Revista Mexicana de Análisis de la Conducta • Mexican Journal of Behavior Analysis
2021 | Núm. 2 • diciembre | No. 2 • December | Vol. 47, 289 - 343
http://dx.doi.org/10.5514/rmac.v47.i2.81164

CULTURE AND CONTINGENCIES: MOLAR INSIGHTS FOR THE METACONTINGENCY ENTERPRISE

CULTURA Y CONTINGENCIAS: APUNTES MOLARES PARA LA EMPRESA DE LA METACONTINGENCIA

Will Fleming,[1] José G. Ardila-Sánchez, & Linda J. Hayes
University of Nevada, Department of Psychology

Resumen

Los científicos de la conducta que trabajan en la empresa de la metacontingencia han construido una sólida línea de procedimientos, métodos y análisis de investigación basados principalmente en las perspectivas teóricas promovidas por Sigrid Glenn y B. F. Skinner. La unidad de análisis en los estudios de metacontingencia es el "culturant", un término que se refiere a las contingencias conductuales entrelazadas y a los productos agregados, vistos como una unidad inseparable seleccionada por eventos o condiciones selectoras. Argumentamos que la metacontingencia puede ser considerada como una clase de contingencias molares en la medida en que se puede considerar que los eventos selectores tienen propiedades reforzantes (es decir, constituyen un

1. No grants or funding supported this paper. Will Fleming conceptualized the paper and was the lead author. José G. Ardila-Sánchez helped review and write the manuscript. Linda J. Hayes supervised the development of the manuscript. We thank Natalie Buddiga, Courtney Smith, and Ben Maritato for their helpful feedback on this manuscript, as well as the members of the Parrott Hayes lab for their assistance.
Correspondence can be sent by mail to 1664 N. Virginia Street, MS 0296, Reno, NV, 89557 or email to wfleming@nevada.unr.edu

patrón de eventos que organiza patrones correlacionados de eventos operantes a través de una contingencia). El propósito de este artículo es presentar una reconceptualización molar del modelo de metacontingencia en términos de contingencias operantes coordinadas y, al hacerlo, proporcionar una apreciación constructiva de cómo un marco conceptual molar es una adición potencialmente importante para la comprensión de los eventos culturales y para la empresa de la metacontingencia. Utilizando los juegos de ajedrez como ejemplo hilador, se identificarán las posibilidades de un marco conceptual molar y se describirán las formas de avanzar en la investigación cultural en el análisis de la conducta.

Palabras clave: metacontingencia, análisis molar, cultura, ajedrez.

Abstract

Behavior scientists working within the metacontingency enterprise have constructed a robust line of investigatory procedures, methods, and analyses primarily built on theoretical perspectives promoted by Sigrid Glenn and B. F. Skinner. The unit of analysis in metacontingency studies is the "culturant", a term referring to interlocking behavioral contingencies and aggregate products seen as an inseparable unit selected by selecting events or conditions. We argue that the metacontingency may be considered a class of molar contingencies insofar as selecting events may be considered to have reinforcing properties (i.e., they constitute a pattern of events that organizes correlated patterns of operant events through a contingency). The purpose of this paper is to present a molar reconceptualization of the metacontingency model in terms of coordinated operant contingencies and, in doing so, provide a constructive appreciation of how a molar framework is a potentially important addition to understanding cultural events for the metacontingency enterprise. Using chess games as an ongoing example, affordances of a molar framework will be identified and ways of advancing cultural research in behavior analysis will be described.

Keywords: metacontingency, molar analysis, culture, chess.

Scientific workers in the metacontingency enterprise have steadily been constructing a science of cultural events. Built upon the selectionist framework proposed by Skinner (1948, 1961, 1981), the metacontingency enterprise views the metacontingency as the basic mechanism of cultural selection. A metacontingency refers to a contingent relation between a culturant and a selecting event or condition external to the culturant that increases the probability of culturant reoccurrences (Baia & Sampaio, 2019; Glenn et al., 2016). A culturant consists of interlocking behavioral contingencies, or IBCs (i.e., functionally related behavior of individuals that produces a certain environmental alteration), and an aggregate product (i.e., the environmental alteration; see Hunter, 2012). Because IBCs and their aggregate product are the unit of selection (Glenn et al., 2016), metacontingencies do not only determine which operant contingencies will be maintained but also what operant events (i.e., organismic activity that produces environmental alterations) will be maintained within IBCs. Said differently, IBCs comprise interrelated operant contingencies that are themselves selected through metacontingencies. Operant events within IBCs are thought to be maintained through local reinforcement contingencies (Glenn et al., 2016), and those interrelated reinforcement contingencies are selected by selecting events through metacontingencies.

In an article aimed in part at orienting experimental research within the metacontingency enterprise, Glenn and colleagues (2016) suggest that culturants could be maintained through metacontingencies even in the absence of localized reinforcing events. Citing several experimental studies in which the only programmed consequences were contingent on the behavior of multiple individuals (Saconatto & Andery, 2013; Tadaiesky & Tourinho, 2012; Vichi et al., 2009), they stipulate that selecting events themselves could maintain both operant contingencies and operant events despite a lack of local reinforcement. This position is both a logical extension of Skinner's conception of cultural selection and a possible refutation of his conception of reinforcement. When reinforcement is conceptualized as a process by which an operant class is strengthened by immediate, contiguous events (as it is explicitly conceptualized in early writings on metacontingencies; e.g., Glenn, 1986), there is coherence in asserting that "temporally-distant" events that are dependent on the behavior of multiple individuals should not be thought of as reinforcing events. The fact, though, that Glenn and colleagues (2016) concede that such events may have reinforcing properties—and actually propose possible metacontingency variants in which selecting events function as reinforcing events—suggests that metacontingencies may be considered a certain class of operant contingencies from a molar orientation.

Such a conceptualization is not necessarily antithetical to the metacontingency enterprise, but it is indicative of a framework that does not rely on a proposed process of cultural selection to understand cultural events and suggests other research trajectories the metacontingency enterprise has not yet explored. When cultural events are viewed as distinct from or elevated above behavioral events, not only is a specific enterprise needed to understand cultural events, but specific intermediary analyses are needed to relate cultural and behavioral events (see Hayes & Houmanfar, 2004). This is not necessary if cultural events are considered as behavioral events operating in accordance with well-established behavioral principles and processes when other factors are recognized. A molar perspective does not disagree with the unit of analysis of the metacontingency enterprise (i.e., the culturant; Baia & Sampaio, 2019), only how it is described. By focusing on the descriptive culturant (Baia & Sampaio, 2019) in terms of coordinated operant contingencies that are correlated with specific organizing events from a molar orientation, specific factors that likely contribute to the reoccurrence of those environmental alterations—that are related to both operant events and the conditions under which they occur—can be emphasized to orient research toward a wider array of functional relations relevant to the prediction and control of cultural events.

In pursuit of a science of cultural events more congruent with behavior science at large, the purpose of this paper is to reinterpret the metacontingency construct in terms of coordinated operant contingencies from a molar orientation. To illustrate differences between metacontingency and coordinated operant contingency constructs, variants of chess will be outlined and analyzed according to each construct. In doing so, arbitrary features of the metacontingency construct that delimit it as a particular class of operant contingencies, rather than a contingency operating at a higher level of selection will be identified. Affordances of a molar orientation to cultural events, will be identified, and current research likely to be relevant to understanding cultural events from a molar perspective will be highlighted.

Molar Views

Although there are several molar orientations to operant and respondent events (e.g., Baum, 1973, 2012; Fryling & Hayes, 2015; Herrnstein, 1970; Rachlin, 1992; Timberlake, 1980) and several definitions by which the term 'molar' is used (Morris et al., 1982; Shimp, 2013), molar orientations to behavior share defining features that set them apart from molecular orientations. Molar behavioral theories typically stipulate that behavior, which can be parsed into patterns of events or activities of certain durations, is controlled by or functionally related to patterns of environmental regularity, both of which can be quantified and summarized as averages or other aggregate indices. In other words, molar orientations emphasize functional relations among patterns of events or activities instead of between discrete events. Discrete operant events are not viewed as functionally related to individual reinforcing events, but rather relative response rates (e.g., Herrnstein, 1961), probabilities of responding (e.g., Baum, 1973), time allocation (e.g., Baum & Rachlin, 1969), or other aggregated measures of responding that produce environmental alterations with a common function are related to relative rates of reinforcement or punishment (e.g., Baum, 1974; Herrnstein, 1970; Herrnstein & Hineline 1966), probability of reinforcement or punishment (Jensen & Neuringer, 2008), response excess or deficits (Jacobs et al., 2019; Timberlake, 1980), or other environmental regularities. Whereas molecular approaches focus on processes that immediately alter an operant class or the behaving organism through contiguous stimulus contacts (Glenn, 1986; Shimp, 2013), molar orientations view discrete events as abstractions decontextualized from larger patterns of events or activities in which they are embedded (Baum, 1973). Any discrete response may simply constitute a snapshot of a pattern unfolding, a pattern that can be better understood and described given prolonged observation of events across various settings. In this way, molar orientations to behavior are teleological[2] in the sense that describing contiguous relations between responses and stimulus events are held as insufficient or incomplete descriptions of regularities among patterns of events that extend backward—and forward—in time. Throughout the rest of this paper, the molar orientation presented here is largely aligned with the perspectives of what Shimp (2021) has referred to as the Herrnstein School, primarily articulated through the works of Rachlin and Baum.

It should also be noted that in contemporary articulations of molar frameworks reinforcement is often abandoned as a descriptive construct of behavioral events due to several limitations. As Baum (2020) describes, such limitations include its original molecularity (i.e., reinforcement was constructed by Skinner [1937, 1938] to describe a contiguous strengthening process), its inability to account for initial occurrences (i.e., reinforcement describes a process of reoccurrence of events, not initialization) and adjunctive activities, and its restricted scope (i.e., only operant behavior that increases as a function of positive environmental alterations is well described by reinforcement; Baum, 2020). As such, induction given correlation or covariance among patterns of events (Baum, 2018; Baum & Aparicio, 2020) may be preferred to reinforcement in accounting for the persistence of behavioral patterns or the allocation of behavior. However, reinforcement and reinforcing events will be discussed here for several reasons, many of which will be elaborated below. First, reinforcement is assumed to

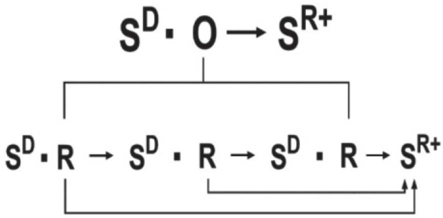
2. However, some molarists are wary of this term (Fryling & Hayes, 2015), and others use it to ascribe causal properties to temporally-extended events (Rachlin, 1992).

maintain operant events within the metacontingency enterprise; reinforcement cannot be wholly abandoned within that enterprise without reconfiguring what a metacontingency is. Second, reinforcement can be conceptualized in terms of the organization of events produced by correlations among patterns of events rather than as a strengthening process (Baum, 1973, 2012; Rachlin, 1992, 2013). From this perspective, reinforcement does not account for why certain patterns of events have organizing properties or induce behavior. Rather, it describes a correlation between patterns of discriminative, operant, and reinforcing events produced by a contingency, resulting in operant events becoming constituent acts within a pattern of behavior or the embedding of a temporally distributed operant activity within another activity. For example, lever pressing that produces access to food in an operant chamber may be said to constitute a pattern of operant events that is correlated with eating food and, thus, occurs as a constituent of eating food or an activity embedded within the activity of eating food. Third, coordinated operant contingencies can be interpreted from both molecular and molar perspectives in which referring to reinforcement offers a useful bridge in comparing different perspectives. Fourth, juxtaposing cultural selection with reinforcement is useful in highlighting specific critiques of metacontingencies and cultural-level processes. And fifth, providing molar translations of reinforcement and reinforcing events may be more constructive for those operating within the metacontingency enterprise than constructing entirely new constructs of cultural events (Fleming & Hayes, 2021).

