2004; Johnson, Turner, & Iwata, 2003; Kasch, Rottenberg, Arnow, & Gotlib, 2002; Perczek, Carver, Price, & Pozo-Kaderman, 2000), while the relation of the BAS subscales to depressed mood, however, is less clear (Alloy et al., 2008; Kasch et al., 2002; Perczek et al., 2000). The BIS/BAS has also been found to longitudinally predict the course of depression six (McFarland, Shankman, Tenke, Bruder, & Klein, 2006) to eight (Kasch et al., 2002) months later, as well as time to onset of depressed mood within bipolar spectrum disorders (Alloy et al., 2008).

The BIS/BAS scales may be useful as risk variables in psychopathology research or a moderator variable in treatment studies of BA. Because the BIS/BAS was developed to measure stable dispositions that correlate with neural pathways in the brain, it seems likely that higher BIS and lower BAS scores may represent a vulnerability to develop depressive symptoms, but it is not clear that BIS/BAS scores would be expected to change over the course of depression treatment. In fact, Dichter et al. (2009) found that, although changes in certain neural responses occurred in depressed individuals who received BATD, there was not a significant change in BIS/BAS scores from pre- to post-treatment. To the extent that scores represent a trait instead of a state, they may function as moderators of treatment effectiveness. Further research on these possibilities is needed.

3.8.2. *The COPE*

The COPE (Carver, Scheier, & Weintraub, 1989) is a 60-item scale that assesses general ways of responding to difficult or stressful events and the frequency with which these coping attempts are used. Gaynor and Harris (2008) employed a modification of two COPE subscales (behavioral disengagement and active coping) with success in their single-subject evaluation of mechanism of change in a BA intervention for depressed adolescents. They modified the wordings of these scales to obtain current, behaviorally specific coping reactions instead of a general coping style, and then subtracted the behavioral disengagement score from the active coping score to obtain a measure of activation. They found large changes in activation scores for three out of four BA participants and found evidence for increased activation as a mediator of within-treatment changes in depressive symptoms for two out of the four participants.

3.8.3. *The Acceptance and Action Questionnaire and the Cognitive Behavioral Avoidance Scale*

Two measures of avoidance, the Acceptance and Action Questionnaire (AAQ; Hayes et al., 2004) and the Cognitive Behavioral Avoidance Scale (CBAS; Ottenbreit & Dobson, 2004), may also be useful to BA researchers. The AAQ measures experiential avoidance as described by Acceptance and Commitment Therapy (ACT; Hayes, Strosahl, & Wilson, 1999). The CBAS measures cognitive and behavioral avoidance across social and nonsocial realms. Both may be useful additional measures of avoidance to be compared with avoidance as per the BADS. These scales have not yet been used to examine BA psychopathology or mechanism.

4. Summary and implications

A major difficulty with research on BA's psychopathology model (and mechanism model) is that reinforcement is traditionally defined

in terms of the contingency between a behavior and an outcome. Thus, when the measurement strategy must infer reinforcement from single instance, self-report data, as is the case with most research reviewed herein using the PES, UES, IES, activity schedules, daily diaries, and to a lesser extent, the EROS and RPI, the measurement of contact with reinforcers is confounded with measurement of the behavior hypothesized to produce such contact. The solution employed by these measures further confounds measurement of reinforcement with measurement of mood. This is an issue of construct validity that is crucial with respect to the proposed model in Fig. 1, especially to the extent that it is desirable to measure each component of the model independently.

Difficulties sorting out these issues may be responsible for an intriguing discrepancy demonstrated by this review between the large amount of BA outcome data and the relatively little measure development and psychopathology work that has occurred. Attempts to measure these processes have been ongoing since the late 1960s, and this research in general is supportive of the BA models, yet to date there is no definitive longitudinal, well-controlled evidence in support of them. Theory-based, a-priori longitudinal research is necessary, and for this new measurement strategies are needed.

4.1. *Summary of research supporting the psychopathology model*

Most research on BA's psychopathology model has used the PES, and these studies must be interpreted in light of construct validity concerns discussed above. Assuming construct validity, these studies demonstrate a relation between positively reinforcing events and mood (Bouman & Luteijn, 1986; Lewinsohn & Graf, 1973; Lewinsohn & Libet, 1972; Lewinsohn, Sullivan, & Grosscup, 1980; Libet & Lewinsohn, 1973; O'Hara & Rehm, 1979; Rehm, 1978; Wierzbicki & Rexford, 1989), an unsurprising finding given how reinforcement was defined in terms of mood but nonetheless supporting a minor component of the model. This aspect of the model—that contact with certain events improves mood—is a generally accepted psychological phenomenon and in some cases has served as the basis for pleasant events scheduling in the absence of a more fully articulated behavioral model such as the one presented herein.

