A Tutorial on the Concept of the Motivating Operation and its Importance to Application

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ABSTRACT

Motivating operations (MOs) exert a powerful influence over operant relations and hold significant implications for those working in applied settings. In this paper, we describe the concept of the MO and provide "real world" examples. Particular emphasis is given to the concept of the conditioned MO (CMO). Implications for intervention are discussed. It is hoped that this endeavour will encourage the utilization of the full conceptual system of the MO.
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The investigation of operant relations is an integral part of applied behavior analysis. A key role of functional analysis, for example, is to identify consequences that reinforce problem behavior (Iwata & Dozier, 2008). This has led to the adoption of interventions that are systematically derived from this understanding (e.g., functional communication training [FCT]; Tiger, Hanley, & Bruzek, 2008). Such developments have had a profound impact on the lives of many people.

As well as asking what maintains a behavior, it is equally important for researchers and practitioners to ask, "Why is this consequence acting as an effective reinforcer for this person now?" (McGill, 1999). Within the operant model, it has been established that the value of a given consequence as a type of reinforcement or punishment is in constant flux, as is the probability of behavior occurring that has previously been associated with such consequences (Fuller, 1949; Skinner, 1953). Keller and Schoenfeld (1950) adopted the term *establishing operation* to describe the effect of antecedent manipulations, such as food deprivation, on the strength of a response. A systematic approach to the analysis of such events was absent, however, leaving "a gap in our understanding of operant functional relations" (Michael, 1993, p. 191). In redressing this balance, Michael (1982, 1993) drew a distinction between antecedent variables that serve to signal the availability of reinforcement or punishment (discriminative stimuli) and those that act on a person's "motivation" for such consequences.

More recently, the term *motivating operation* (MO) has come to subsume that of the establishing operation (Laraway, Snycerski, Michael, & Poling, 2003). The MO refers to an event or stimulus condition that momentarily alters (a) the value of consequences that act as types of reinforcement or punishment, and (b) the probability of behaviors that have been previously associated with such consequences. In short, an MO changes how much you "want" something and how hard you will "work" to get it (Michael, 1982).

The concept of the MO has had a notable influence on the science and practice of applied behavior analysis. There are few, if any, areas in which MOs should not be an important consideration for behavior analysts. MOs exert an influence on the effectiveness of any intervention that involves the manipulation of consequences. For example, the ability of a reinforcement contingency to increase the occurrence of a particular behavior depends on the degree of motivation that currently exists for that reinforcer. FCT is one of the most frequently used interventions for problem behavior. This typically involves the differential reinforcement of an alternative, socially acceptable response (Tiger et al., 2008). MOs may have a notable influence on this process. For example, the replacement response will not be evoked in the absence of an MO for the consequence that maintains it (see Brown et al., 2000). Likewise, the extent to which time-out or response cost will suppress a given response is dependent on the current MO for the reinforcer that is to be removed. A number of treatments for problem behavior also rely on modifications to the value of the reinforcer maintaining the behavior (e.g., noncontingent reinforcement).

Several comprehensive reviews of the applied literature on the MO are now available (e.g., Langthorne, McGill, & O'Reilly, 2007; McGill, 1999; Smith & Iwata, 1997; Sundberg, 2004). Despite the importance of the MO to applied behavior analysis, it appears that elements of the conceptual system provided by Michael and colleagues, such as the *conditioned motivating operation* (CMO) (e.g., Laraway et al., 2003; Michael, 1982; Michael, 1993, 2000; Michael, 2007), have been less influential than would be expected (see McGill, 1999). As such, the current paper aims to shed

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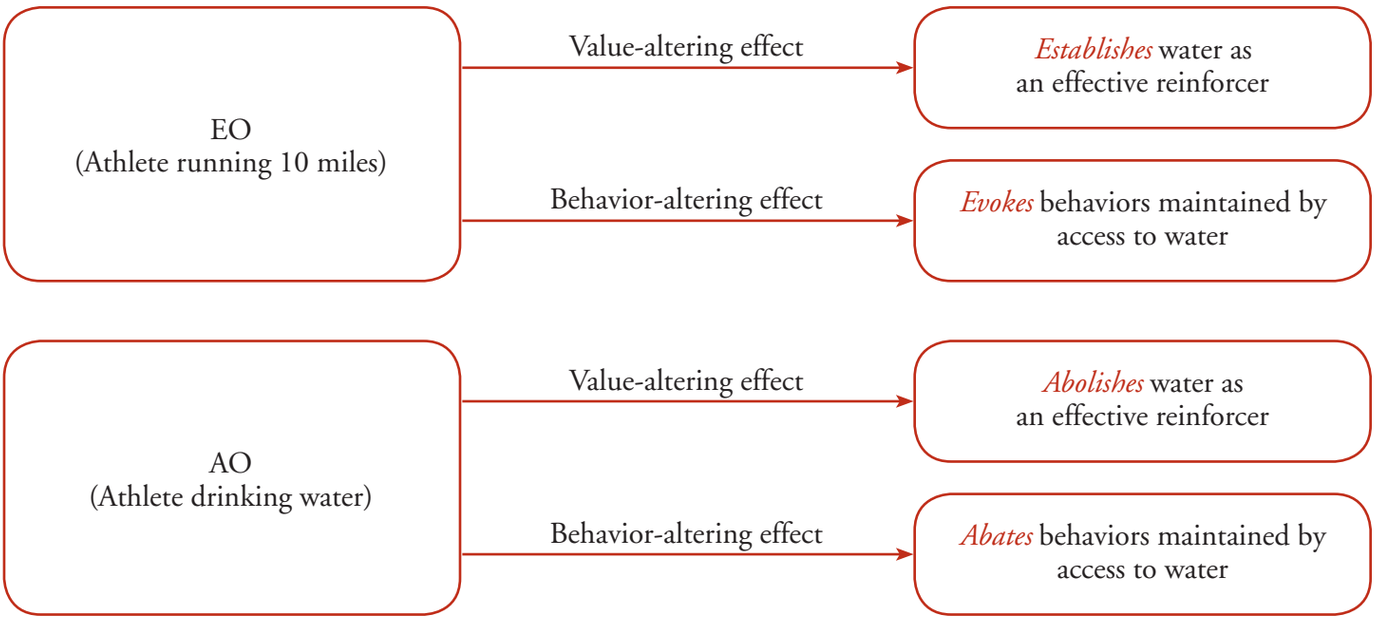