When reinforcement is considered to describe a process of correlation between patterns of operant and reinforcing events rather than one in which an operant class is strengthened by immediate, contiguous reinforcing events, patterns of operant events can be considered to be reinforced (i.e., correlated with a pattern of reinforcing events by a contingency) instead of discrete events (Baum, 2004; Locey & Rachlin, 2013; Rachlin, 2013). This conceptualization is not entirely at odds with the operant construct (although it requires reconceptualizing reinforcement, perhaps to the point of abandoning it as an explanatory construct; Baum, 2012). Operants are functionally defined in part by consequences (Davison & Nevin, 1999; Herrnstein, 1970; Rachlin, 2017; Shimp, 2020; Skinner, 1945, 1951, 1969). Some consequences can be produced by a single environmental alteration, but some consequences require multiple environmental alterations produced by what can be analyzed in terms of multiple responses (e.g., Doughty & Lattal, 2001; Slocum & Tiger, 2011). Consequences amount to particular environmental alterations that can be mechanical or stimulatory in nature (Kantor, 1953; Skinner, 1957). To say that a pattern of operant events can be reinforced is only to suggest that (1) some patterns of reinforcing events are contingent on multiple environmental alterations and (2) multiple environmental alterations can be correlated with patterns of reinforcing events. Although patterns of operant events can always be interpreted in terms of conditioned reinforcers produced by individual operants, conditioned reinforcers only maintain reinforcing properties in certain situations in which they constitute events correlated with and discriminative of reinforcing events (see Baum [1973] for a discussion). Since conditioned discriminative and reinforcing functions are determined by relations stimuli have with established reinforcers, response chains (Findley, 1962; Keller & Schoenfeld, 1950) and similar constructs are applicable to analyses in terms of reinforcing patterns of operant events that produce specific intermediary outcomes—in which stimuli can acquire discriminative and reinforcing properties—and outcomes that function to maintain the reoccurrence of operant events under similar circumstances.

Accordingly, molar operant contingencies can be diagrammed in at least two ways, one that emphasizes successive environmental alterations and one that emphasizes the functionality of entire behavioral patterns:

Figure 1. Three-Term Operant Contingency



*Note***.** An operant three-term contingency (*above*), described in terms of a coordinated operant contingency involving discriminated responses (*below*). Arrows denote dependency relations. Dots denote evocative relations. S^D = discriminative stimuli or events; S^{R+} = reinforcing stimuli or events; O = operant events, R = constituent operant events.

Several features of Figure 1 are worth noting. First, it is important to note that the three-term contingency model (*top model*) can be used to describe an operant contingency from either a molar or molecular orientation. As noted above, a contingency model can be interpreted from a molecular orientation in which an operant class is strengthened by each contiguous consequence, but it can also be considered from a molar orientation in which conditionalities are described in terms of dependency relations that constitute a setting in which operant events and reinforcing events can be correlated. The expanded discriminative stimulus chain (*bottom model*), may appear more molecular, but notice that the difference between the two models involves replacing the "O" in the top model with a chain of "R"s linked by discriminative stimuli or events in the bottom model. An operant may consist of what some consider to be a single response (e.g., pressing a lever, although even such a "response" constitutes a pattern that takes up time; Rachlin, 1992), but it may also consist of many responses that produce discriminable environmental alterations. Since the bottom model describes a circumstance in which multiple environmental alterations, which can be analyzed in terms of multiple operant events, are required to produce reinforcing events that organize them, it can described as a coordinated operant contingency in which functional relations can become established between different environmental alterations and events that can occur given specific environmental alterations.

Depending on historical and individual factors, changes in the environment may or may not acquire discriminative functions. However, they are likely to if responses produce discriminable changes in the environment and those responses are correlated with reinforcing events (Case & Fantino, 1981; Shahan, 2010). If specific reinforcing events are conditional on multiple environmental alterations, an operant event cannot be defined by any single response or intermediary alteration, nor can any single response constitute that operant event. If some environmental events only maintain discriminative properties because of their correlation with reinforcing events, an operant event that produces such a conditioned event is incompletely defined because it is nested within a larger operant event. Accordingly, describing an operant in terms of coordinated operant contingencies only suggests that environmental alterations produced by organism-environment interactions, which constitute operant events, can be analyzed in terms of multiple dependency relations with respect to which functional relations can be established.

When behavior is viewed as being nested within larger patterns or activities (Baum, 2004, 2012), future events can be thought to cause behavior in the sense that behavior currently observed may only constitute a restricted window into an ongoing event when the entire pattern is taken to be the event. Rachlin (1992) states that this may always be the case, even when patterns comprise responses that produce what might be called immediate reinforcing events. Even "discrete responses" like a pigeon pecking a key or a rat pressing a lever comprise many events (e.g., contacting different visual stimuli, approaching objects, physical contact, etc.; Baum, 2004). Reinforcing events may be correlated with any number of environmental alterations conditional on organismic activity. Organisms respond *to produce* environmental alterations; understanding any operant event requires observation of consequences that maintain it (Rachlin, 2017) which may only be reinforcing due to correlations with other events. A history of reinforcement is important because it constitutes aspects of a pattern having already occurred, but a pattern does not end with each discrete response (Baum, 2012; Rachlin, 1992). Given that one pattern of behavior may always be contextualized within another, identifying reinforcing events is an analytical problem of identifying events dependent on organismic environmental alterations that organize and maintain such alterations which may or may not occur together at the same time or location or in a certain order.

Since molar perspectives, free from restrictions imposed by stimulus-response contiguity relations, stipulate that behavior amounts to time spent engaged in various nested activities (Baum, 2002), molarists often quantify behavioral observations in terms of time allocation with respect to producing specific outcomes (e.g., Baum & Rachlin, 1969). Analyzing behavior in terms of time allocation not only allows for standardization of all behavior on a continuous scale (Baum, 2002; Baum & Rachlin, 1969) but permits analyses of discontinuous events that share functionalities. As Baum (2002) points out, behavioral patterns do not always follow a linear sequence. Accordingly, coordinated operant contingency models, like that shown in the bottom of Figure 1, should not always be considered linearly. A coordinated operant contingency model describes dependency relations between environmental alterations and a change in circumstance that constitute a setting in which various activities can be correlated with reinforcing events. Linear behavioral sequences are functionally related to linear dependencies between necessary environmental alterations upon which reinforcing events are contingent, whether those dependencies are mechanically conditional or functionally established. Outlining an operant contingency—or any other behavioral contingency—is a matter of describing environmental dependencies that compose a setting with respect to which functional properties can be acquired and functional relations can be established and maintained[3] (Ribes-Iñesta, 1997). Even when some events require other events to occur in a particular sequence in order to occur, whether those events will occur one after the other is determined by other factors. A knight in chess will always have to be moved from a dark square to a light square in order to capture a piece on a dark square, but that does not mean that both moves will occur in immediate succession. Conversely, in order to capture a piece in a different row and column with a rook, the rook must be moved horizontally and vertically but not necessarily in any particular order. Activities are contextualized and constrained by dependencies, and those dependencies may not require environmental alterations to occur without disruption to an ongoing stream of events that result in a particular outcome. Molecular perspectives promote a linear conceptualization of events because, for intermediary events to retain reinforcing or discriminative properties, they should be contiguous with reinforcing events. This is not true for molar orientations in which reinforcement concerns correlations among events (Baum, 1973; Rachlin, 2013), although some events may only be correlated when they follow a particular sequence that may or may not require contiguity for certain environmental alterations to occur. Chess, as a turn-based game, is a special case in which dependency relations change in analytically discrete instances according to a linear sequence of events.

Chess and Contingencies

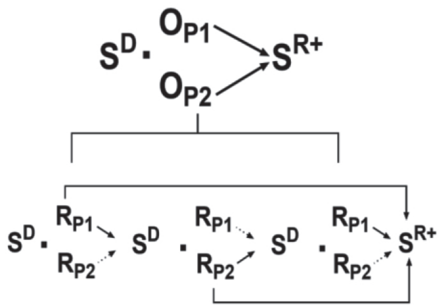
Although identifying reinforcing events of interest is a somewhat arbitrary exercise when behavior is understood as nested within larger patterns (as there may always be larger patterns), identifying organis-

3. Notably, this definition of functional relation is different than those typically described in molar approaches. A functional relation can be established between responding and stimulation based on correlations between events, such as discriminative properties of stimuli. Said differently, some functional relations are established through interaction.

mic environmental alterations that are discriminative of other alterations toward reinforcing events is useful considering that responding is sensitive to delays and other environmental changes. A certain operant event may only be effective at producing a certain environmental alteration conditional on some other environmental change. In playing chess and similar activities, operant events embedded within larger patterns (e.g., winning the game) should be sensitive to intervening environmental alterations. You could win a game of chess in four moves if your opponent never moves a piece, but you would be violating the rules and would likely encounter aversive events (e.g., your opponent complaining) rather than win the game by conventional standards maintained by players. Players must take turns playing chess to avoid aversive social mediation and to achieve a certain outcome (i.e., winning the game *fairly*), and in doing so both players contribute to environmental alterations discriminable for future responses. If one player's behavior was insensitive to environmental alterations produced by their opponent's behavior, that player would likely never win and certainly be at a disadvantage. Said differently, responding with respect to environmental alterations produced by another organism composes part of behavioral patterns correlated with or embedded in events occurring within playing a chess game (e.g., capturing pieces) that are themselves correlated with or embedded within other events (i.e., winning games).

By accounting for environmental alterations produced by another person that should likely alter responses within a particular pattern of behavior controlled by specific reinforcing events, like winning chess games, the models in Figure 1 can be redesigned in terms of coordinated operant contingencies involving two individuals, as shown in Figure 2:

Figure 2. Coordinated Operant Contingencies Involving Two Individuals



*Note***.** Solid arrows denote dependency relations. Dotted arrows denote correlated conditional relations. P1 and P2 denote behavior of different individuals.

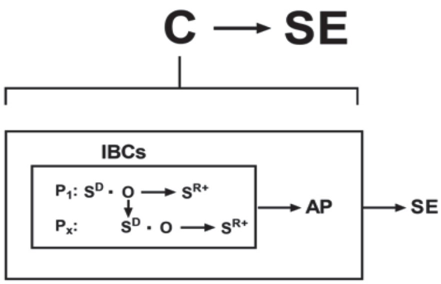
The models in Figure 2 are similar to those illustrated in Figure 1 except that two individuals are behaving with respect to reinforcing events that can only have the same probability of occurrence for both individuals if that probability is 50/50 across games. In the expanded model (*bottom*), stimuli are discriminative of response patterns for two individuals in which individuals respond in ways that produce discriminable environmental alterations for each other. While the same events may be differentially discriminative of patterns of varying complexity for each player (e.g., a certain configuration of pieces on the board may be discriminative of making one move for one player and three moves for another player), environmental events that can acquire such discriminative properties are serially dependent on the behavior of both players. Notice that, unlike in Figure 1, both models in Figure 2 are coordinated operant contingency models, not because multiple people are involved but because reinforcing events are dependent on multiple environmental alterations analyzed in terms of behavioral patterns in each case.