More challenging has been generating clear support for the relation between reinforcing events and depression rather than reinforcing events and immediate mood. Some support for this aspect of the model comes from the earliest research which did not rely on nomothetic self-report strategies but instead focused on idiographic measurement using home observations over time (Lewinsohn & Shaffer, 1971) as well as more recent research exploring the relation between daily diary-reported engagement in highly rewarding activities and depression over time (Hopko, Armento, et al., 2003; Hopko, Lejuez, et al., 2003), and engagement in highly rewarding activities as per the EROS or the RPI and depression over time (Armento & Hopko, 2007; Carvalho et al., in press). These studies do a better, albeit not perfect, job at disentangling reinforcement from mood and behavior. In total, this research supports relations between reinforcement and depression over time as per Fig. 1. Parallel with these findings are correlational findings using the BADS supporting relations between activation behavior and decreased depression in non-depressed (Kanter et al., 2006) and depressed samples (Kanter, Busch et al., 2009; Kanter, Rusch, et al., 2009).

Other studies using the PES support a relation between reinforcement and depression (Lewinsohn & Graf 1973, 1978; MacPhillamy & Lewinsohn, 1974) as well but these data are largely correlational in nature. Such correlational research cannot successfully identify the reciprocal influences of reinforcement, mood and behavior over time hypothesized by the BA model. In fact, the time frames (typically one week or one month) and statistical procedures employed in existing longitudinal research also have not allowed for investigation of the full hypothesized cycle of depression over time.

Another body of largely correlational research supports relations between aversive events (negative reinforcers and punishers) and depression, including research using the UES (Lewinsohn & Talkington, 1979; Sweeney et al., 1982) and the IES (Youngren & Lewinsohn, 1980). Parallel with these findings are findings using the BADS that avoidance behavior correlates with depression in non-depressed (Kanter et al., 2006) and depressed samples (Kanter, Busch and Rusch, 2009; Kanter, Rusch, et al., 2009), and a larger body of research (reviewed by Ottenbreit & Dobson, 2004) demonstrating relations between avoidance and depression across multiple studies. In fact, the strength of findings of relations between increased aversive events/avoidance behavior and depression may be stronger than findings of relations between decreased positive events/healthy behavior and depression. This suggests that the psychopathology model, which primarily emphasizes decreased positive reinforcement for healthy behavior, and secondarily emphasizes increased negative reinforcement for avoidance behavior, may benefit from a reversal of emphasis.

4.2. Mechanism research

Research supporting the BA mechanism model is quite limited. Most studies employing variants of the PES during treatment have shown that decreased depression correlates with increased contact with pleasant events (Fuchs and Rehm, 1977; Turner et al., 1979) but this does not only occur in BA treatments (Jacobson et al., 1996; Zeiss et al., 1979) and there is one exception to the general finding (Hammen & Glass, 1975). Daughters et al. (2008) demonstrated similar relations over the course of treatment using the EROS. Lewinsohn and Talkington (1979) showed that contact with aversive events decreases with depression over the course of treatment. Regarding increased activation behavior and depression over the course of treatment, support comes from Gaynor and Harris (2008), using an adapted version of the COPE as well as a daily diary card, and two single case reports using the BADS (Kanter, Busch, et al., 2008; Kanter, Dieguez-Hurtado, et al., 2008; Manos et al., 2009).

4.3. General recommendations

To the extent that BA treatment emphasizes pleasant activity scheduling as a central component, the PES, UES and IES represent straightforward attempts to measure the frequency of pleasant, unpleasant, and interpersonal activities engaged in by the client and thus map onto the treatment technique nicely. Using these measures as process measures assumes that increased *frequency* of pleasant activity and decreased *frequency* of unpleasant activity is the goal of BA. However, modern BA is much more nuanced about the quality and functions of the behaviors to be activated, and the existing schedules are not capable of addressing such nuance. Specifically, while the frequency of pleasant activity has been shown to correlate with depression, it may be that only very specific, functional behaviors (e.g., one or two of the 320 items) need to be extinguished to cause depression, or need to be activated to ameliorate depression.

BATD (Lejuez et al., 2001) also offers a more fine-grained hypothesis than simple quantity of activity. Specifically, BATD suggests that a key issue in depression is the frequency of reinforcement for depressive behaviors relative to the frequency of reinforcement for non-depressed behaviors. The issue is the relative ratio of reinforcement of “good” to “bad” behavior, not simple frequency. Gaynor and Harris (2008), using the COPE, employed a solution with some resemblance to BATD’s relative ratio hypothesis. They subtracted the “unhealthy” behavior scale (behavioral disengagement) from the “healthy” behavior scale (active coping) and used the resulting computed scale for their mechanism analyses, with promising results. Similar solutions may be profitable for future researchers.

Researching the full model presented in Fig. 1 presents several challenges related to the issue of timing. From a traditional mediational perspective, it is important to establish a temporal sequence in which the mediator occurs before the outcome (Kraemer, Stice, Kazdin, Offord, & Kupfer, 2001). For example, consider the treatment diagram in Fig. 1, in which treatment may be seen as the independent variable, behavior change may be seen as the mediator, and change in mood may be seen as the immediate outcome (with change in depression a more distal outcome). In this model, activation behavior, contact with reinforcement and changes in mood may occur so close in time that it may be difficult to determine which came first. For example, a house-bound client is given an assignment to go for a walk (treatment). The client goes for a walk (mediator), thereby contacting positive reinforcement while walking and immediately feels better (outcome). For all practical purposes, no temporal sequence of first walking and then feeling better can be established; the effect is, as far as measurement is concerned, simultaneous. This is not a problem for the theory in and of itself but it is a problem for attempts to empirically evaluate the theory. One solution may be provided through the utilization of ecological momentary assessment techniques (described below) during BA treatment.

