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Interlocking Behavior and Cultural Selection

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Skinner's (1981) *Selection by Consequences* was an important paper that set the occasion for cultural analysts to explore further what he called "cultural selection." In many of his writings (e.g., Skinner, 1948; 1953; 1961; 1971) Skinner is occupied by societal challenges, rather than mere individual concerns. In *Walden Two* (1948) he describes a utopian society free from aversive control. In *Science and Human Behavior* (1953) he addresses how the behavioral science may contribute to changing large-scale behaviors. In *Beyond Freedom and Dignity* (1971) he addresses the philosophy of behaviorism and its contribution to better understanding human nature and the contingencies that influence us. In spite of the weaknesses of *Selection by Consequences,* there are at least two reasons to celebrate the 35th anniversary of the paper. One is the selectionist perspective on cultural evolution, and the second is the insight that large-scale behavior is still *behavior*.

Despite the importance of Skinner's (1981) paper, he was very brief, and some of the commentaries were a bit crude. "Would 'Consequences' have been published in *Science* in 1981 if the author had been anonymous? The answer would be a resounding no (…)" (Barlow, 1988, p. 20). Barlow had his reasons to write like that: Skinner (1981) proposed a third level of selection, but was rather vague. Perhaps the most interesting part of the topic "*The Third Kind of Selection*" is the assertion that "It is the effect on the group, not the reinforcing consequences for individual members, which is responsible for the evolution of culture" (p. 502).

The present comment takes the just previously cited assertion as a starting point. By taking this as a contextual cue, we will present the concepts of interlocking behavioral contingencies, aggregate product, and metacontingency as a basis for our argument that the term *cultural selection* should be restricted to selection processes at the group level.

Interlocking Behavioral Contingencies

Keller and Schoenfeld (1950) suggested that *social* stimuli do not differ from other stimuli except for their origin. According to them, social stimuli "(…) arise from other organisms, their behavior or the product of their behavior. Moreover, social stimuli do not differ in their *function* from those of inanimate origin; they act as eliciting, reinforcing, discriminative, and so on." (p. 352). A few years later, Skinner stated in *Science and Human Behavior* (1953) that social behavior is "the behavior of two or more people with respect to one another or in concert with respect to a common environment" (p. 297). These two definitions, for both social stimuli and social behavior, suggest a definition of interlocking behavioral contingencies (IBCs). IBCs are social contingencies defined by the mutual interaction that occurs between at least two organisms, where each organism's behavior serves as stimulus for the behavior of others. Thus, in the IBCs one individual serves as "eliciting, reinforcing, discriminative, etc."

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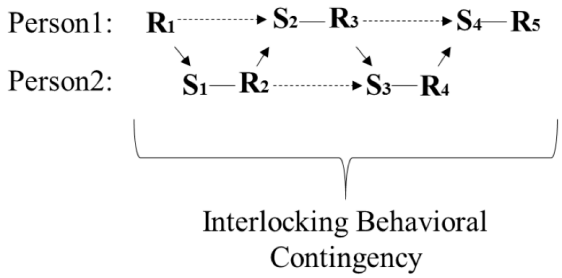

Figure 1. Representation of Interlocking Behavioral Contingency.
The figure depicts a mutual relation between two individuals. R_1, R_3, and R_5 are Person 1 responses. S_1 and S_3 are stimuli generated by Person 1 responses. R_2 and R_4 are Person 2 responses. S_2 and S_4 are stimuli generated by Person 2 responses. Straights arrows shows how a one response enters into another person's contingency as a discriminative stimulus. Dashed arrows shows how a response that enters into another person's contingency as a discriminative stimulus may also serve as a consequent stimulus for a previous response.

for the behavior of another (see also Skinner, 1953, Chapter XIX).

Figure 1 depicts an example of an IBC relationship where R_1, R_3, and R_5, are the responses of Person 1, while S_1, and S_3 are the stimuli for Person 2 and R_1 and R_4 are responses. They arise from Person 1's behavior, whereas S_2 and S_4 are the stimuli for Person 1's responses, which arise from Person 2's behavior. In the figure below, the dashed lines mean that for the stimuli that arise from Person 1 and 2, the behavior may function as both/either antecedent and/or consequent stimuli.