This type of contingency can be used to describe interactions in chess. During a game of chess, environmental events are discriminative of when one player should move a piece and when the other should wait. Environmental alterations produced by one player do not only produce potential discriminative stimuli for the other. Organisms are always behaving with respect to stimulation (Hayes & Fryling, 2018; Kantor, 1924-1926), even if in a way that does not produce discriminable environmental alterations for the behavior of other individuals. The number of intermediary environmental alterations is influenced by historical contacts that both are and are not correlated with reinforcing events in addition to structural dependencies and previously established functional relations (e.g., conditional inducers, see Baum, 2012). Although only one player can win a chess game at a time (if a draw is not forced by insufficient material or inability to move pieces), this model is still applicable when playing and winning are viewed as correlated events across games. Even if one player only wins a fraction of the time, that fraction of winning may be enough to maintain chess games and moves made within them. This feature suggests the first shortcoming of the metacontingency model, namely:

(1) Metacontingencies only describe selection of cooperative events among individuals, not competitive events

Consider the metacontingency model proposed by Glenn and colleagues (2016) below:

Figure 3. Metacontingency Involving Two Individuals



Note. Metacontingencies can involve more individuals, but at least two are required to participate within IBCs. C = culturant; SE = selecting event; AP = aggregate product; IBCs = interlocking behavioral contingencies. The relations constituting IBCs here are only an example.

In this model, two individuals are behaving in such a way as to produce a particular aggregate product on which a specific selecting event is contingent. That selecting event increases the likelihood that the culturant will reoccur. A selecting event may select a culturant in which individuals punish each other's behavior, but the model does not describe competitive situations as well as the coordinated operant contingency model. For example, the metacontingency model may describe chess playing between two individual**s** (IBCs) that ends in a completed game (an aggregate product) that may then result in cash prizes for both players (a selecting event). But competition describes a situation with differential outcomes for different individuals (Cariveau et al., 2020). To suggest that a single event can select a series of competitive interactions is misleading because outcomes of competitive circumstances are likely to have differential effects on the behavior of competing individuals. Two people may play chess together, but if one always wins while the other always loses, and only winning reinforces (i.e., is positively correlated with) playing chess, one player is likely to continue playing whereas the other is not. Rewards may maintain gameplay by both players, but, if rewards are differential based on who wins and who loses, then the selecting event refers to a set of differential outcomes. If both individuals receive the same reward for specific aggregate products—as selecting events are typically programmed to occur in metacontingency experiments—or if the same event shares a function between individuals (e.g., both individuals "win"), the situation would be less competitive than it is cooperative. Chess would not be chess.

The restricted relevance of the metacontingency model to only describing circumstances in which cooperation rather than competition is increased or maintained is not necessarily a limitation to the metacontingency model. If the metacontingency enterprise is only concerned with situations in which multiple individuals behave with respect to one another to produce shared outcomes that maintain such interactions, the enterprise may not be concerned with competition between individuals or even groups of individuals. Given the promoted relevance of metacontingency analyses for organizations and cultural events, though, understanding circumstances in which competition occurs is likely to be useful for the metacontingency enterprise. From a metacontingency perspective, entire organizations can be considered culturants that produce aggregate products (Delgado, 2012; Houmanfar et al., 2010; Krispin, 2016). Organizations can be thought of as single entities that function to produce certain environmental alterations, but they can also be considered as metacontingencies themselves in which individuals within sub-groups participate within IBCs that produce aggregate products that are selected for by internal social mediation mechanisms (Foxall, 2015; Houmanfar et al. 2009; Ludwig, 2017).

Implicitly, the metacontingency model may be used to describe competition between groups. Selecting events or conditions, like consumer demand (Glenn et al., 2016; Glenn & Malott, 2004; Houmanfar & Rodrigues, 2006), are, in some cases, likely determined on the basis of competition between groups for the same resources. In terms of contingencies, selecting events may be probabilistic because individuals within multiple groups are behaving with respect to outcomes that are not shared across groups. As such, intermittent selecting events may be indicative of multiple groups competing for the same outcomes, but, unlike coordinated operant contingency models, metacontingency models do not explicitly describe such relations. In not doing so, metacontingency models assume that individuals in groups do not participate in IBCs toward particular outcomes for other groups. Whereas coordinated operant contingency models can describe a cultural "arms race"—to borrow a classic evolutionary metaphor (Dawkins & Krebs, 1979)—in which interactions among and within competing groups evolve to maximize resources, the metacontingency model is limited to understanding change in IBCs through fluctuations in selecting events or conditions. From an evolutionary molar perspective, the Red Queen (Van Valen, 1973) is a valuable piece for understanding cultural change through coordinated operant contingency models.

The absence of an antecedent term to the culturant in the metacontingency model illustrated in Figure 2 and that proposed by Glenn and colleagues (2016) suggests a second inadequacy of the metacontingency model:

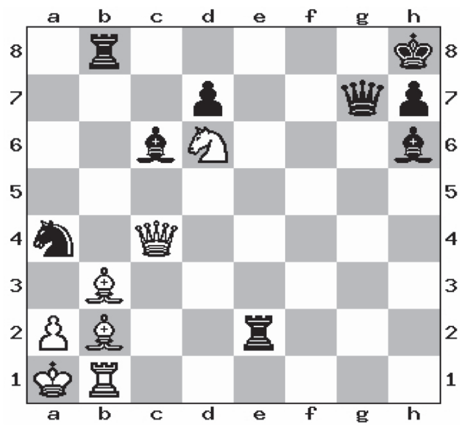
(2) Circumstances in which culturants occur are only discriminable by group members at the operant level of analysis

The lack of an antecedent term in the metacontingency model initially provoked scientific activity to account for circumstances in which culturants were likely to occur (Houmanfar & Rodriguez, 2006; Houmanfar et al., 2010), but most of these accounts are based on discriminative and/or motivational functions of stimuli shared across multiple individuals (which have been described in terms of institutional stimulus functions; see Ardila Sánchez et al., 2019). A coordinated operant contingency model can account for circumstances in which patterns of responses should occur given that discriminable functions of stimuli are established through reinforcement. Discriminable events, like operant events that produce environmental alterations, constitute constituent acts of behavioral patterns. A metacontingency account may stipulate that selecting events promote discriminative functions for an entire group, but such functions only occur with respect to specific responses by specific individuals; a group—as a single entity—does not respond in itself with respect to discriminative stimulus functions. A culturant may be more or less likely to occur in certain situations, not because a culturant is evoked or induced by stimulus contacts, but because the functionally related behavior of multiple individuals is.

Chess is a particularly useful example to illustrate the utility of molar—rather than molecular—analyses because individuals can typically respond in accordance with reinforcing events varying in immediacy and number of environmental alterations. Generally, the goal of chess is to (1) capture your opponent's king or, if you cannot win due to insufficient pieces or undesirable positioning, (2) create a circumstance where you force a draw. Capturing your opponents' kings can be described as a pattern of reinforcing event that organizes how pieces are moved across games. As capturing your opponent's other pieces is typically correlated with capturing kings (i.e., limiting your opponent's capacity to respond to your moves generally increases the relative control you can exert over your opponent's moves), a move that immediately captures an opponent's piece is likely to occur if other contingencies are not contacted. Such behavior constitutes a pattern (i.e., capturing pieces) that is reinforced by (i.e., correlated with, embedded within) winning games. However, there are often situations in which one should forgo capturing a piece immediately in order to capture a more powerful or essential piece on a subsequent move, improve positioning, or force checkmate.

For example, consider your current move as white in the chess game shown in Figure 4:

Figure 4. Your Move as White in a Chess Game



Note. Image generated from https://www.apronus.com/chess/pgnviewer/ and published with permission from author.

In this position, there are several pieces you can capture on this turn. Your queen can capture your opponent's knight on a4, light-square bishop on c6 or their rook on e2. Additionally, your light-square bishop can capture the knight, and your dark-square bishop can capture your opponent's queen on g7. If capturing stronger pieces is more positively correlated with winning games than capturing weaker pieces, local reinforcement may be maximized by capturing the queen (valued at 9 points in chess) rather than the knight (3 points), bishop (3 points), or rook (5 points). Moving a piece to any other position would not capture any pieces and thus would not maximize reinforcement on this turn. However, your best move in this position—toward capturing your opponent's king—is moving your queen to g8. Not only does this move not capture any pieces this turn, but you are forcing your opponent to capture your queen on their next turn by placing their king in check. When considering only alternatives on your current move or even your opponent's next move, this sacrifice should be selected against. However, because your light-square bishop is on the same diagonal as your queen and your dark-square bishop would place your opponent in check if their queen is moved, neither your opponent's king nor queen can capture your queen. Your opponent is forced to capture your queen with their rook on b8, allowing you to declare checkmate on your next turn by moving your knight to f7. While your best current response toward winning the game requires not capturing a piece and necessitates losing your most powerful piece, your move on the current turn produces a circumstance that allows you to win the game on your next turn. Said differently, a certain pattern of operant events is necessary to produce a particular series of environmental alterations that maximizes reinforcement in the long-term despite having to forgo what may typically constitute more immediately reinforcing alternatives in the short-term, given that responding with respect to such alternatives is also correlated with winning games.

A chess game may be analyzed in terms of metacontingencies if two players compete against two other players in a turn-by-turn fashion, under certain conditions. For example, a team-based version of chess may involve players on each team alternating who moves each turn. If each player's behavior is under discriminative control of the board arrangement and who moved last, relations among the behavior of all players—including those on each team—constitute IBCs. Although IBCs involving behavior of all players produce aggregate products (e.g., completing a game), only IBCs of one team results in winning the game. This alteration in itself is not enough to constitute a circumstance well-described by metacontingencies, though, because:

(3) Selecting events may not be well characterized as external to IBCs

Because winning the game is not an event external to the culturant (i.e., IBCs resulting in completing a game), winning the game in itself cannot be considered a selecting event unless aggregate products can be considered selecting events. Glenn and colleagues (2016) suggest a possible metacontingency variant in which aggregate products also function as selecting events with reinforcing functions, echoing earlier constructions of metacontingencies in which IBCs are automatically selected (Glenn, 2004), but that conceptualization is not reflected in their most recent definition of metacontingency. In order for a selecting event to be external to a culturant, an event must be contingent on an aggregate product, not the aggregate product itself. This may involve receiving a reward for playing the game—as suggested by an example given by Glenn and colleagues (2016)—or some other environmental alteration contingent on an aggregate product.

Even if selecting events are programmed to be contingent on aggregate products, they may not be external to IBCs in at least three ways. First, for a selecting event to be external to IBCs in which the behavior of individuals is maintained by reinforcement, selecting events should not have reinforcing properties. Glenn and colleagues (2016) suggest another metacontingency variant in which this is the case. If so, the behavior of individuals participating within IBCs may be controlled by mutual reinforcing events in which other events acquire discriminative and reinforcing properties through correlation (de Carvalho et al., 2020), making a construct like cultural selection unnecessary. Second, events programmed to be external to IBCs may actually constitute environmental alterations within IBCs over the long term. An event may be made contingent on an aggregate product, but that event may only acquire selective properties because it is discriminative of a lack of an aversive event. This is a possible interpretation of iterated prisoner's dilemma game experiments in which individuals consistently cooperate with each other rather than maximizing immediate rewards by defecting. If group members consistently cooperate to avoid circumstances in which others are likely to defect and minimize rewards for all members, rewards earned may only be indicative of loss avoidance. And third, selecting events may be utilized as "programmed" reinforcing or punishing events by individuals aware of environmental dependencies (Rachlin et al., 2000). If one individual is aware of conditions necessary to produce environmental alterations, they may behave to produce such alterations when others behave in one way or behave in a way that does not produce such alterations when individuals behave in other ways. This type of interaction does not necessarily even require an individual to be aware or able to describe contingencies controlling their behavior (Skinner, 1974), but such awareness is likely given ample histories of self-observation with respect to contacted contingencies.