Figure 1. Depiction of the value- and behavior-altering effects of the MO. The run acts as an EO (establishes water as an effective reinforcer and evokes (i.e., increases) behaviors maintained by access to water. The drinking of water acts as an AO (abolishes water as an effective reinforcer and decreases behaviors maintained by access to water).

further light on the concept of the MO. Descriptions of the MO concept are related to real-world examples to help achieve this aim. Particular emphasis is given to the concept of the CMO. We will discuss the implications of the MO for assessment and intervention. It is our hope that this exercise will demonstrate the applied importance of the MO and encourage practicing behavior analysts to use the full conceptual system as initially envisaged by Michael and colleagues.

The Motivating Operation: A Brief Tutorial

Diverse strands of psychological research have attempted to describe and explain the concept of motivation (Kennedy & Meyer, 1998). The MO provides a functional account of this concept by relating changes in the variables that underpin motivation to basic principles of behavior. The MO is the result of an evolution in operant terminology. Michael (1982, 1993) originally used the term *establishing operation* (EO) to refer to antecedent events that momentarily alter (a) the effectiveness of consequent events that function as reinforcers or punishers (termed the *reinforcer-establishing* effect), and (b) the frequency of responses that have been associated with those consequences in the past (termed the *evocative effect*). For convenience, movements in the opposite direction were subsumed within the rubric term of the EO. As Michael (1982) stated, "'establishing' should be taken to be short for 'establishing or abolishing'" (p.151). The use of the term EO in this manner, however, did not adequately describe the bidirectional effects of motivating events.

As such, Laraway et al. (2003) refined the concept, proposing that the omnibus term of the *motivating operation* replace that of the EO. MOs refer to antecedent events that share two main properties. The first property, termed the *value-altering effect*, refers to the effect of an antecedent event on the effectiveness of other stimuli that function as types of reinforcement or punishment (Laraway et al., 2003). An EO establishes the effectiveness of a particular type of reinforcement or punishment, whereas an abolishing operation (AO) abolishes the effectiveness of a particular form of reinforcement or punishment. For example, the value of a drink for an athlete is established as an effective reinforcer following a long run, whereas it is abolished after he has consumed a large quantity of water.

The second property of the MO is referred to as the *behavior-altering effect* (Laraway et al., 2003). An EO evokes (i.e., increases) behavior that has been previously associated with the events it establishes as reinforcers (and vice-versa for behaviors associated with punishment), whereas an AO abates (i.e., decreases) behavior that has been associated with events it abolishes as reinforcers (and vice-versa for behaviors associated with punishment). Taking the same example, an athlete who has just completed a long run will be more likely to display behaviors that have been associated with drinking in the past, such as walking to a drinking fountain. Likewise, the probability of the athlete displaying the same behavior abates after drinking a large quantity of water. Descriptions of the behavior-altering effect of the MO have typically been restricted to changes in frequency. However as Michael (2007) noted, the MO may alter other dimensions of behavior such as response latency, magnitude, or relative frequency. Figure 1 provides a depiction of the value- and behavior- altering effects of the MO.

MOs may have multiple and simultaneous effects (Laraway

et al., 2003). Multiple concurrent operants (i.e., responses maintained by different reinforcers) often are available to the individual in natural contexts, and a single MO manipulation may alter response allocation between two or more different behaviors. For example, Berg et al. (2000) demonstrated that a young girl with developmental disabilities was more likely to play with her mother following time spent alone and more likely to play with toys following periods with high levels of maternal attention. As such, a single event (e.g., access to maternal attention) may function as both an EO and an AO for responses maintained by different consequences. Likewise, behaviors from the same response class may be influenced by multiple MOs. For example, the value of noncontingent escape may be influenced by a variety of MOs, such as the amount of sleep the individual has had, the difficulty of the request, and so on.