Aggregate Product

The *Aggregate product* is a term coined by Sigrid S. Glenn[1]. Over the years, its definition has changed (e.g., see Martone and Todorov, 2007). Its recent definition and presentation may be explored in the work of Glenn (2010) and others (e.g., Andery, Micheletto, & Sério, 2005; Houmanfar & Rodrigues, 2006; Todorov, 2013). Todorov (2013) defines aggregate product as "(…) an effect on the environment that would not occur as consequence of only one person's behavior. An aggregate product is the result of interlocked behavioral contingencies involving at least two persons" (p. 67).

Let us, for the time being, forget about IBCs and focus only on the aggregate product. According to Todorov's definition, an aggregate product is an effect on the environment. Any resemblance to operant responses may not be accidental and we must make this resemblance even clearer: We believe that this clarification will keep the terms, at the individual and cultural levels of analysis, consistent with each other. A "response" is described as "a unit of behavior, a discrete and usually recurring segment of behavior" (Catania, 2013, p. 462). Responses are usually assigned to classes of responses because no two responses can exactly be the same (Catania, 2013, p. 453). In descriptive usage, "class of response" may be defined in terms of the effects this class generates on the environment. Using Catania's own example, the response class of lever presses is defined in terms of its effects (operation of a switch). We define aggregate product within the same logic. In a descriptive usage, an aggregate product is a result of IBCs, it is "a discrete and usually recurring segment" of IBCs; second, aggregate product is defined in terms of its effect on the environment; and, third,

[1]This term was first called aggregate outcome (e.g., Glenn, 1988). The meaning and the name itself have changed across different versions of the concept of metacontingency presented and formulated by S. S. Glenn. For a review of the evolution of the aggregate product and metacontingency, see Martone and Todorov (2007).

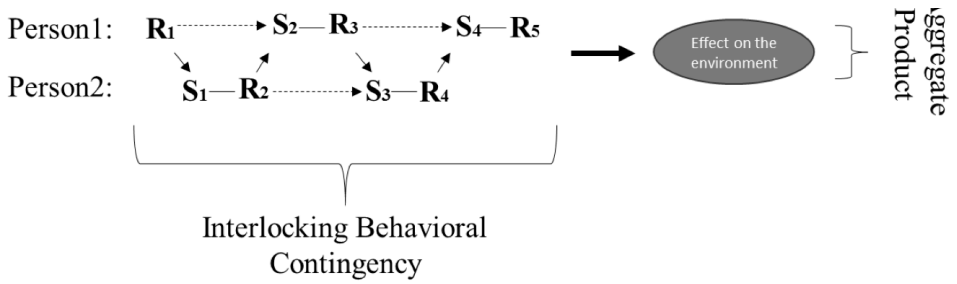

Figure 2. Representation of interlocking behavioral contingency and their aggregate product.

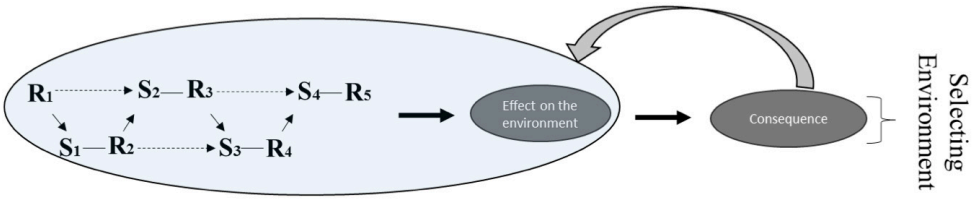

Figure 3. Representation of a functional relation in a metacontingency.

aggregate products are assigned to classes because no two aggregate products can be the exact same. Now, let us get back to the IBCs. One individual alone cannot produce an aggregate product. When we identify an aggregate product, we automatically have to suppose that IBCs had occurred, even if we cannot identify the IBC's that are responsible for a given aggregate product: An aggregate product does not exist without a previous IBC. In this way, aggregate products are not a resultant effect of the cumulative effect generated by multiple isolated individual responses, but rather they are a result of the *coordinated* action between two or more organisms.

Metacontingency

Metacontingency is a unit of analysis on a cultural level. After this term was first coined by Glenn (1986), over the years it has been defined in different ways (e.g., Martone & Todorov, 2007). One recent version is found in Glenn (2010), where a metacontingency is described as a functional relation between (i) IBCs and their aggregate product with (ii) a selecting cultural environment. Figure 3 depicts this relationship. The big arrow in the figure shows that the consequence that follows the aggregate product modifies parameters of the IBCs and their aggregate products.