Another issue arises even if the behavior of all group members is not sensitive to selecting events:

(4.a) Selecting events may always be described as temporally-extended reinforcing events for patterns of behavior

This would likely be the case in the example described above if teams of players took turns playing instead of a normal chess game. Imagine that Figure 1 is showing your partner's turn. Your partner's behavior may be under control of a contingency in which immediately capturing queens is correlated with winning games. As such, they may be likely to capture the queen with the light-square bishop from the previous example. If you are behaving with respect to possible outcomes of making such a response (e.g., capturing your bishop with their bishop while placing you in check, followed by a loss of additional material) and that of moving the queen to g8, you may tell your partner, "Don't take their queen. Move yours to g8." Your instruction may induce your partner's response of moving your team's queen to g8. Such an interaction is describable as an IBC and conventional in a way that influencing your partner's moves by making moves on your turn or otherwise altering an environment is not. The behavior of group members may be sensitive to the same contingencies, but they do not have to be; verbal behavior allows IBCs to operate despite differential partial contact with contingencies. Complex verbal repertoires and different histories of contingency contact participate in sensitivity to certain contingencies that exert control over the behavior of others whose behavior may not be sensitive to such contingencies. Reinforcing events contingent on the behavior of multiple individuals can foster the maintenance of complex IBCs in which group members reinforce and punish each other's responding, whether through praise, reprimands, or other events. Not only is verbal behavior thought to be facilitative for cultural selection in this regard (Glenn, 1991), but numerous metacontingency experiments have demonstrated the maintenance of such "leader-follower" interactions in which one individual "tells" other group members how to behave, either by direct instruction (Hosoya & Tourinho, 2016; Sampaio et al., 2013) or presentation of stimuli discriminative of specific events (Hunter, 2012; Smith et al., 2011). In other experiments, group members have been shown to punish responding by implementing timeout (Ortu et al., 2012) and fining (Morford & Cihon, 2013).

Although these interactions are typically provided as evidence of IBCs, they are also indicative of different patterns of operant events organized by the same pattern of events with reinforcing properties for different individuals' behavior. Just as delivering instructions and providing praise for following them may constitute a pattern of operant events that is reinforced, following instructions may also constitute behavior that is reinforced by the same events. If the correlation between patterns of reinforcing events and behavior is weakened, one group member may be just as likely to stop delivering instructions as another is to stop following them. What operant events occur when reinforcement is leaned is dependent on available alternatives, behavior that has been previously correlated with such reinforcing events, and other contextual and historical circumstances. In terms of metacontingencies, understanding the likelihood that group members continue producing aggregate products when selecting events are leaned will always depend on behavioral factors relevant to a given circumstance.

Our chess example can be amended, again, to avoid a situation in which selecting events can constitute reinforcing events for patterns of behavior for all group members. Suppose that your team is playing in a televised chess tournament. All chess players are playing by the same set of rules in which the goal of the game is to capture your opponents' king. However, after a couple rounds, the director of the chess tournament is informed that ratings are declining and advertisers are withdrawing their ads, resulting in a loss of revenue. The director, in an attempt to boost ratings, may alter the rules of the tournament so that, in order to win games, (1) teams must lose their king before their opponents do and (2) pieces must be captured when able. Altering winning conditions would likely alter aggregate products produced (i.e., losing your king first instead of capturing your opponents' king first). Accordingly, how each team plays would be controlled by the pattern described by winning conditions institutionalized, but those interactions would not in themselves explain the change in winning conditions. Although the behavior of team partners would be organized by different reinforcing events, they would unlikely be able to contact changes in conditions determining reinforcing events, or the entirety of patterns in which changes in reinforcing events are nested. In such a case, individuals whose behavior participates in IBCs would likely be determined by events that could not function as reinforcing events because they do not contact them. However, an individual—the director—is still contacting such events, and their behavior would likely be reinforced on the basis of payments for increasing ratings, in this example. Accordingly:

(4.b) Selecting events may always constitute temporally-extended reinforcing events for controlling the behavior of others, even if not all individuals contact them

There is likely not a case in which complex social reoccurrences are not in part controlled by the behavior of others whose behavior is under control of temporally-extended reinforcing events. Individuals that control operant contingencies (i.e., arrange conditionalities between operant and reinforcing events) by which other individuals' behavior is controlled in organizational settings may not always be privy to events and conditions that exert influence over their behavior or that of others, but their operant behavior is likely always organized by patterns of events correlated with their behavior, temporally-extended or otherwise. It is likely that the maintenance of IBCs in such circumstances is in part influenced by sensitivity to temporally-extended events.

Cultural Selection

The issue of sensitivity to molar contingencies is indicative of the utility of the metacontingency construct toward understanding relevant factors related to the reoccurrence of culturants, which may be summarized as:

(5) Focus on cultural selection may obscure relevant factors that determine the extent to which IBCs reoccur

Although some scientific workers within the metacontingency enterprise are concerned with understanding the composition of IBCs (see Baia & Sampaio, 2019 for a discussion on descriptive culturants), a substantial proportion of scientific activity is primarily focused on how selecting events increase or decrease the probability of culturant reoccurrence. Because an emphasis is placed upon reproduction of aggregate products, IBCs are often assumed by observation of aggregate products. In some cases, observation of behavioral occurrences within IBCs has been dismissed on the basis of reductionism (Glenn, 2004; Houmanfar & Rodriguez, 2006; Houmanfar et al., 2010). According to Ortu and colleagues (2012):

> "It is not clear that such explanation [of behavior within IBCs] is required any more than explication of neural changes is required to establish the functional relations of operant analyses." (p. 120).

While there may be functional relations between culturants and selecting events that are not analogous to those between operant and reinforcing events, experimental evidence from metacontingency studies suggests that factors that contribute to sensitivity to temporally-extended events are important. As noted above, several scientific workers have observed leader-follower interactions in which one individual's delivery of instructions facilitates others contacting contingencies in metacontingency experiments. Besides the relevance of an individual's history of contacting instructions, other factors may determine the extent to which an individual's behavior is sensitive to temporally-extended events, like delay discounting. In the behavior-analytic enterprise at large and the behavioral economic enterprise in particular, delay discounting assessments have been developed as a measure of "temporal horizons" (Bickel et al., 2006), or the degree to which an event can function as a reinforcer despite delay to its receipt. Leader-follower relations also suggest that the extent to which individuals share histories of interacting within similar verbal communities, derive stimulus relations, and respond according to abstract properties of stimulus objects may be especially relevant for the production of aggregate products. When IBCs are assumed, though, not only is investigation of relations regarding these factors obscured but they are also not controlled for. If factors that contribute to the production of aggregate products are not accounted for, relations constructed between culturants and selecting events may lack generalizability. Interpreting cultural events in terms of coordinated operant contingencies from a molar orientation may engender scientific activity toward behavioral factors such as these when the nesting of operant events rather than culturants is emphasized.

The importance of these factors has not escaped recognition by some within the enterprise. Several scientific workers within the metacontingency enterprise have discussed the relevance of understanding relational responding (Houmanfar et al., 2009; Mattaini, 2019), although delay discounting has not been incorporated into metacontingency frameworks. When the possible relevance of behavioral factors is discussed, it is typically discussed in terms of interdisciplinary relations. Accordingly:

(6) Focus on cultural selection may foster construction of relations among redundant constructs across enterprises

If dependencies and processes concerning cultural events are considered in behavioral terms, parallel constructs across levels are not necessary. For example, one might contend that sensitivity to reinforcement is different than sensitivity to cultural selection. Sensitivity to temporally-extended reinforcing events may be measured in terms of delay discounting, but another metric may be necessary to measure sensitivity to temporally-extended selecting events. Such a construct would not be necessary when describing cultural events and factors in terms of coordinated operant contingencies from a molar orientation, but they may be considered essential for accounting for factors relevant to understanding cultural selection. The development of several terms parallel between the metacontingency enterprise and the behavior analytic enterprise at large to describe cultural events and relations—such as cultural reinforcement (Baia & Sampaio, 2019), cultural punishment (Baia & Sampaio, 2019), and cultural cusps (Glenn et al., 2016; Malott, 2019)—suggests that the metacontingency enterprise may be constructing a science that necessitates relating constructs between enterprises rather than an independent enterprise that relates events to other events pertaining to its own subject matter. A molar coordinated operant contingency account does not deny the possibility of functional relations exclusive to cultural patterns (e.g., those related to rate of aggregate product production) or the analytical utility in doing so, only the need to discuss them in terms that are not behavioral.

A molar coordinated operant contingency account may be criticized on the basis that, by framing processes in behavioral terms, it does not consider sociological aspects of cultural events. This position is highlighted clearly by Baia and Sampaio's (2019) distinction between descriptive and functional culturants. One may contend that behavioral events occurring in IBCs—which can be described as descriptive culturants—may be functionally related to processes that alter the reoccurrence of functional culturants. As such, conducting separate analyses of behavior occurring in IBCs and increases or decreases in culturants by altering conditions under which selecting events occur may reveal relations between operant events and culturants. Such analyses can be performed, but they would still be possible even if events were framed in terms of coordinated operant contingencies without needing to mediate effects of consequences on behavior through cultural constructs. For example, rather than analyzing relations by which the composition of IBCs changes when culturants decrease as a result of leaning schedules of selecting events, changes in patterns of behavior functionally related to leaning schedules of mutual reinforcement can be analyzed when selecting events are considered reinforcing events.

Molar coordinated operant contingency descriptions may also foster analyses of sociological factors that have largely been ignored in metacontingency experiments. While many metacontingency experiments have utilized remarkably interesting designs that are well-suited for conducting parametric analyses of changes in circumstances afforded by group interactions and programmed selecting events, such as monetary rewards, few have explored relations between production of aggregate products and changes in sociological circumstances that may influence behavior. For example, reconsider the chess tournament described above in which the tournament director changes winning conditions based on revenue-generating ratings. Not only can generating revenue be considered a pattern of reinforcing events that organizes the production of aggregate products, but revenue accumulates and may participate in different behavioral patterns when it does. The director may be able to use additional revenue to increase ratings without altering winning conditions, such as by paying renowned chess players to participate, purchasing better televising equipment, or expanding the size of the tournament. Metacontingency experiments often utilize points that may be used in this way, but analyses are not performed on relations between increasing an individuals' capacity to produce environmental alterations and which alterations occur.

Most metacontingency experiments that demonstrate IBCs involve constructed conditions under which participants can earn more points by cooperating with other group members to produce rewards than they can alone. Although important, it seems that:

(7.a) Focus on cultural selection may be preventing examination of conditions under which IBCs are likely to be established

Procedures within the metacontingency enterprise are designed to promote production of specific, discrete aggregate products, and sometimes to force the occurrence of IBCs (e.g., Sampaio et al., 2013; Tadaiesky & Tourinho, 2012). To this end, most metacontingency experiments involve discrete trials in which (1) all group members must make a certain type of response (e.g., pressing one of an array of buttons) and (2) selecting events are programmed to occur contingent on aggregate products dependent on responses by all group members. These requirements may be useful for increasing the probability that individuals contact contingencies in which certain consequences are produced by multiple individuals, but—more often than not—circumstances are not arranged in a way that, without these requirements, all group members would need to participate in order to produce consequences. For example, in an experiment by Sampaio and colleagues (2013), different individuals were required to place figures with different numbers of arrows pointed in different directions onto a board. The figures had to be arranged in accordance to sample figures as well as the order in which they were placed on the board. Although participants may have worked together to fill out the board, it is unlikely that they would have worked together if one individual was allowed to place all the figures on the board. Leader-follower interactions were observed in which one individual across groups essentially did initially "place" all the figures on the board by instructing other individuals how to place their figures. If experiments were based on a molar coordinated operant contingency model, emphasizing behavioral factors may orient research toward circumstances in which multiple individuals behave together to produce reinforcing events when alternatives that do not require cooperation are possible. Such an approach may lead to investigations on delay reduction facilitated by IBCs and how different behavioral repertoires are established to produce certain environmental alterations rather than circumstances where participants work together to produce rewards in settings that cannot be produced otherwise.