Another issue of timing concerns possible lags in time between activation behavior and contact with reinforcement. Depending on the nature of the behavior, contact with reinforcement may take quite some time and be difficult to link with the original changes in activation. For example, consider a client who is completing activation assignments toward the goal of obtaining a job. This client may start with assignments to search for jobs and work on a resume, with later assignments of actually applying for positions and going on interviews. It may be quite some time, however, between these activities and reaching the goal of actually being hired, and it is sometimes difficult to link these activation assignments with changes in depression before such goals are met, although such activation assignments may be a significant contributor to change in mood (perhaps due to changes such as spending more time out of bed, feeling a sense of reward or accomplishment due to completing value-driven tasks, and eventually increasing time spent out of the home and interacting with others). Unfortunately, these smaller links (e.g., getting out of bed to look for jobs in the newspaper and experiencing reinforcement due to an increased sense of accomplishment) may be difficult to recognize and even more difficult to measure.

4.4. Future directions

It is clear that simple, self-reported activity level (as per the PES or related measures), assessed at few time points is unlikely to provide additional support for the BA model of psychopathology. For research in this area, a multi-faceted longitudinal assessment strategy is suggested, and a return to intensive single-subject analyses, using modern statistical procedures, may be beneficial. Measurement of key behaviors, hypothesized key stimulus events (or losses of or reductions in those events), and depressed mood all must be measured over time. Behavior and mood may be measured with emerging technologies, including modern-hand held technology allowing for ecological momentary assessment of mood and descriptions of behavior at frequent random intervals. In addition, recent advances in accelerometry permit investigators to unobtrusively track levels of physical activity in daily life. While physical activity is not equivalent to activation in the BA model, demonstrating that reductions in physical movement predict subsequent reductions in mood would provide new support.

Data obtained through these methods would have to be analyzed using statistical techniques sensitive to time series data such as growth curve modeling and lag sequential analysis. As these methods require high levels of subject burden, it may also be useful to employ single-subject time series methods (see Borckardt et al., 2008). To the

extent that the sequential pattern of these data show reductions in key behaviors following losses of or reductions in key stimulus events and concomitant increases in depressed mood, it can be inferred that the events had reinforcing or punishing qualities in support of the behavioral model of depression.

An example of such innovative measurement is provided by research on the relation between activity restriction and depression in the disabled, the medically ill, and the elderly (Williamson & Shaffer, 2000). In this work, researchers measured how many pleasurable, social, and functional activities the client could no longer engage in due to illness or frailty (i.e., a loss or erosion of positive reinforcement). Multiple studies have demonstrated a relation between restriction of activities and higher depression over and above the effect of illness severity (e.g., Williamson, 2000). Thus, it may be particularly fruitful for BA researchers to turn to specific populations for evidence in support of some aspects of the BA model.

The BADS, EROS and RPI are relatively new measures and may show promise, especially if the BADS is used simultaneously with the EROS or RPI. To the extent that the BA model requires measurement of both behavior, functionally defined, and contact with environmental reinforcement, the BADS and the EROS or the RPI together may achieve this goal. The BADS specifically was designed as a topographically non-specific measure of key BA-related behaviors, and the EROS and RPI were specifically designed to measure RCPR. However, they employ different time frames—the BADS asks respondents to report on the previous week, while the EROS and RPI ask respondents to report on the previous month. If the BADS and either the EROS or RPI are used together, a slight modification of one measure to align to the time frames may be beneficial. It is noted, however, that these scales are relatively new and how they will perform in psychopathology and mechanism research is still largely unknown. Researchers are encouraged to utilize these measures but also to consider measure refinement and new measure development.

5. Conclusion

Despite a recent proliferation of research on BA treatments, there has been little research to date examining either the psychopathology model of BA or BA's model of mechanism of change. The available research partially supports BA's psychopathology model but lacks technical precision and scope needed to provide more concrete support. Research examining the model longitudinally demonstrating losses of, or chronically low levels of reinforcement that precede increases in depressive symptoms is necessary in order to make more definitive claims. There is also little research to support BA's mechanism model. One potential roadblock to completing research on both of these models is lack of appropriate and precise measures of the processes proposed to be taking place. This review points to a few promising options, such as the use of daily diary cards from which weekly reward value ratings can be calculated, as well as the BADS, EROS, RPI (and the possibility of using the BADS with either the EROS or the RPI), and modified COPE, but each of these options requires additional validation and may require changes in order to appropriately measure the processes of interest. Researchers are encouraged to further develop these measures and to work to develop new measures that more accurately target these processes.

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