Michael (2007) also noted that a single stimulus change may not only function as an MO but as a form of reinforcement or punishment. The deprivation of attention, for example, may function as an EO for subsequent attention-maintained behavior but may also function as a type of punishment for any behavior that precedes the onset of deprivation. Likewise, providing access to food may reinforce food-maintained behaviors but may also serve to abolish the effectiveness of food as a reinforcer. Aspects of the MO await empirical verification; however, it is critical that the importance of such relations is recognized in applied settings.

Distinguishing Motivating Operations From Discriminative Stimuli

Prior to discussing MOs in greater detail, it is important to draw a clear distinction between MOs and another class of antecedents, *discriminative stimuli*. Discriminative stimuli are events that have been associated with the availability or non-availability of reinforcement in the past. The presence of a green light on a drinks dispenser, for example, signals the availability of a can of soda, whereas the presence of a red light signals its unavailability. There has been some attempt to expand the concept of discriminative stimulus to account for the effects of MOs (e.g., McDevitt & Fantino, 1993). Such an enterprise holds few benefits. Consider the influence of food deprivation on a response maintained by access to food. Two simple tests can help determine whether an antecedent event, such as food deprivation, is discriminative or motivational. First, the question can be asked, "Is the consequence more available or more valuable following a period of deprivation?" The antecedent event is likely to be a discriminative stimulus if the reinforcer (access to food) is more available in the presence of the event. Of course, access to food is no more likely when you are food deprived, so food deprivation is not a discriminative stimulus. Rather access to food is more valuable when you are food deprived, so food deprivation is an MO.

More systematically, a second question may be asked, "Does the antecedent event meet both requirements of the definition of a discriminative stimulus?" An antecedent event, such as food deprivation, can only be considered a discriminative stimulus if (a) in its presence, reinforcement is available for a certain class of responses, *and* (b) in its absence, reinforcement is not available for that class of responses. When an individual is food deprived, reinforcement (access to food) is available for responses such as snack preparation so the requirements of (a) are met. When an individual is not food deprived, access to food remains just as available should the individual engage in snack preparation so the second part of the test fails.

The same logic applies to behaviors that are maintained by negative reinforcement. Consider the onset of an aversive stimulus, such as a difficult demand. For the onset of the demand to function as a discriminative stimulus, escape from the demand must be available in the presence of the demand but not in its absence. Furthermore, escape must be an effective reinforcer in both the presence and absence of the demand (i.e., escape must be more available rather than more valuable in the presence of the demand). However, it is not possible to withhold escape from the demand in the absence of the demand, and escape is not an effective reinforcer in the absence of the demand. The demand functions as an MO because its onset establishes its own removal as an effective type of reinforcement and thereby evokes an escape response.

The provenance of MOs is an important consideration for applied behavior analysts. Knowledge of how certain events acquire their value- and behavior-altering effects can have important implications for intervention in applied contexts (McGill, 1999; Sundberg, 1993). Historically, behavior analysts have tended to place greater emphasis on those events that acquire value- and behavior-altering effects from the organism's evolutionary history (such as the deprivation of food or drink), and neglected those events that acquire their value- and behavior-altering effects as a result of the organism's learning history. As such, after briefly discussing unconditioned MOs, we will focus on the different types of conditioned MOs and their relevance to understanding and treating applied problems.

Unconditioned Motivating Operations

Certain events may acquire their value- and behavior-altering effects as a result of the person's evolutionary history. Such events are termed unconditioned MOs (UMOs). Deprivation of reinforcement, such as food, drink, environmental stimulation or preferred activities, establishes the value of these same stimuli as reinforcers and exerts an evocative effect on behaviors that have been associated with these consequences in the past. Satiation of these types of stimuli abolishes their reinforcing value and abates associated behaviors.

Deprivation and satiation also influence the extent to which the contingent removal of primary types of reinforcement will function as a type of punishment. Thus, a person must be deprived of food (or in common parlance be hungry) in order for the contingent removal of food to act as an effective type of punishment. The onset of certain forms of aversive stimulation, such as pain, or temperature changes above or below a comfortable level, similarly act as UMOs for negatively

Table 1. Summary Information for Each Type of CMO

CMO-type	Description	Example
CMO-S	Alters the value of consequences that are under the control of an MO with which it has been paired	Time on the clock influences the reinforcing value of food
CMO-R	Alters the value of its own removal or continued presence as a type of reinforcement or punishment	Delivery of a demand establishes the reinforcing value of its removal
CMO-T	Alters the value of another stimulus or event as a type of reinforcement or punishment	Presence of a lock on a fridge establishes the reinforcing value of a key when access to food is valuable as a source of reinforcement

reinforced behavior (i.e., behavior that produces escape from these events). These sources of motivation are unlearned.