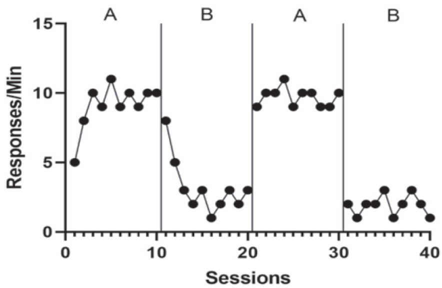
In a similar vein:

(7.b) Focus on cultural selection may not foster analyses concerned with which contingencies are contacted

Behavior that is functionally related to the behavior of others is often exceedingly creative and complex. Playing chess, whether on a team or not, can involve individuals making moves that are only correlated with events several moves removed or nested within activities that actualize over the course of several moves. Organizations develop complex internal practices for researching the long-term profitability of products. Sports teams devise strategies unexpected by their opponents to achieve goals. Society as an environment offers individuals an exceeding number of alternatives correlated with the same reinforcing events (e.g., earning money). By insisting that IBCs can be assumed or by focusing on arranging situations in which they can be safely assumed, metacontingency experiments have not focused on how IBCs can become more intricate, efficient, and complex across environmental alterations with varying behavioral and sociological factors. Said differently, metacontingency experiments have not been devised to allow for observation of events and factors contributing to the variability observed in IBCs within environments experimental settings attempt to emulate by providing groups with ample means of demonstrating that variability. By limiting rates of reinforcement possible through imposing discrete trials (e.g., Costa et al., 2012), forcing all group members to respond to produce cultural consequences (e.g., Soares et al., 2019), not offering multiple response options by which reinforcement can be progressively maximized based on progressively more complex discriminations and event organizations, and not focusing on the transformation of IBCs (e.g., Vichi et al., 2009), metacontingency experiments have not capitalized on the complexity their subject matter affords when it is allowed to progress further from individuals gaining smaller or larger rewards (i.e., participants participating in higher valued patterns where they can access greater and greater rewards dependent on reorganization given established functional and dependency relations).

To some extent, experimental controls established to study operant processes may have provided a poor model for understanding sociological factors related to cultural events. Consider the data represented in Figure 5:

Figure 5. Hypothetical Single-Subject Data

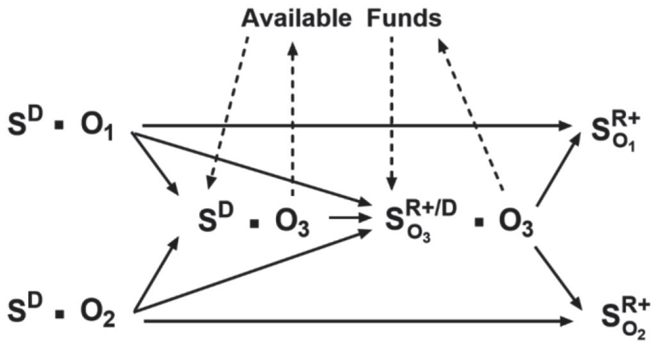


If only one variable is manipulated across A and B conditions, an experimenter has arguably demonstrated a functional relation between behavior and that variable. Restricting differences between conditions is fundamental to demonstrating functional relations of this kind. If such controls were not implemented, determining the "cause" of behavior change would be unclear because more than one environmental change may be functionally related to behavior observed. Maintaining regularity within conditions, including those described by contingencies, may be ideal for studying processes like cultural selection only when parameters of selecting events are considered. However, selecting events may produce changes in circumstances in which individuals are able to behave within higher valued patterns. This is a critical feature of culturants. Since selecting events maintain operant contingencies, they maintain evolving social environments in which multiple individuals behave. As behavior changes, so do the various social environments of individuals participating within IBCs. Demonstrating changes in rate of occurrences of a culturant using graphs like that above may be possible and is standard practice, but, unlike variation within operant responses, variation within occurrences of culturants may undermine their stability across time when social dynamics and cumulative sociological factors are considered. As such, each data point for such a graph may be indicative of new behavioral conditions that, in turn, may influence future iterations of culturants described through data points.

Herein lies what may constitute a defining difference between culturants and operant events. Although culturants may always be described in terms of coordinated operant contingencies, operant events do not always involve behavior in which individuals control environmental conditions that is, in itself, controlled by correlations with reinforcing events. Arranging contingencies that control the behavior of others may simply constitute more behavior that produces the same reinforcing events more effectively. Metacontingency experiments are often devised to demonstrate an increased probability of producing more rewarding consequences when individuals behave in accordance with selecting events contingent on aggregate products rather than when they behave alone (e.g., Costa et al., 2012; Sampaio et al., 2013). However, such experiments often dichotomize outcomes so that an individual may either produce consequences contingent on their own behavior and/or (as the consequences may not be exclusive) participate in producing consequences contingent on the behavior of multiple individuals. Variation among operant events may not be of interest to experimenters because operant events are defined by reinforcing events contingent on the environmental alterations they produce. Culturants can be defined in a similar way, but inherent within the culturant construct is the progressive maximization of abstracted properties of outcomes by altering environments in which behavior occurs. As Glenn (2004) states, individuals work together when working together produces something more than each participating individual could achieve alone. Contact with outcomes that are progressively reinforcing by virtue of establishing more and more intricate and effective IBCs may be a process of interest to scientific workers within the metacontingency enterprise concerned with prediction and control of cultural events. This type of process may even describe an alternate cultural selection process, one in which the selection of new interlocking patterns of behavior can be accounted for.

To illustrate how the influence of selecting events on culturants may be determined by social interactions occurring within IBCs, consider a simplified chess tournament example suitable for an experimental setting arranged according to relations represented in Figure 6. Suppose there are three participants at different computer terminals completing trials for points that can be exchanged for money at the end of the experiment. Two participants—P1 and P2—are asked to select one of the six different chess pieces each trial (left-most S^Ds). After both participants (O_1 and O_2) have made their selections, participant P3 is then asked to state whether or not the two pieces selected match two specified pieces (S^D before the left-most O_3). P3 can generate the most amount of points by stating that they do match when they do and generate less points in any other circumstance. As such, points are determined by how P1, P2, and P3 respond. After receiving points ($S_{O_3}^{R+/D}$), P3 can then disperse points to P1 and P2 to reinforce selecting certain pieces ($S_{O_1}^{R+}$ and $S_{O_2}^{R+}$), retain points in a group bank to use on additional trials, or allocate points toward their own personal bank for exchange at the end of the experiment (right-most O_3). Across trials, the pieces P1 and P2 should select to maximize rewards may change, and P3 may disperse points differentially to maximize points as requirements change.

Figure 6. Coordinated Operant Contingencies Related to Accumulating Rewards



When conceptualized in terms of coordinated operant contingencies from a molar orientation, not only can the relevance of sociological factors that change in accordance with IBCs be highlighted at particular actionable nodes of environmental alteration, but interactions that may be related to the reoccurrence of culturants can be identified. For example, it is clear by this model that minimizing points delivered to P1 and P2 should increase the longevity of the interaction. If conditions were arranged so that new aggregate products (i.e., P1 and P2 selecting pieces matching those shown on to P3) were frequently necessary to maximize points delivered to P3, total points may be maximized if (1) P3 keeps a large proportion of points in the bank to maintain responding by P1 and P2 in the absence of trials that generate points and (2) P3 always disperses marginal amounts of points to P1 and P2. P3 can always undermine the rate of occurrences of the culturant by allocating more points to their own bank for short-term gains, but their own points—and those for the other group members—can also be maximized in the long-term by maintaining enough points to consistently correlate reinforcing events with responding by P1 and P2. If P3 diminishes available funds to levels lower than those necessary to maintain consistent responding by other group members, P3 may become unable to maintain contingencies that control the behavior of other group members and, subsequently, point maximization. In this sense, available funds can be considered a sociological factor, not simply because it constitutes a necessary condition for consistently generating aggregate products but because it determines the extent to which one individual can maintain contingencies that control the behavior of others.

Affordances provided by sociological factors determined by IBCs may partially explain why interactions described by metacontingencies persist across individuals. In the above example, if P3 can maintain a high level of available funds, the production of aggregate products may be maintained despite trials that fail to generate sufficient points. This type of cushioning can allow for persistence of aggregate product production despite behavioral changes that may inhere short-term costs with long-term benefits as operant events are organized by reinforcing events. New group members can be trained in order to maximize long-term gains. New aggregate products may be produced that require several attempts in order to generate larger gains. Sociological factors may constitute conditions that promote variation—or growth—in IBCs with specific risks. As such, risky behavior (Hastjrarjo et al., 1990; Molm et al., 2009; Pietras et al., 2003) is likely an important consideration for understanding the maintenance of occurrences of culturants occurring in everyday settings. IBCs that do not involve risky behavior are not likely to persist given that contacting other patterns of operant events may be necessary for continued contact with reinforcing events.

Competitive contingencies do not only describe the probability of selecting events or conditions external to IBCs. Conflict within IBCs may arise based on differential contacts with events. If either P1 or P2 is able to contact the amount of points generated each trial, they may behave in ways that maximize reinforcement in the intermediate-term while jeopardizing maximization in both the immediate and the long-term. For example, P1 can exert countercontrol (Delprato, 2002) by selecting pieces that do not maximize points delivered to P3 on any specific trial to increase the number of points P3 delivers when correct pieces are selected. In the short-term, such countercontrol measures are unlikely to maximize points acquired by any group member given that (1) P3 is not able to maximize points when P1 and P2 do not select certain pieces and (2) P3 is likely to deliver less or no points for incorrect responses to produce variability in what P1 and P2 select. In the long-term, reinforcing P1 or P2's behavior with as few points as possible should allow for aggregate product generation to be maintained as long as possible, as circumstances may arise in which points are seldom earned (e.g., points become contingent on increasingly diverse and novel aggregate products). These types of patterns of responses are dependent on specific stimulus contacts. Given that the reoccurrence of particular environmental alterations may be undermined if more group members are able to contact selecting or other environmental events, describing individual patterns of behavior participating within IBCs that may extend across different time-scales is not only important for constructing precise accounts of interactions but determining changes in pattern participations across occurrences.

It should also be noted that interactions like those modeled in Figure 6 may not follow the linearity between group interactions and selecting events suggested by the metacontingency model. When a coordinated operant contingency model is utilized from a molar orientation, the internality of selecting events within IBCs is emphasized. Selecting events, like receiving points or generating revenue, may only participate in the maintenance of IBCs because they provide resources that individuals can effectively use to maintain the behavior of others. If such events are necessary to provide means by which individuals can maintain contingencies, those events can be considered integral to IBCs extended across time, especially in cases where maximization involves continuously increasing control of environmental events. IBCs may always be maintained by selecting events like maximizing revenue, but revenue acquired now may not only be acquired now to maximize additional revenue in the short-term but to increase capacity to maximize revenue in the long-term. When considered in molar terms, selecting events may always be poorly characterized as external if they participate in more temporally-extended patterns. In the case of contingencies like those modeled in Figure 6, they may not even be external to temporally-restricted IBCs given that they may provide the means by which individuals can control the behavior of others that constitutes IBCs.

The principle for minimizing behavioral costs to maximize long-term benefits produced by the behavior of multiple individuals may carry important implications for understanding abstract cultural patterns. While many cultural interactions may be maintained by events like those depicted in these examples in which individuals behave in ways that maximize monetary gains with clear relevance to constituting larger patterns of survival, selecting events may be produced longer when financial resources do not need to be expended to maintain IBCs. Some may play chess for prizes, but most people do not. Winning chess games organizes moving pieces within chess games. A citizen may pick up trash off the street simply because the overt pattern of being a good citizen is highly valued, just as a spy may assassinate a foreign diplomat because serving their country is a temporally-extended reinforcing event that organizes such acts. None of these events are as simple as they seem (a myriad of factors should be considered in every case), but in each case self-observation allows for the constitution of abstract, temporally-extended patterns of behavior to organize events that may otherwise be unrelated. These types of pattern would likely not persist if they were not correlated with other reinforcing events (e.g., eating food), but when such conditions are minimally maintained, events with no direct survival value may function as reinforcing events due to their correlation with other reinforcing events. As all of these cases are also interpretable in terms of molar contingencies in which consequential events share abstract, acquired properties that define patterns that serve as final causes for behavior (Rachlin, 1992), molar accounts may be fundamental for understanding how societies maintain practices by which certain environmental alterations acquire reinforcing properties so that the behavior of individuals is more easily and efficiently controlled.