At the individual level, a contingency is a conditional probability that some events (e.g., responses) can be related to others (e.g., stimuli) (Catania, 2013). In the same way, but at the cultural level, a metacontingency is a conditional probability that some events (IBCs and their aggregate products) can be related to others (stimuli). In short, metacontingencies explain the differential relation between variants of interlocking behavioral contingencies and their aggregate products with an external selecting environment (Glenn, 2010).

Experimental Analysis: An Example

Experimental analysis on metacontingency has increased over the last few years, with a lot of work being done in the graduate departments of universities in Brazil. Vichi, Andery, and Glenn (2009) were the first authors to publish an experimental study using the metacontingency concept. Their work has been followed by many others (e.g., see special issue of the *Revista Lati-*

noamericana de Psicología, vol. 44, 1). While there are recent advances in the experimental analysis in the area of metacontingency, the literature of the experimental analysis of behavior describes experiments that show the functional relation of metacontingency even though the term is not used (e.g., Glaser & Klaus, 1966; Lindsley, 1966; Schmitt & Marwell, 1968). Azrin and Lindsley (1956) may have been the first authors to publish an experimental paper that shows functional relation in a metacontingency: their paper was published 30 years before the metacontingency concept made its first appearance.

Azrin and Lindsley (1956) designed a task in order to measure cooperative responses (which we may call an aggregate product) in children. The question asked by the experimenters was whether cooperation between children could be developed, maintained, or eliminated with a single reinforcement available for the dyad of children and following each cooperative response. The experimental design involved three phases: In phase 1, every cooperative response was rewarded with a jellybean. This phase lasted 15 min. In phase 2, cooperative responses were not rewarded for a period of at least 15 min. Phase 3 was a repetition of phase 1, with a duration of at least three minutes with a stable rate of response.

All four dyads of children learned the task with the manipulation implemented by Azrin and Lindsley (1956). During phases 1 and 3, the dyads performed at a constant and steady rate of cooperative response. During phase 2, a decelerating response rate was apparent until almost no responses were performed. Figure 4 reprints Azrin and Lindsley's results.

Cultural selection of behavior

Skinner (1981) stated that "… human behavior is the joint product of (i) the contingencies of survival responsible for natural selection of the species and (ii) the contingencies of reinforcement responsible for the repertoires acquired by its members, including (iii) the special contingencies maintained by an evolved social environment". (p. 502). By saying that the "human behavior is the joint product", we believe that Skinner contradicted himself by simultaneously stating "It is the effect on the group, not the reinforcing consequences for individual members, which is responsible for the *evolution of culture*" (italics added). The third level of selection is the cultural level. We believe that the effect on the group, *per se*, does not explain the *evolution of cultures,* which differs from Skinner's view. There are at least two ways of interpreting what Skinner meant by "effects on the group" which we will discuss below (represented by the points (i) and (ii)).

A culture may be defined as a "complex adaptive social system possessing several observed and agreed upon characteristics prevalent and recognizable over time even though members of the system are replaced by new ones" (Sandaker, 2009, p. 288). A culture is composed of different cultural practices, in which both individual (e.g., isolated) behavior and interlocked behavioral contingencies coexist. Consequences may serve as reinforcing stimuli for individual behavior of members of a given group.

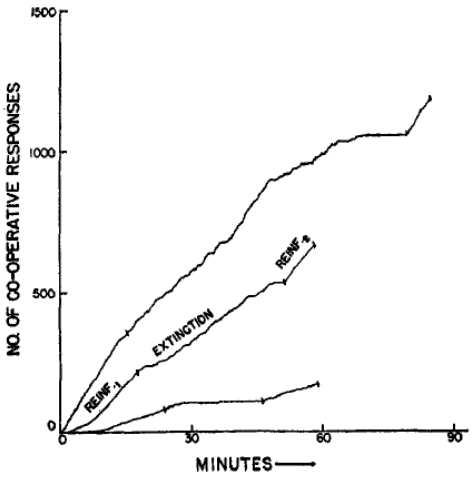

Figure 4. Results of Arzin and Lindsley (1956). The graph shows number of cooperative responses as a function of time. Reprinted with permission[1].

[1]This article as a whole is now in the public domain.