The implications of the direct modification of UMOs for the treatment of problem behavior have been discussed elsewhere (e.g., McGill, 1999). Such modifications would involve replacing EOs for problem behavior (such as the deprivation of attention or preferred tangibles, high levels of aversive stimuli, the absence of environmental stimulation) with AOs (for example high levels of social contact and access to preferred tangibles, low levels of aversive stimuli, and sufficient levels of environmental stimulation). Berg et al. (2000) demonstrated that the attention-maintained problem behavior of two children with developmental disabilities was much more likely to occur following long periods of time spent without any social contact (the EO). Providing high levels of social contact before treatment sessions functioned as an AO and reduced the occurrence of attention-maintained problem behavior. Likewise, Horner, Day, and Day (1997) reported that sleep deprivation functioned as an EO for the tangible-maintained aggression and self-injury of one boy with autism. Allowing the boy to have a nap appeared to function as an AO and reduced the occurrence of problem behavior. Frequently, the direct modification of UMOs for problem behavior involves providing a better 'quality of life' for the individual (McGill, 1999). As Iwata, Vollmer, Zarcone, and Rodgers (1993) noted, however, interventions that solely involve the modification of MOs do not disrupt the contingencies that maintain problem behavior. As such, problem behavior would be expected to re-emerge whenever the EO for problem behavior is present.

Conditioned Motivating Operations

Other events acquire their value-altering effects as a result of the person's learning history. Such events are termed conditioned motivating operations (CMOs). Previously neutral events may acquire the status of a CMO after having systematically preceded or having been paired with a UMO, another CMO, or particular types of reinforcement or punishment. Three forms of CMOs have been proposed: *surrogate CMOs*, *reflexive CMOs,* and *transitive CMOs*. Table 1 provides summary information for each type of CMO.

The Surrogate CMO

A surrogate CMO (CMO-S) is a previously neutral stimulus that, following temporal association with a UMO or other CMO, independently alters the effectiveness of other stimuli as reinforcers or punishers and alters the probability of associated behaviors. The CMO-S acts on the value of those consequences that are under the control of its associated MO. Consider, for example, a person who always has lunch at midday. The time on the clock in addition to having discriminative properties (such as signalling the opening of the canteen) may also exert a motivative influence. Following the repeated pairing of food deprivation and the time of 12:00 p.m. on a clock, the time on the clock may eventually acquire motivative properties of its own. That is, through repeated association with the unconditioned establishing operation (UEO; food deprivation), the previously neutral stimulus (time on the clock) may itself establish the reinforcing value of food and evoke food-related behavior independent of actual levels of food deprivation (see Figure 2 for a depiction of this relation). The time on the clock may also establish the punishing value of food unavailability and reduce behaviors that have been associated with such delays in the past, such as answering the telephone, independent of current levels of food deprivation.

Similar effects could occur in the opposite direction. Consider, for example, stimuli that are temporally associated with water satiation (such as the sight of an empty glass). Following repeated pairing with the UMO (having had sufficient amounts of water to drink), the previously neutral stimulus (seeing an empty glass) may acquire abolishing and

abative effects. Specifically, the onset of such stimuli may abolish the current reinforcing value of further access to water and reduce related behaviors, such as going to the tap to refill the glass, independent of actual levels of water deprivation. The water is no more or less available in such a situation, but it is less reinforcing.