Conclusion

Interpreting metacontingencies in terms of coordinated operant contingencies from a molar perspective does not only raise concerns for the metacontingency enterprise but offers ways of thinking about cultural events to address limitations and conceptual discontinuities that constrain the metacontingency construct, as shown in Table 1:

Table 1. Metacontingency Concerns and Molar Insights

Metacontingency Concerns	Molar Insights
Metacontingencies only describe selection of cooperative events among individuals, not competitive events	Environmental events with differential functions across individuals may maintain IBCs when outcomes are probabilistic. IBCs may become increasingly complex to increase probabilities of those outcomes
Circumstances in which culturants occur are only discriminable by group members at the operant level of analysis	Environmental events acquire discriminative functions when contacts are correlated with reinforcing and aversive events
Selecting events may not be well characterized as external to IBCs	Selecting events constitute environmental regularity that promote IBCs, reinforcing events, and means by which individuals control the behavior of others
Selecting events may always be described as temporally-extended reinforcing events for patterns of behavior, even if not all individuals contact them	Selecting events alter behavior through behavioral processes that are useful to identify in order to predict and control environmental alterations that are dependent on multiple responses. Such prediction and control may be functionally related to the number of individuals who directly contact selecting events
Focus on cultural selection may obscure relevant factors that determine the extent to which IBCs reoccur	Metacontingency experiments should focus on factors that determine when individuals work together to produce particular outcomes when they do not necessarily have to in order to access certain consequences
Focus on cultural selection may foster construction of relations among redundant constructs across enterprises	Behavioral functions of environmental alterations should be identified to avoid attributing causal properties to cultural processes that are dependent on behavioral processes and particular functional relations constituting IBCs. Expansionism should be avoided
Focus on cultural selection may be preventing examination of conditions under which specific IBCs are likely to be established, and it may not foster analyses concerned with which contingencies are contacted.	Metacontingency experiments should be arranged to allow for individuals to extenuate how IBCs evolve contingent on affordances produced by them. The elaboration of patterns of problem solving may, in itself, constitute a form of cultural selection amenable to both cooperative and competitive circumstances

A molar perspective on cultural events highlights the importance of distinguishing descriptive from functional culturants (Baia & Sampaio, 2019). Analyzing how certain environmental alterations produced by multiple individuals become more or less probable is certainly a worthwhile endeavor for any behavioral enterprise interested in cultural events. When considered from a molar behavioral perspective, though, emphasis is not placed on whether an alteration was produced by one or multiple individuals but rather factors contributing to individuals behaving together instead of individually to produce outcomes. There are certainly important relations to be investigated when individuals behave to produce common outcomes in settings where they are required to do so, but it is likely that the probability of environmental alterations is functionally related to conditions in which individuals behave together to produce certain outcomes. If metacontingency experiments continue to focus on increasing or decreasing the production of aggregate products when participants are each required to respond to produce particular environmental events, the enterprise may be restricting the generality of findings to contrived situations in everyday life where individuals only work together in compliance with rules requiring them to do so. If participants are not required to work together to produce certain outcomes given rules delivered, many metacontingency experiments may constitute competitive situations in which individuals arrange contingencies to prevent other individuals from contacting reinforcing events in order to maximize reinforcement. IBCs may involve individuals specifying rules for behaving in such circumstances, but, when such rules are dictated by experimenters, experimenters themselves may be effectively participating in IBCs they are assuming occur when aggregate products are produced.

The molar orientation presented here suggests different experimental designs than have been previously examined in metacontingency experiments. Metacontingency experimenters may find “meta-experiments” like that described above in which dependency relations are arranged so that one individual maintains reinforcement contingencies for the behavior of others to be a useful procedure for studying metacontingent control. Some metacontingency experiments have demonstrated IBCs by virtue of discriminative stimulus control (Sampaio et al., 2013; Tadaiesky & Tourinho, 2012), but few if any metacontingency experiments have demonstrated control over how one individual controls the behavior of others through arranging contingencies through which individuals reinforce the behavior of others. Not only is such an experimental arrangement more aligned with the idea that metacontingencies select operant contingencies (even if they can be described in terms of differential contact with operant contingencies), but they may be useful for an inward examination of behavioral science itself. By reinforcing the behavior of an individual who is able to control the behavior of others in particular ways, metacontingency experimenters may be able to begin to analyze cultural and sociological factors that contribute to predicting and controlling the behavior of others as behavior scientists do.

This perspective also promotes a different set of cultural analyses than those typically utilized in metacontingency experiments. Coordinated operant contingency models should not be thought of as static because cultural change is defined in part by changes in dependency relations and established functional relations by individuals behaving with respect to one another. Understanding cultural change from a molar coordinated operant contingency perspective is a matter of describing changes in these types of relations as the behavior of individuals interacting with one another and other environmental events evolves. Investigating changes in frequency of occurrences of culturants may reveal important inquires but does not capitalize on the dynamics of complex cultural change. Not only may metacontingency experiments benefit from allowing for and analyzing change in IBCs when different organizations of IBCs allow for differential outcomes across different dimensions (e.g., reward magnitude), but they may also be used to study the contribution of sociological factors to the establishment of different IBCs while retaining a behavioral orientation with respect to dependency and functional relations. This approach may be considered reductionistic by those who hold cultural processes to be more than behavioral processes occurring in tandem, but it is by no means expansionistic.

Skinner (1984) suggests that cultural selection operates without requiring processes additional to or above those occurring on the operant level of analysis. Cultural selection processes may always parallel operant processes or be described in operant terminologies when cultural selection is thought to describe the selection of culturants, but describing the evolution of IBCs may in itself describe a certain type of cultural process conducive with the aims of understanding factors that increase or decrease the probability of functional culturants. Like pressing a key faster to maximize reinforcement, cultural events may be thought to occur when individuals control the behavior of others to more effectively produce certain outcomes. Even if metacontingency experiments arrange environmental conditions that promote individuals working together when they do not necessarily need to in order to produce the same outcomes (but perhaps at a faster rate, for example), they may not necessarily be arranged to continue to allow for IBCs to evolve in accordance with contacting higher-valued reinforcing events. Certain factors limit the extent to which individuals may control environmental conditions. Investigating how individuals control contingencies toward maximizing reinforcing outcomes—and which factors reliably thwart maximization—may not only be important for understanding cultural change but is seemingly in line with Skinner's (1981) proposition that cultural selection describes group problem solving.

Considering that any environmental regularity produced by individuals controlling the behavior of others may constitute a necessary environmental alteration correlated with reinforcing events of higher value, a molar perspective may be valuable insofar that it promotes analyses by which cultural activities are embedded within other activities. Not only is a molar perspective empirically coherent with findings from behavioral analyses, but several molar behavior analysts have constructed accounts of preanalytic assumptions underlying their accounts of behavior (Baum, 1973, 2012; Rachlin, 1992). Although many workers within the metacontingency enterprise have discussed philosophical orientations to differentiating cultural from psychological events (Glenn, 1986, 1991, 2004; Houmanfar & Rodrigues, 2006; Houmanfar et al., 2010) and others have commented on shared preanalytic assumptions between metacontingency orientations and cultural materialism (Glenn, 1988; Houmanfar et al., 2001), the metacontingency enterprise has yet to specifically lay out its assumptions regarding behavioral and cultural events and factors pertaining to both. Although the enterprise does not necessarily have to decide on a molecular or molar approach per se (e.g., Shimp, 2020), a clear orientation may be constructive.

Ribes-Iñesta (2018) pointed out that the dichotomy molecular-molar in behavior analysis is used in two ways: (a) as a type of analysis or theory (i.e., a model) and (b) as a mode of investigation or methodology (i.e., some measurement units). Moreover, Ribes-Iñesta argues that method and theory should not be developed separately, therefore, a proper molar account of behavior can only result from a balanced progress between these two scientific activities. This may be why although some behavior analysts have developed molar frameworks (Rachlin, 1992) and molar measurement units (Baum, 1995), their general model remains molecular insofar they are still based on Skinner's (1938) molecular categories of behavior (e.g., rates of events) extended in time. Methodologies that isolate response and stimulus functions and theories whose relevant facts are single responses of organisms are insufficient to show the total organization of the event; a field perspective is required to fully account for the molar dimensions of behavior. In contrast with an operant molar analysis, a field-oriented analysis focuses on total configurations rather than selection of patterns or activities. The field is a molar unit that represents a specific organization of factors as a system or event. Field theorists (e.g., Kantor, 1924-1926, Ray & Delprato, 1989, Ribes-Iñesta, 2018) contend that the study of behavior is necessarily a molar affair having specific implications for an understanding of human and animal learning. From this perspective, behavior-environment relations are conceptualized within a field of interdependent factors, and learning is conceived as reorganization of field-factors rather than in terms of acquisition of repertories, patterns of responses, or time allocation. This view is shared by W. Timberlake and colleagues who developed a behavior systems framework (Timberlake, 1983, Timberlake & Allison, 1974, Timberlake & Lukas, 1989). A behavior systems view posits that behavior is organized in different levels: the behavior system, subsystems, modes, perceptual-motor modules, and actions. Further, this perspective considers that learning involves the reorganization of behavior systems with respect to environmental conditions.

All these models share important features that have been recently pointed out (Camacho, 2017, Silva et al., 2019) and represent some of the constituting elements of molar models. One of such shared features between these approaches is an ecological orientation to animal learning, that is, behavior consists of changes in terms of adaptive outcomes that follow the animal's biological equipment; behavior does not necessarily lead to instrumental or efficient outcomes (Silva et al., 2019). Another common feature of molar models is a preferred use of measurements that identify dynamic processes and functional relations (Camacho, 2017). For example, Baum (1995) identifies the feedback system in terms of the reinforcement feedback function and functional relations, and Ribes-Iñesta (2018) identifies functional contact in terms of processes of detachment and mediation relations. In general, the analysis of molar events should derive from a balanced work between (a) investigation, such as developing molar measurement units; and (b) interpretation, such as incorporating concepts that afford an analysis of molar dimensions of the products (i.e., data) of scientific investigations.

Applying behavioral-based or field-theoretical molar frameworks to understanding cultural events would not only be useful for the metacontingency enterprise but also constructive for understanding how individuals contact and construct increasingly abstract contingencies. Although several behavior analysts have discussed and experimentally analyzed factors that contribute to how increasingly complicated patterns of behavior can be reinforced, a more complete account of patterns of behavior based on acquired properties of stimuli and factors that contribute to extended behavioral events is necessary. A molar account of complex behavioral patterns may not require constructs like self-generated rule governance (Hayes et al., 1998) or relational networks (Hayes et al., 2001) to explain why behavior is maintained. Patterns of responses that involve complex discriminations are shaped by progressively complex contingencies, but the issue of capacity remains. Just as some behavioral processes—particularly those that are considered verbal—may be species specific (Hayes, 1992; Hayes & Sanford, 2014; Rachlin, 1992), some contingencies may only be contacted when supported by social factors. Molarists have explored factors that contribute to individuals behaving to maximize delayed reinforcement for all group members at the cost of forgoing opportunities to maximize immediate reinforcement in iterated prisoner's dilemma games (Baker & Rachlin, 2002; Locey & Rachlin, 2012), but additional metacontingency experiments in which particular reinforcing events require more complex discriminations based on prior events or temporally-removed rewards may be useful for elaborating a molar account of behavior.