These consequences are not scheduled for the group, as a unit, but behaviors that are maintained by individual consequences may still affect the evolution of the respective group (e.g., Glenn, 2004). Thus, despite Skinner affirmation that "It is the effect on the group, not the reinforcing consequences for individual members, which is responsible for the evolution of culture" (p. 502), we may say that the evolution of a given group may depend on "the reinforcing consequences for individual members". At this point, we arrive at the first possible interpretation (i). We could argue that reinforcing consequences for individual members *are not*, indeed, responsible for the evolution of cultures, *unless* those consequences are maintaining a sufficient number of individual behaviors that summed up will affect the cultural evolution. If there are many people engaged in a given practice (e.g., smoking), the effects of their behavior will generate an effect on the group as a whole (e.g., high indices of lung cancer). Such an effect would not otherwise be produced if only a small number of people were engaged in the practice. Therefore, what defines the evolution of the culture, in this case, is indeed the effect on the group. On the other hand, we do not explain these behaviors based on the effect on the group, but rather based on the reinforcing consequences for these individual behaviors. In other words, the effect on the group does not have any functional relation with the practice (see Glenn [2004] for a more detailed discussion); the practice is still maintained by individual consequences. Glenn (2004) calls this kind of conditional relation a macrocontingency.

The cultural level of selection, conversely, establishes functional relation "on the group" level. As asserted in the first part of this comment, cultural selection explains variation and recurrence of IBCs *and* their aggregate products. There must be IBCs and aggregate products in order to have cultural selection, that is, there must be group interaction and an effect on the environment arising from its interaction. In this context, metacontingency serves as a conceptual tool that describes this conditional relation. Thus we arrive at the second interpretation (ii) that explains cultural selection as the effect on the group, and not "the reinforcing consequences for individuals members". However, this effect on the group may not contribute to the evolution of the culture: Recurrence of a given IBC and its aggregate product will still not affect the evolution of a given culture, *unless* this IBC recurs in a sufficiently large number of groups that summed up will affect the evolution of the culture.

Then we define *cultural selection*: a selection mechanism that establishes functional relation in a metacontingency.

Culture, as a part of the complex phenomenon of human behavior, is also a joint product of the three levels of selection. The unit of selection of cultures, the cultural practices, will involve different selection processes that will explain their evolution (e.g., see Catania & Harnad, 1988, p. 38[2]). Then, we believe that cultural evolution (*i.e.*, evolution of cultural practices) will depend on the three levels of selection, the cultural level being just one of them.

Selector environment on cultural selection

We should also point out that cultural selection is not exclusive to humans. It also evolves within groups of social animals. Thus, cultural selection is not only a result of "special contingencies maintained by an evolved social environment" as argued by Skinner (1981, p. 502). Cultural selection may be a result of the natural environment as part of phylogenic contingencies. The hunting strategy of lionesses is an example. Different strategies were noted within the different habitats of lions (e.g., Stander, 1992). Interlocking behavioral contingencies (position in the environment) played by lionesses may be a function of the success

[2]While replying to a comment to his article ("*Consequences*"), Skinner seems to agree that cultural practices are selected on two levels, even though he does not elaborate very much on that. For further discussions on this topic, see Mattaini (1996).

rate that these IBCs will result in. Stander (1992) reported that lionesses tended to play different roles while hunting. The position that a given lioness holds in the hunting group is adjusted in response to the presence or absence and position of other individuals (p. 452). Even if some lionesses were absent during the hunting episode, other members played the same role as a substitute for the absent lioness within the group strategy. Given the fact that a lioness is replaced without altering the success, the roles that each lioness plays may not depend upon individual success, but rather on the success of the IBCs. Pitman and Durban (2011) also reported cultural selection within killer whales' habitat.

Summary and conclusions

Skinner cannot be blamed for not analyzing every detail of the selection mechanisms occurring at a cultural level. He was not particularly interested in the conditional relations that nowadays are described by the metacontingency concept. His main experimental work was focused on how independent variables controlled individual behavior (e.g., Ferster & Skinner, 1957; Skinner, 1938). In *Selection by Consequences*, as well as in previous works (e.g., Skinner, 1948, 1953), Skinner gave behavior analysts the opportunity to explore in a field that was commonly dominated by other disciplines; he gave us the opportunity to develop more sophisticated analyses of cultural affairs. In this comment, we try to show how selection at a cultural level may be described by the metacontingency concept. We also argue for the use of the term "cultural selection" to describe variation and selection of IBCs and aggregate products.

We conclude by saying that behavior analysts have been occupied with cultural selection and cultural evolution during the last few decades, which seems to be strengthening a behavioral approach to cultural phenomena. When we describe the aggregate product as a result of the joint coordinated effort of two or more organisms IBCs, it is important to note that the cooperation in the group are object of selection as well as the aggregate product.