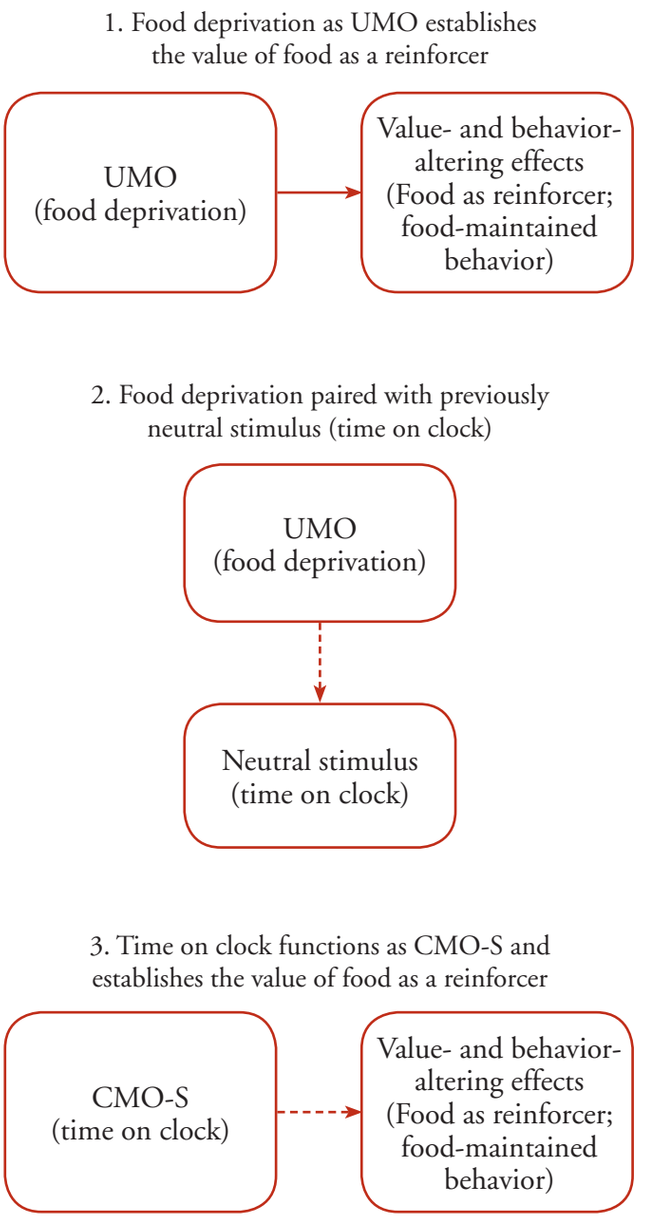

Figure 2. Depiction of the CMO-S relation. As a result of the pairing between the UMO (food deprivation) and the neutral stimulus (time on the clock), the previously neutral stimulus (time on the clock) acts as a CMO-S. It exerts value- and behavior-altering effects that are similar to the UMO (e.g., alters the value of food as a type of reinforcement and alters the probability of food-related behavior).

A small number of studies have demonstrated that the onset of diverted attention (i.e., someone paying attention to another person) can evoke attention-maintained problem behavior in individuals with developmental disabilities (e.g., O'Reilly, Lancioni, King, Lally, & Dhomhnaill, 2000). It may be that diverted attention functions as a form of surrogate CEO (CEO-S). It seems reasonable to suggest that situations that involve a caregiver interacting with another person are associated with momentary reductions in the level of social contact received by the person. Over time, this initially neutral event would be expected to acquire establishing and evocative properties, independent of actual levels of social contact. If diverted attention were to function as a CEO-S for attention-maintained behavior, one would expect there to be higher rates of problem behavior occurring in the diverted attention condition than in the standard attention condition even if actual levels of attention were the same. This pattern of responding corresponds closely to that found in O'Reilly et al. (2000). The problem behavior of two individuals with developmental disabilities occurred at zero rates in an initial attention condition during which the child's parents interacted with one another every 10 s while ignoring the child. However, problem behavior occurred at notably higher levels in a subsequent diverted attention condition during which both parents interacted with a third person every 10 s.

One possible intervention when a CMO-S is implicated in problem behavior is to weaken the relationship between the CEO-S (e.g., diverted attention) and the EO with which it was originally paired (e.g., absence of social contact). For example, providing high levels of social contact during a diverted attention condition would terminate the relationship between the CMO-S and MO. That is, diverted attention would no longer be associated with decreases in social contact. This tactic was used by O'Reilly et al. (2000). Each child's parents delivered attention to the child every 10 s during the diverted attention condition, thereby terminating the CEO-S relation and effectively reducing the occurrence of challenging behavior in this condition.

The Reflexive CMO

Michael described the reflexive CMO (CMO-R) as constituting a 'promise' or 'threat' CMO. The onset of a CMO-R is associated with either the *improvement* or *worsening* of the person's condition. Therefore, its onset alters the value of its own removal (or continued presence) as a type of reinforcement (or punishment) and alters the probability of behaviors occurring that have previously been associated with these consequences. The CMO-R therefore acts on its own reinforcing value and not on that of another stimulus (as is the case with the CMO-S). Take a young infant for whom the onset of certain social stimuli (such as seeing his or her mother frown) is correlated with the subsequent onset of an aversive stimulus, such as being scolded and thus the 'worsening' of his or her condition. The onset of the mother's frown may establish its own offset as an effective form of reinforcement and evoke

behaviors that have been associated with its removal in the past, such as the infant beginning to cry or ceasing the activity in which he or she was engaged, thereby acting as a reflexive conditioned establishing operation (CEO-R).

The onset of other social stimuli (such as the infant seeing a mother's smile) may be correlated with the subsequent provision of other more effective types of social reinforcement (such as a cuddle or praise), leading therefore to the 'improvement' of his or her condition. The sight of the smile therefore may establish its continued presence as an effective type of reinforcement and evoke behaviors that have led to this in the past, such as smiling back or continuing to engage in the behavior that evoked the smile. Similar effects may apply with punishment. For example, the onset of the smile would be likely to establish its own offset as an effective type of punishment.

As Michael (2007) noted, the CMO-R may have important implications for practitioners involved in developing adaptive behavior. In such programs, the onset of certain stimuli, such as an initial verbal request from the trainer, may be followed by further intense social interaction that may have an aversive component if the desired response has not occurred (e.g., repetition of the verbal request, modeling, or hand-over-hand prompting). The onset of the verbal request from the trainer (such as "match green") may function as a CMO-R in this situation and evoke the desired response from the student.

A large number of studies have demonstrated that the onset of demands can evoke negatively reinforced problem behavior. There have, however, been very few clear demonstrations of the CMO-R in this context. Carr, Newsom, and Binkoff (1980) provided an examination of the influence of 'safety signals' on the negatively reinforced aggressive behavior of two boys with severe intellectual disability. For both participants, the frequency of aggression reduced to low levels in conditions under which a stimulus change was present that had been previously correlated with the removal of demands (the removal of the experimenter's gloves for one participant, and the removal of a buttoning board for the other participant). In conditions under which this stimulus change did not occur (i.e., the experimenter kept his gloves on, the buttoning board remained present) aggressive behaviors continued to occur at high rates. Interestingly, this analysis was completed in the absence of any actual demands.