Enterprisal considerations presented here may or may not be considered of use to the metacontingency enterprise. As alluded to, some constructs already present within the enterprise, like selecting events having reinforcing functions, suggest that some workers within the enterprise already consider behavior from molar perspectives. Despite such glimmers of a molar approach, experimental arrangements and trajectories of construct development are indicative of molecular accounts of behavior that do not seem to orient activities toward analyzing relations among events that are emphasized when reinforcement is considered a process based on correlations among events rather than contiguities between them. When metacontingencies are considered a type of molar coordinated operant contingency, they can be situated within a pattern of evolution in which the organization of operant events evolve in complexity to constitute patterns of behavior intertwined with that of other individuals. Understanding differential functions of events across different patterns of behavior—and how stimulus functions change as more complex contingencies are contacted—through analyses of molar coordinated operant contingencies may be useful for predicting and controlling the evolution of cultural events while retaining a behavioral orientation. Alternative metacontingency models were proposed by Glenn and colleagues (2016) in part to describe circumstances in which higher-order contingencies can be contacted. A molar coordinated operant contingency account serves a similar purpose while promoting a behavioral orientation that focuses on contacting reinforcing events by increasingly complex environmental alterations rather than environmental alterations that necessitate more than one individual. A molar approach does not necessarily alter the foundation of the metacontingency enterprise, just the availability of pieces scientific workers can use to play an endless game.

References

Ardila-Sánchez, J. G., Houmanfar, R. A., & Alavosius, M. P. (2019). A descriptive analysis of the effects of weather disasters on community resilience. *Behavior and Social Issues, 28*(1), 298-315. https://doi.org/10.1007/s42822-019-00015-w

Baia, F. H., & Sampaio, A. A. S. (2019). Distinguishing units of analysis, procedures, and processes in cultural selection: Notes on metacontingency terminology. *Behavior and Social Issues, 28*(1), 204–220. https://doi.org/10.1007/s42822-019-00017-8

Baker, F. & Rachlin, H. (2002). Teaching and learning in a probabilistic prisoner's dilemma. *Behavioral Processes, 57(2),* 211-226. https://doi.org/10.1016/S0376-6357(02)00015-3

Baum, W. M. (1973). The correlation-based law of effect. *Journal of the Experimental Analysis of Behavior, 20*(1), 137–153. https://doi.org/10.1901/jeab.1973.20-137

Baum, W. M. (1974). On two types of deviation from the matching law: Bias and undermatching. *Journal of the Experimental*

Analysis of Behavior, 22(1), 269-281. https://doi.org/10.1901/jeab.1974.22-231

Baum, W. M. (1995). Introduction to molar behavior analysis. *Mexican Journal of Behavior Analysis, 21,* 7-25. http://rmac-mx.org/introduction-to-molar-behavior-analysis/

Baum, W. M. (2002). From molecular to molar: A paradigm shift in behavior analysis. *Journal of the Experimental Analysis of Behavior, 78*(1), 95-116. https://doi.org/10.1901/jeab.2002.78-95

Baum, W. M. (2004). Molar and molecular views of choice. *Behavioural Processes, 66*(3), 349-359. https://doi.org/10.1016/j.beproc.2004.03.013

Baum, W. M. (2012). Rethinking reinforcement: Allocation, induction, and contingency. *Journal of the Experimental Analysis of Behavior, 97*(1), 101-124. https://doi.org/10.1901/jeab.2012.97-101

Baum, W. M. (2018). Three laws of behavior: Allocation, induction, and covariance. *Behavior Analysis Research and Practice, 18*(3), 239-251. https://doi.org/10.1002/jeab.689

Baum, W. M. (2020). Avoidance, induction, and the illusion of reinforcement. *Journal of the Experimental Analysis of Behavior, 114*(1), 116-141. https://doi.org/10.1002/jeab.615

Baum, W. M., & Aparicio, C. F. (2020). Response-reinforcer contiguity versus response-rate-reinforcer-rate covariance in rats' lever pressing: Support for a multiscale view. *Journal of the Experimental Analysis of Behavior, 113*(3), 530-548. https://doi.org/10.1002/jeab.594

Baum, W. M., & Rachlin, H. C. (1969). Choice as time allocation. *Journal of the Experimental Analysis of Behavior, 12*(6), 861-874. https://doi.org/10.1901/jeab.1969.12-861

Bickel, W. K., Kowal, B. P., Gatchalian, K. M. (2006). Understanding addiction as a pathology of temporal horizon. *The Behavior Analyst Today, 7*(1), 32-47. https://doi.org/10.1037/h0100148

Camacho, I. (2017). Apuntes sobre dos sentidos de la distinción molar/molecular [Notes on two meanings of the molar/molecular distinction]. *Conductual, 5,* 99-107. http://conductual.com/content/apuntes-dos-sentidos-distincion-molar-molecular

Cariveau, T., Muething, C. S., & Trapp, W. (2020). Interpersonal and group contingencies. *Perspectives on Behavior Science, 43*(1)*,* 115-135. https://doi.org/10.1007/s40614-020-00245-z

de Carvalho, L. C., dos Santos, L., Regaco, A., Couto, K. C., de Souza, D. G., & Todorov, J. C. (2020). Cooperative responding in rats: II. Performance on fixed-ratio schedules of mutual reinforcement. *Journal of the Experimental Analysis of Behavior, 114*(3)*,* 291-307. https://doi.org/10.1002/jeab.628

Case, D. A. & Fantino, E. (1981). The delay-reduction hypothesis of conditioned reinforcement and punishment: Observing behavior. *Journal of the Experimental Analysis of Behavior, 35*(1)*,* 93-108. https://doi.org/10.1901/jeab.1981.35-93

Costa, D., Noguerira, C. P. V., & Vasconcelos, L. A. (2012). Effects of communication and cultural consequences on choices combinations in INPDG with four participants. *Revista Latinoamericana de Psicologia, 44*(1)*, 1*21-131.

Davison, M., & Nevin, J. A. (1999). Stimuli, reinforcers, and behavior: An integration. *Journal of the Experimental Analysis of Behavior, 71*(3)*,* 439-482. https://doi.org/10.1901/jeab.1999.71-439

Dawkins, R., & Krebs, J. R. (1979). Arms races between and within species. *Proceedings of the Royal Society Series B-Biological Sciences, 205*(1161)*,* 489-511. https://doi.org/10.1098/rspb.1979.0081

Delgado, D. (2012). The selection metaphor: The concepts of metacontingencies and macrocontingencies revisited. *Revista Lationamericana de Psicologia, 44*(1)*,* 13-24.

Delprato, D. J. (2002). Countercontrol in behavior analysis. *The Behavior Analyst, 25*(2)*,* 191-200. https://doi.org/10.1007/BF03392057

Doughty, A. H., & Lattal, K. A. (2001). Resistance to change of operant variation and repetition *Journal of the Experimental Analysis of Behavior, 76*(2)*,* 195-215. https://doi.org/10.1901/jeab.2001.76-195

Findley, J. D. (1962). An experimental outline for building and exploring multi-operant behavior repertoires. *Journal of the Experimental Analysis of Behavior, 5*(1 Suppl), 113-166. https://doi.org/10.1901/jeab.1962.5-s113

Fleming, W., & Hayes, L. J. (2021). Relations between description and experimentation in metacontingency enterprise: An interbehavioral analysis. *Perspectives on Behavior Science.* Published online. https://doi.org/10.1007/s40614-021-00286-y

Foxall, G. R. (2015). Consumer behavior analysis and the marketing firm: Bilateral contingency in the context of environmental concern. *Journal of Organizational Behavior Management, 35*(1-2), 44-69. https://doi.org/10.1080/01608061.2015.1031426

Fryling, M. J., & Hayes, L. J. (2015). Similarities and differences among alternatives to Skinner's analysis of private events. *The Psychological Record, 65,* 579-587. https://doi.org/10.1007/s40732-015-0130-7

Glenn, S. S. (1986). Metacontingencies in Walden Two. *Behavior Analysis* 1665 *and Social Action, 5*(1-2), 2-8. https://doi.org/10.1007/BF03406059

Glenn, S. S. (1988). Contingencies and metacontingencies: Toward a synthesis of behavior analysis and cultural materialism. *The Behavior Analyst, 11*(2), 161-179. https://doi.org/10.1007/BF03392470

Glenn, S. S. (1991). Contingencies and metacontingencies: Relations among behavioral, cultural, and biological evolution. In P. A. Lamal (Ed.), *Behavioral analysis of societies and cultural practices* (pp. 39-73). Washington, DC: Hemisphere.

Glenn, S. S. (2004). Individual behavior, culture, and social change. *The Behavior Analyst, 27*(2), 133-151. https://doi.org/10.1007/BF03393175

Glenn, S. S. & Malott, M. M. (2004). Complexity and selection: Implications for organizational change. *Behavior and Social Issues, 13*(2), 89-106. https://doi.org/10.5210/bsi.v13i2.378

Glenn, S. S., Malott, M., Andery, M., Benvenuti, M., Houmanfar, R. A., Sandaker, I., et al. (2016). Toward consistent terminology in a behaviorist approach to cultural analysis. *Behavior and Social Issues, 25*(1), 11–27. https://doi.org/10.5210/bsi.v25i0.6634.

Hastjarjo, T., Silberberg, A., & Hursh, S. R. (1990). Risky choice as a function of amount and variance in food supply. *Journal of the Experimental Analysis of Behavior, 53*(1), 155-161. https://doi.org/10.1901/jeab.1990.53-155

Hayes, L. J. (1992). Equivalence as process. In S. C. Hayes & L. J. Hayes (Eds.), *Understanding verbal relations* (pp. 97–108). Context Press.

Hayes, L. J., & Fryling, M. J. (2018). Psychological events as integrated fields. *The Psychological Record, 68,* 273-277. https://doi.org/10.1007/s40732-018-0274-3

Hayes, L. J., & Houmanfar, R. (2004). Units and measures: A response to Glenn and Malott. *Behavior and Social Issues, 13*(2), 107–111. https://doi.org/10.5210/bsi.v13i2.379

Hayes, S. C., Barnes-Holmes, D., & Roche, B. (2001). *Relational Frame Theory: A Post-Skinnerian account of human language and cognition*. Plenum Press.

Hayes, S. C., & Sanford, B. T. (2014). Cooperation came first: Evolution and human cognition. *Journal of the Experimental Analysis of Behavior, 101*(1), 112-129. https://doi.org/10.1002/jeab.64

Hayes, S. C. White, D., & Bissett, R. T. (1998). Protocol analysis and the "silent dog" method of analyzing the impact of self-generated rules. *The Analysis of Verbal Behavior, 15,* 57-63. https://doi.org/10.1007/BF03392923

Herrnstein, R. J., (1961). Relative and absolute strength of response as a function of frequency of reinforcement. *Journal of the Experimental Analysis of Behavior, 4*(3), 267-272. https://doi.org/10.1901/jeab.1961.4-267

Herrnstein, R. J. (1970). On the law of effect. *Journal of the Experimental Analysis of Behavior, 13*(2), 243-266. https://doi.org/10.1901/jeab.1970.13-243

Herrnstein, R. J., & Hineline, P. N. (1966). Negative reinforcement as shock-frequency reduction. *Journal of the Experimental Analysis of Behavior, 9*(4), 421-430. https://doi.org/10.1901/jeab.1966.9-421

Hosoya, N., & Tourinho, E. (2016). Efeitos de interações verbais na seleção e manutenção de contingências comportamentais entrelaçadas [Effects of verbal interactions in the selection and maintenance of interlocking behavioral contingencies]. *Acta Comportamentalia, 24*(3), 331–345. https://www.redalyc.org/pdf/2745/274546929006.pdf

Houmanfar, R., Hayes, L. J., & Fredericks, D. W. (2001). Religion and cultural survival. *Psychological Record, 51,* 19-37. https://doi.org/10.1007/BF03395384

Houmanfar, R., & Rodrigues, N. J. (2006). The metacontingency and the behavioral contingency: Points of contact and departure. *Behavior and Social Issues, 15*(1), 13-30. https://doi.org/10.5210/bsi.v15i1.342

Houmanfar, R., Rodrigues, N. J., & Smith, G. S. (2009). Role of communication networks in behavioral systems analysis. *Journal of Organizational Behavior Management, 29*(3-4), 257-275. https://doi.org/10.1080/01608060903092102

Houmanfar, R., Rodrigues, N. J., & Ward, T. A. (2010). Emergence and metacontingency: Points of contact and departure. *Behavior and Social Issues, 19*(1), 53-78. https://doi.org/10.5210/bsi.v19i0.3065

Hunter, C. S. (2012). Analyzing behavioral and cultural selection contingencies. *Revista Latinoamericana de Psicología, 44*(1), 43-54.