References

Andery, M. A. P. A., Micheletto, N., & Sério, T. M. de A. P. (2005). A análise de fenômenos sociais: esboçando uma proposta para a identificação de contingências entrelaçadas e metacontingências. *Brazilian Journal of Behavior Analysis*, *1*, 149-165. Retrieved from: http://www.periodicos.ufpa.br/index.php/rebac/article/view/2167/2467

Azrin, N. H. & Lindsley, O. R. (1956). Reinforcement of cooperation between children. *Journal of Abnormal and Social Psychology*, *52*, 100 -102. http://dx.doi.org/10.1037/h0042490

Barlow, G. W. (1988). Skinner on Selection: A case study of intellectual isolation. In A. C. Catania, A. C. & S. Harnad, (Eds). *The selection of behavior: The operant behaviorism of B. F. Skinner* (pp. 20-22). New York, NY: Cambridge University Press.

Catania, A. C. (2013). *Learning (5th Ed.)*. Cornwall-on-Hudson, NY: Sloan Publishing.

Galef, B. G. (1976). Social transmission of acquired behavior: a discussion of tradition and social learning in vertebrates. In J. S. Rosenblatt, R. A. Hinde, E. Shaw, & C. Beer (Eds.), *Advances in the Study of Behavior* (Vol. 6, pp. 77 - 100). New York City: Academic Press.

Glenn, S. S. (1986). Metacontingencies in walden two. *Behavior Analysis and Social Action, 5*, 2-8. Retrived from: http://sigridglenn.org/pdfs/Glenn1986.pdf

Glenn, S. S. (2004). Individual behavior, culture, and social change. *The Behavior Analyst*, *27*(2), 133-151. Retrieved from: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2755396/

Glenn, S. S. (2010) Metacontingencies, selec-

tion and OBM: Comments on "Emergence and metacontingency". *Behavior and Social Issues*, *19*, 79-85. http://dx.doi.org/10.5210/bsi.v19i0.3220.

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

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

Lindsley, O. R. (1966). Experimental analysis of cooperation and competition. In T. Verhave (Ed.). *The experimental analysis of behavior* (pp. 470-501). New York, NY: Appleton Century Crofts.

Martone, R. C., & Todorov, J. C. (2007). O desenvolvimento do conceito de metacontingência. *Brazilian Journal of Behavior Analysis*, *3*, 181-190. Retrieved from: http://www.periodicos.ufpa.br/index.php/rebac/article/view/830/1177

Mattaini, M. A. (1996). Envisioning cultural practice. *The Behavior Analyst*, *19*(2), 257-272. Retrieved from: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2733617/pdf/behavan00020-0115.pdf

Pitman, R. L., & Durban, J. W. (2011). Cooperative hunting behavior, prey selectivity and prey handling by pack ice killer whales (*Orcinus orca*), type B, in Antarctic peninsula waters. *Marine Mammal Science*, *28*(1), 16-36. doi: 10.1111/j.1748-7692.2010.00453.x

Schmitt, D. R., & Marwell, G. (1968). Stimulus control in the experimental study of cooperation. *Journal of the Experimental Analysis of Behavior*, *11*, 571-574. doi: 10.1901/jeab.1968.11-571

Skinner, B. F. (1938). *The behavior of organisms*. New York: Macmillan.

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

Skinner, B. F. (1953). *Science and human behavior*. New York: Macmillan.

Skinner, B. F. (1961). The design of cultures. *Daedalus*, *90*(3), 534-546.

Skinner, B. F. (1971). *Beyond freedom and dignity*. New York: Knopf

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

Stander, P. E. (1992). Cooperative hunting in lions: the role of the individual. *Behavioral Ecology and Sociobiology*, *29*(6), 445-454.

Todorov, J. C. (1987). A constituição como metacontingência. *Psicologia: Ciência e Profissão*, *7*, 9-13. Retrieved from: http://www.scielo.br/pdf/pcp/v7n1/03.pdf

Todorov, J. C. (2013). Conservation and transformation of cultural practices through contingencies and metacontingencies. *Behavior and Social Issues*, *22*, 64-73.

Vasconcelos, I. G. & Todorov, J. C. (2015) Experimental analysis of the behavior of persons in groups: Selection of an aggregate product in a metacontingency. *Behavior and Social Issues*, *24*, 111-125.

Vichi, C., Andery, M. A. P. A., & Glenn, S. S. (2009). A metacontingency experiment: the effects of contingent consequences on patterns of interlocking contingencies of reinforcement. *Behavior and Social Issues*, *12*, 41-57. http://dx.doi.org/10.5210/bsi.v18i1.2292