These 'safety signals' may have functioned as CMO-Rs. For example, the sequence of the experimenter wearing his gloves (a previously neutral stimulus) followed by demands (an aversive stimulus) may have led to the gloves acquiring aversive properties similar to the demand itself, "thereby becoming a CEO-R. If this is the case, one would expect the onset of the experimenter wearing his gloves (which signals the 'worsening' of the boy's condition) to establish its own removal as an effective type of reinforcement and evoke aggressive behavior even in the absence of any actual demands (see Figure 3 for a depiction of this relation). Likewise, the offset of the experimenter wearing his gloves (which signals the 'improvement' of the boy's condition) would abolish the effectiveness of its own removal as a type of reinforcement and would abate aggressive behaviors accordingly by functioning as a reflexive conditioned abolishing operation (CAO-R). Again, given the necessary history, this would be expected to occur independent of demand presentation. The glove functions as a CMO-R because it acts on the value of its own removal and not that of the demands, which would be the case if it functioned as a CMO-S. Could the glove be functioning as a discriminative stimulus? To function

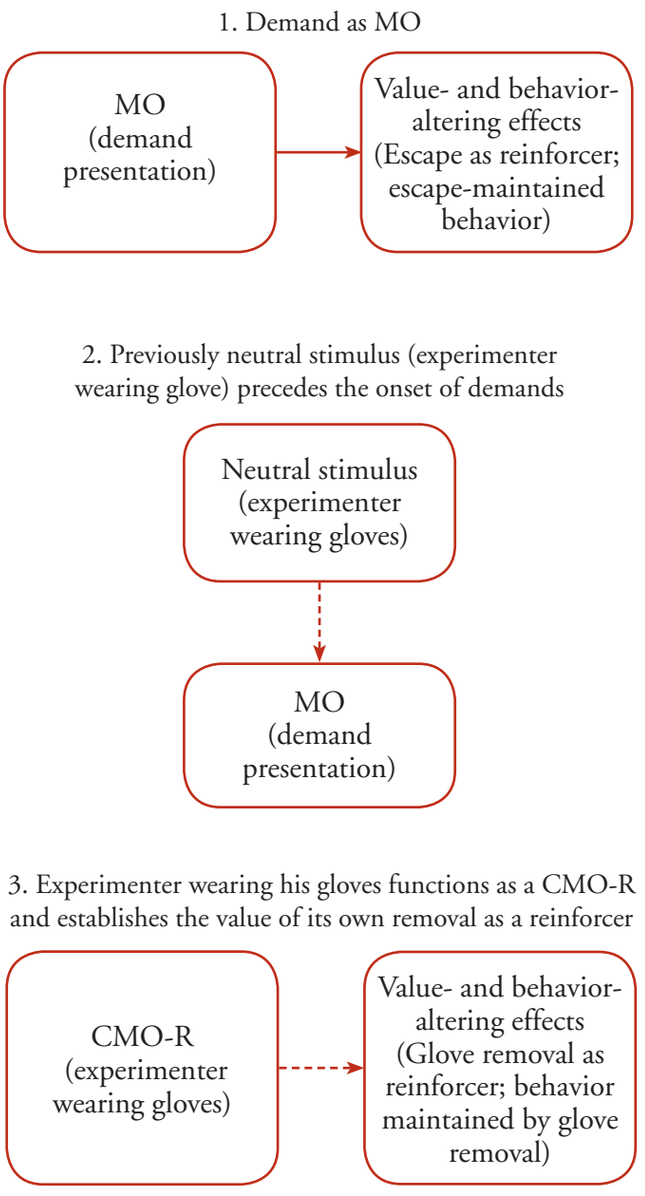

Figure 3. Depiction of the CMO-R relation. As a result of having systematically preceded the onset of an aversive stimulus (such as a demand), the previously neutral stimulus (the experimenter wearing gloves) acquires aversive properties of its own, thereby becoming a CMO-R. As such, the onset of the CMO-R (the experimenter wearing gloves) exerts value- and behavior-altering effects, such as establishing glove removal as an effective type of reinforcement and evoking behaviors that have led to this in the past.