Jacobs, K. W., Morford, Z. H., & King, J. E. (2019). Disequilibrium in behavior analysis: A disequilibrium theory redux. *Behavioural Processes, 162,* 197-204. https:doi.org/10.1016/j.beproc.2019.02.006

Jensen, G., & Neuringer, A. (2008). Choice as a function of reinforcer "hold": From probability learning to concurrent reinforcement. *Journal of Experimental Psychology: Animal Behavior Processes, 34*(4), 437-460. https://doi.org/10.1037/0097-7403.34.4.437

Kantor, J. R. (1924-1926). *Principles of psychology (Vol. I-II)*. Principia Press.

Kantor, J. R. (1953). *The logic of modern science.* Principia Press.

Keller, F. S., & Schoenfeld, W. N. (1950). *Principles of psychology.* New York: Appleton-Century-Crofts.

Krispin, J. V. (2016). What is the metacontingency? Deconstructing claims of emergence and cultural-level; selection. *Behavior and Social Issues, 25*(1)*,* 28-41. https://doi.org/10.5210/bsi.v25i0.6186

Locey, M. L., & Rachlin, H. (2012). Temporal dynamics of cooperation. *Journal of Behavioral Decision Making, 25(3),* 257-263. https://doi.org/10.1002/bdm.729

Locey, M. L., & Rachlin, H. (2013). Shaping behavioral patterns. *Journal of the Analysis of Behavior, 99*(3)*,* 245-259. https://doi.org/10.1002/jeab.22

Ludwig, T. D. (2017). Process safety behavioral systems: Behaviors interlock in complex metacontingencies. *Journal of Organizational Behavior Management, 37*(3-4)*,* 224-239. https://doi.org/10.1080/01608061.2017.1340921

Malott, M. E. (2019). How a few individuals brought about a cultural cusp: From a Mexican mural program to a movement. *Perspectives on Behavior Science, 42*(4)*,* 773-814. https://doi.org/10.1007/s40614-019-00211-4

Mattaini, M. A. (2019). Out of the lab: Shaping an ecological and constructional cultural systems science. *Perspectives on Behavior Science, 42*(4)*,* 713-731. https://doi.org/10.1007/s40614-019-00208-z

Molm, L. D., Schaefer, D. R., & Collett, J. L. (2009). Fragile and resilient trust: Risk and uncertainty in negotiated and reciprocal exchange. *Social Psychology Quarterly*, *73*(2), 119–131. https://doi.org/10.1177/0190272510369079

Morford, Z. H., & Cihon, T. M. (2013). Developing an experimental analysis of metacontingencies: Considerations regarding cooperation in a four-person prisoner's dilemma game. *Behavior and Social Issues, 22*(1), 5-20. https://doi.org/10.5210/bsi.v22i0.4207

Morris, E. K., Higgins, S. T., & Bickel, W. K. (1982). Comments on cognitive science in the experimental analysis of behavior. *The Behavior Analyst, 5*(2), 109-125. https://doi.org/10.1016/0022-0965(88)90063-X

Ortu, D., Becker, A. M., Woelz, T. A. R., & Glenn, S. S. (2012). An iterated four-player prisoner's dilemma game with an external selecting agent: A metacontingency experiment. *Revista Latinoamericana de Psicología, 44*(1), 111-120.

Pietras, C. J., Locey, M. L., & Hackenberg, T. D. (2003). Human risky choice under temporal constraints: Tests of an energy budget model. *Journal of the Experimental Analysis of Behavior, 80*(1), 59-75. https:/doi.org/10.1901/jeab.2003.80-59

Rachlin, H. (1992). Teleological behaviorism. *American Psychologist, 47*(11), 1371-1382. https://doi.org/10.1037/0003-066X.47.11.1371

Rachlin, H. (2013). About teleological behaviorism. *The Behavior Analyst, 36*(2), 209-222. https://doi.org/10.1007/BF03392307

Rachlin, H. (2017). In defense of teleological behaviorism. *Journal of Theoretical and Philosophical Psychology, 37*(2), 65-76. http://dx.doi.org/10.1037/teo0000060

Rachlin, H., Brown, J., & Baker, F. (2000). Reinforcement and punishment in the prisoner's dilemma game. In D. Medin (Ed.). *The psychology of learning and motivation, 40,* (pp. 327-364). New York: Academic Press. https://doi.org/10.1016/S0079-7421(00)80024-9

Ray, R.D., Delprato, D.J. (1989). Behavioral systems analysis: methodological strategies and tactics. *Behavioral Science, 34,* 81–127. https://doi.org/10.1002/bs.3830340202

Ribes-Iñesta, E. (1997). Causality and contingency: Some conceptual considerations. *The Psychological Record, 47,* 619-635. https://doi.org/10.1007/BF03395249

Ribes-Iñesta, E. (2018). *El estudio científico de la conducta individual: una introducción a la teoría de la psicología* [The scientific study of individual behavior: An introduction to the theory of psychology]. El Manual Moderno.

Sampaio, A. A. S., Araújo, L. A. S., Gonçalo, M. E., Ferraz, J. C., Alves Filho, A. P., Brito, I. S., Barros, N. M., & Calado, J. I. F. (2013). Exploring the role of verbal behavior in a new experimental task for the study of metacontingencies. *Behavior and Social Issues, 22*(1), 87–101. https://doi.org/10.5210/bsi.v22i0.4180

Saconatto, A. T., & Andery, M. A. P. A. (2013). Seleção por metacontingências: Um análogo experimental de reforçamento negativo. *Interação em Psicologia, 17*(1), 1-10. https:doi.org/10.5380/psi.v17i1.26779

Shahan, T. A. (2010). Conditioned reinforcement and response strength. *Journal of the Experimental Analysis of Behavior, 93*(2), 269-289. https://doi.org/10.1901/jeab.2010.93-269

Shimp, C. P. (2013). Toward the unification of molecular and molar analyses. *The Behavior Analyst, 36*(2), 295-312. https://doi.org/10.1007/Bf03392316

Shimp, C. P. (2020). Molecular (moment-to-moment) and molar (aggregate) analyses of behavior. *Journal of the Experimental Analysis of Behavior, 114*(3), 394-429. https://doi.org/10.1002/jeab.626

Shimp, C. P. (2021). Shaping changes everything: Comments on Baum, Killeen, Machado & Vasconcelos, and Pitts. *Journal of the Experimental Analysis of Behavior, 115*(2). 611-619. https://doi.org/10.1002/jeab.682

Silva, K. M., Silva, F. J., & Machado, A. (2019). The evolution of the behavior systems framework and its connection to interbehavioral psychology. *Behavioural Processes, 158,* 117-125. https://doi.org/10.1016/j.beproc.2018.11.001

Skinner, B. F. (1937). Two types of conditioned reflex: A reply to Konorski and Miller. *Journal of General Psychology, 16,* 272-279. https://doi.org/10.1080/00221309.1937.9917951

Skinner, B. F. (1938). *The behavior of organisms: An experimental analysis.* Appleton-Century.

Skinner, B. F. (1945). The operational analysis of psychological terms. *Psychological Review, 52*(5), 270-277, 291-294. https://doi.org/10.1037/h0062535

Skinner, B. F. (1948). *Walden two.* New York: Macmillan.

Skinner, B. F. (1951). The experimental analysis of behavior. *Proceedings and Papers of the Thirteenth International Congress of Psychology*, 62-91.

Skinner, B. F. (1957). *Verbal behavior.* New York: Appleton-Century-Croft.

Skinner, B. F. (1961). The design of cultures. *Daedalus, 90,* 534-546.

Skinner, B. F. (1969). Operant behavior. In B. F. Skinner, *Contingencies of reinforcement: A theoretical analysis* (pp. 105-132). New York: Appleton-Century-Crofts. (Modified version).

Skinner, B. F. (1974). *About behaviorism.* New York: Knopf.

Skinner, B. F. (1981). Selection by consequences. *Science, 213*(4507), 501-504. https://doi.org/10.1126/science.7244649

Skinner, B. F. (1984). The evolution of behavior. *Journal of the Experimental Analysis of Behavior, 41*(2), 217-221. https://doi.org/10.1901/jeab.1984.41-217

Smith, G., Houmanfar, R., & Louis, S. (2011). The participatory role of verbal behavior in an elaborated account of metacontingency: From conceptualization to investigation. *Behavior and Social Issues, 20*(1), 122-146. https://doi.org/10.5210/bsi.v20i0.3662

Slocum, S. K., & Tiger, J. H. (2011). An assessment of the efficiency of and child preference forward and backward chaining. *Journal of Applied Behavior Analysis, 44*(4), 793-805. https://doi.org/10.1901/jaba.2011.44-793

Soares, P. F. R., Martins, J. C. T., Guimarães, T. M. M., Leite, F. L., & Tourinho, E. Z. (2019). Effects of continuous and intermittent cultural consequences on culturants in metacontingency concurrent with operant contingency. *Behavior and Social Issues, 28(1), 1*89-202. https://doi.org/10.1007/s42822-019-00009-8

Tadaiesky, L. T., & Tourinho E. Z. (2012). Effects of support consequences and cultural consequences on the selection of interlocking behavioral contingencies. *Revista Latinoamericana de Psicología, 44*(1)*,* 133-147.

Timberlake, W. (1980). A molar equilibrium theory of learned performance. *Psychological Learning and Motivation, 14,* 1-58. https://doi.org/10.1016/S0079-7421(08)60158-9

Timberlake, W. (1983). The functional organization of appetitive behavior: behavior systems and learning. In: Zeiler, M.D., Harzem, P. (Eds.), *Advances in the Analysis of Behaviour* (Vol. 3). Biological Factors in Learning. Wiley, Chichester, England, pp. 177–221.

Timberlake, W., Allison, J. (1974). Response deprivation: an empirical approach to instrumental performance. *Psychological Review, 81,* 146–164. https://doi.org/10.1037/h0036101

Timberlake, W., Lucas, G.A. (1989). Behavior systems and learning: from misbehavior to general principles. In: Klein, S.B., Mowrer, R.R. (Eds.), *Contemporary Learning Theories: Instrumental Conditioning Theory and the Impact of Biological Constraints on Learning*. Erlbaum, Hillsdale, NJ, pp. 237–275.

Van Valen, L. (1973). A new evolutionary law. *Evolutionary Theory, 1*(1)*, 1-30.*

Vichi, C., Andery, M. A. P. A., & Glenn, S. (2009). A metacontingency experiment: The effects of contingent consequences on patterns of interlocking contingencies of reinforcement. *Behavior and Social Issues, 18*(1), 41–57. https://doi.org/10.5210/bsi.v18i1.2292

Received: February 8, 2021
Final Acceptance: August, 2, 2021