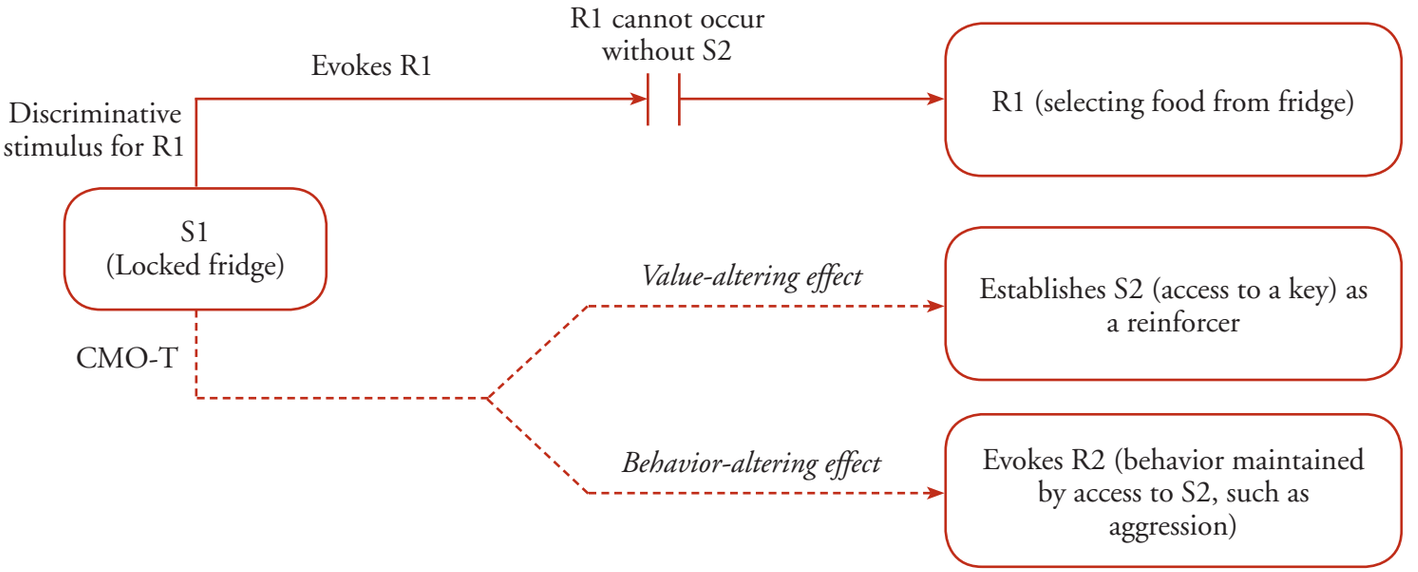

Figure 4. Depiction of the CMO-T relation (Adapted from Michael, 1982, p. 152). An ongoing response (such as selecting food from a refrigerator) is blocked (by the presence of a lock on the refrigerator). The initial stimulus change, which would normally function as a discriminative stimulus for the now blocked response (such as the sight of the locked refrigerator), instead functions as a CMO-T. It establishes the reinforcing value of a second stimulus change (such as getting the key for the refrigerator). This CMO-T evokes a second response that has been effective in achieving this second stimulus change in the past (such as aggression). The CMO-T is conditional and would only be expected to exert any influence when an EO is in effect for the terminal response (such as when the person is 'hungry').

as a discriminative stimulus, escape from the glove would have to be equally valuable both in the presence *and* absence of the glove. However, the glove fails on this second condition. Escape from the glove cannot function as an effective type of reinforcement in the absence of the glove. The glove therefore makes escape more valuable (not more available) and as such functions as a CMO-R.

Several interventions are possible when a CMO-R is involved in problem behavior. First, the contingency between the behavior evoked by the CEO-R (the experimenter putting on his glove) and the consequence (removal of the glove) could be eliminated. That is, problem behavior would no longer lead to the removal of the gloves. Second, the association between the CMO-R and MO could be terminated. For example, the experimenter could wear his glove in both the presence and absence of demands. Alternatively, the demand could be presented regardless of whether the experimenter is wearing his glove.

As Michael (2007) noted, however, such an intervention would be ineffective without attending to those aspects of the demand that led to the glove acquiring aversive properties in the first instance. Having extinguished a CEO-R such as that described above, the CEO-R relation would be expected to re-emerge if a neutral event is again associated with subsequent worsening (e.g., through the presentation of unchanged demands), (McGill, 1999). A number of possible interventions exist to attenuate the aversiveness of the original EO, such as poorly presented demands (Carbone, Morgenstern, Zecchin-Tirri, & Kolberg, 2007; McGill, 1999). These interventions include delivering reinforcement for task compliance (Lalli et al., 1999); embedding demands in the context of preferred activities (Carr et al., 1980); using errorless learning (Ebanks & Fisher, 2003); fading instructions (Pace, Iwata, Cowdery, Andree, & McIntyre, 1993); altering the duration, rate, and novelty of demands (Smith, Iwata, Goh, & Shore, 1995); varying the tasks (McComas, Hoch, Paone, & El-Roy, 2000); and providing a choice of tasks (Dyer, Dunlap, & Winterling, 1990).

The Transitive CMO

A transitive CMO (CMO-T) refers to stimuli in the context of which the value of existing conditioned reinforcers or punishers is altered, as is the likelihood of behaviors occurring that have been associated with such consequences in the past. An example of a transitive conditioned establishing operation (CEO-T), typically seen in approaches such as incidental teaching (Hart & Risley, 1975), involves contriving a situation in which one stimulus increases the value of a second stimulus as a type of reinforcement. The second stimulus cannot be obtained until a given behavior has occurred (Sundberg, 1993). A CMO-T relation may be present when an ongoing response or behavior chain (such as purchasing a soft drink) is blocked or interrupted (perhaps by having the incorrect change). In such circumstances, the initial stimulus change, which would normally function as a discriminative stimulus for the now blocked response (such as the sight of the machine), instead

functions as a CMO-T. It establishes the reinforcing value of a second stimulus change (such as getting correct change for the machine). This CMO-T evokes a second response that has been effective in achieving this second stimulus change in the past (such as asking the shop assistant for some change). The initial stimulus change (sight of the drinks machine) acts as a CEO-T for the second stimulus change (getting the correct change) and alters behavior accordingly. The CMO-T is conditional and would only be expected to exert any influence when an EO is in effect for the terminal response (such as when the person is 'thirsty').

Several approaches could be taken to weaken the CMO-T relation when it is implicated in evoking problem behavior.

Such relations may be relatively commonplace in applied settings. Consider an individual with developmental disabilities who lives in a residential home where access to food in the refrigerator is restricted by a lock on the refrigerator door. In such a situation, the response of independently opening the refrigerator door and subsequent reinforcement, in the form of access to food, is unavailable. This may establish the presence of someone who can open the refrigerator door (i.e., a staff member with the key) as an effective source of reinforcement and evoke behaviors that have led to this in the past, such as aggression (see Figure 4 for a depiction of this relation). In the absence of the lock on the refrigerator, the reinforcing value of the staff member with a key is abolished. Behaviors such as manding or aggression abate. Note that this relation is dependent on the current level of food deprivation; that is, if food is not currently an effective reinforcer, the sight of the lock on the refrigerator is unlikely to exert the aforementioned effects. Indeed, not only must the EO for food be present, but the person must also have a history of accessing food from the refrigerator and a history that includes a relationship between locks and keys before the sight of the locked refrigerator can be conditioned as a CMO-T.

Such relations may play an important role in evoking problem behavior. Call, Wacker, Ringdahl, & Boelter (2005) demonstrated that the attention-maintained problem behavior of one individual was evoked at consistently high levels only when diverted attention was combined with the delivery of demands, and problem behavior was followed by attention. It may be that the presence of demands established the reinforcing value of attention by functioning as a CEO-T. As a parallel to the locked refrigerator example, one could envisage that the onset of a demand that an individual cannot independently complete (i.e., the sight of the lock on the refrigerator), establishes social contact (i.e., the key for the lock) as an effective type of reinforcement and evokes problem behavior that has led to attention in the past (i.e., aggression directed towards a staff member with access to the key). Indeed, McGill (1999) suggested that if demands were to function as a CEO-T for attention-maintained problem behavior, one would expect higher levels of such behavior in the presence of demands than in the typical attention condition of the functional analysis, a pattern of responding that corresponds to that reported by Call et al. If the individual could complete the demand independently, it is unlikely that social contact would be established as an effective type of reinforcement.

Several approaches could be taken to weaken the CMO-T relation when it is implicated in evoking problem behavior (e.g., aggression that is maintained by access to a staff member with a key to the locked refrigerator). First, the MO that is related to the final step of the chain (e.g., access to food) could be modified. For example, providing free access to food would weaken the ability of the CEO-T to evoke problem behavior. Second, the relation between the behavior (aggression) and its consequence (a member of staff providing a key for the lock on the refrigerator) could be eliminated. Third, the CMO-T relation could be terminated. For example, staff members could no longer have access to keys for the lock. Thus, although aggression would still lead to contact from staff, they would not be able to open the refrigerator. Alternatively, the relation could be terminated by using a lock that the individual could easily operate without the need for a key.

CMO-Ts also may be an important consideration when teaching adaptive behavior, such as mands (Endicott & Higbee, 2007; Hall & Sundberg, 1987; Sundberg, Loeb, Hale, & Eigenheer, 2002) or bids for joint attention (Taylor & Hoch, 2008). Sundberg et al. (2002), for example, contrived CEO-Ts in order to teach mands for information in children with autism. The experimenters gave two children with autism access to a container that contained a preferred item with which they could play (i.e., the container functioned as a discriminative stimulus for playing with toys). The toy was then removed (i.e., the play response was blocked) and an empty container presented to the child. The presence of the empty container (the CEO-T) served to establish the reinforcing value of information regarding the location of the toys and evoked prompted mands for information ("Where?"). In a subsequent phase, an extra step was added to the chain, so that the adult response ("I gave it to the teacher") functioned as a CEO-T for a second mand for information ("Who?") by the child. Note that for the empty container to evoke mands, the hidden toys must have been functioning as an effective source of reinforcement (i.e., the EO for the toys must have been present).

Summary

MOs exert a powerful influence over operant contingencies and are a necessary part of a complete account of human behavior. Michael (1982, 1993, 2007) has provided the field with a means to effectively describe the influence of 'motivation' on human behavior. Scientists and practitioners interested in the influence of the MO should continue to rely on the full conceptual system provided by Michael and colleagues in order to describe the functional relations they uncover. Some elements of this system (such as the CMO) have not been utilized on occasions when they seem to provide a more accurate description of the facts than do alternative terms. Such relations appear to be relatively commonplace in applied settings and, as such, hold implications for behavior analysts. For practitioners, the CMO concept may provide explanations for otherwise puzzling phenomena. This improved understanding may aid in the identification of effective interventions for people who display problem behavior or have limited repertoires of adaptive behavior. It is hoped that the current paper will help behavior analysts to identify the relevance of such relations in applied contexts.

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