INTRODUCTION:
SOME DIMENSIONS OF THE OPERANT SOCIAL BEHAVIOR OF ANIMALS

INTRODUCCIÓN:
ALGUNAS DIMENSIONES DE LA CONDUCTA SOCIAL OPERANTE DE LOS ANIMALES

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Skinner (1953) defined social behavior as "the behavior of two or more people with respect to one another or in concert with respect to a common environment" (Skinner, 1953, p. 297). To this definition, Sakuma and Moriyama added a qualification to Skinner's definition that is especially germane to the present issue of the Mexican Journal of Behavior Analysis:

Social behavior … is not limited to human behavior. Most nonhuman animals living in groups also engage in behavior patterns fitting the above definition. Furthermore, social behavior includes behavior toward not only conspecifics but also heterogeneous organisms sharing the same environment. Thus, [Skinner's] definition of social behavior can be revised as the behavior of an individual that affects the behavior of other living organisms sharing the same environment. (2019, this issue, p. 485)

This journal published a special issue on social behavior seven years ago (Santoyo, 2012). A second special issue on the same general topic a few years later should come as no particular surprise, however, given the ubiquity of social behavior among living organisms, wherever they are found. The present special issue is unique from the first such issue in that it considers such behavior only among nonhuman animals (acceding to conventional use for convenience's sake, simply animals), whereas the first issue included only one article in which the analysis was of animal social behavior (Tan & Hackenberg, 2012). he area of animal social behavior is exceptionally broad, covering not only the ethology, comparative psychology, and neurology of animals in combinations of two or more, but also such topics as the many facets of the human-animal bond of interest to developmental psychologists and applied animal behaviorists.

In addition to focusing this special issue on questions of animal social behavior, given the journal's behavior-analytic theoretical orientation, animal social behavior is considered in each of the articles from that perspective, with the caveat that within this orientation, or any other orientation for that matter, there is variability in terms of methods, mechanisms, and interpretations. Thus, a general definition of what we will call operant social behavior is invited. We suggest that operant social behavior is the "behavior of an individual that affects the behavior of other living organisms sharing the same environment that is determined by the antecedents and consequences of such behavior." This distinguishes operant social behavior from social behavior controlled by either respondent or phylogenic variables (although, of course, both could play a role in operant social behavior, just as they do in nonsocial operant behavior). It also may be useful to distinguish "operant social behavior" and "social operant behavior." The latter is the broader and more general term that would include social interactions as stimuli, responses and consequences, while the former refers to operants defined in terms of the responses of two or more organisms (e.g., de Carvalho, dos Santos, Regaço, & de Souza, 2019, this issue).

Given the above delineation of the subject matter of this special issue, the next question, and the central theme of this issue, is how the behavior of co-acting organisms might develop and maintain antecedent and consequent functions. Closely related to this question is that of what methods and measures might be useful in the experimental analysis of the operant social behavior of animals, which we consider first. Much of the study of human social behavior involves the analysis of verbal behavior, which is precluded with animals. The present collection of articles include examples of many different methods for the study of operant social behavior in animals. Some involve direct visual observation (Ackerman & Lattal, 2019, this issue; Lopez, Zamora, & Cabrera, 2019, this issue). Others describe the use of conventional operant techniques perfected in the study of individual organisms (de Carvalho et al., 2019, this issue; Okouchi, Takafuji, & Sogawa, 2019, this issue; Vanderhooft, Tan, & Hackenberg, 2019, this issue). In addition, Kuroda describes the application of cutting-edge digital technology (Kuroda, 2019, this issue) to the analysis of social behavior. Some investigators used standard operant conditioning apparatus (de Carvalho et al. 2019, this issue) and others have developed specialized chambers and devices to study specific classes or instances of social behavior (Vanderhooft et al, 2019, this issue; Kitano, Yamaguchi, Saeki, & Ito, 2019, this issue; Pitts, Hughes, & Williams, 2019, this issue; Sakuma & Moriyama, 2019, this issue; Williams et al., 2019, this issue; Yamaguchi, Saeki, Taniguchi, & Ito, 2019, this issue). These methods can be, and were, applied by the different authors to analyzing both the development of social behavior and, once established, its maintenance.

The aforementioned constructions of social environments raises the broader question of what does, in fact, constitute a social environment. Social environments, as the previous definition suggests, imply the presence of two or more co-actors in the same space. Most of the investigations reported in this special issue took place in an environment in which the co-actors were in sensory contact with one another, most often visually. "Same space," however, might be more accurately defined in terms of interrelated, interlocking, or reciprocal contingencies of reinforcement. In Okouchi et al.'s (2019, this issue) experiment, for example, two pigeons produced reinforcers for one another, but were located in separate operant chambers visually isolated from one another. The pigeons used by Kitano et al. (2019, this issue) in a control condition, as in several earlier experiments (e.g., Sanabria, Baker, & Rachlin, 2003), competed in a prisoner's dilemma game not against another pigeon, but against a digital computer programmed to "respond" according to different algorithms. In both of these experiments, the behavior of one co-actor is affecting the

behavior of another, but the source of such behavior is not in sensory contact with the actor. Research in which animals pit their skills against nonorganic behaving systems invites consideration of an amendment to Sakuma and Moriyama's (2019, this issue) qualification of Skinner's (1953) definition of social behavior to something like "the behavior of an individual that affects the behavior of other behaving systems sharing the same environment." (2019, this issue, p. 485).

From the present perspective, the salient features of any environment, social or not, are the antecedents to and consequences of behavior occurring in it. In the case of social behavior, these antecedent and consequent functions may be social or they may be nonsocial, but with effects on social operants. An example of the nonsocial antecedent stimuli are the discriminative stimuli in Epstein and Skinner's classic "Jack and Jill" demonstration (Epstein, 1981) in which visual stimuli initiated a reciprocal chain in which a series of coordinated response between two pigeons, Jack and Jill, ultimately resulted in food for both. Millard (1979; see also Hake, Donaldson, & Hyten, 1983) earlier had demonstrated how one pigeon's behavior, a social stimulus, functioned as a discriminative stimulus controlling the responding of a co-actor. Epstein and Skinner (Epstein, 1981) introduced to Millard's demonstration a more dynamic interactive role for both the light discriminative stimuli and the co-actors behavior. In this issue, in several of the articles, the behavior of one organism set the occasion for a co-actor's behavior to be reinforced in both open field (Ackerman & Lattal, 2019, this issue; Lopez et al., this issue) and conventional experimental chambers modified for assessing social control (de Carvalho et al, 2019, this issue).

In the analysis of operant social behavior, the relation between responses and consequences can be described by the matrix shown in Figure 1, in which social and nonsocial operants are considered in relation to social and nonsocial consequences. Examples of three of the four cells of the matrix can be found in the articles comprising this issue.

There are no examples of the top left cell among the articles in this special issue. A potential example of this relation is a situation where a social operant of the sort described by de Carvalho et al. (2019, this issue) might be required for access to other organisms as in Vanderhooft et al.'s (2019, this issue) experiment.

Moving clockwise to the top right cell, there are many examples of social operants with nonsocial consequences among the articles in this special issue. de Carvalho et al. (2019, this issue) and Kuroda (2019, this issue) reinforced, respectively, coordinated responding and physical proximity with the nonsocial conse-

Social operant, social consequence	Social operant, nonsocial consequence
Nonsocial operant, social consequence	Nonsocial operant, nonsocial consequence

Figure 1. A 2 x 2 matrix of combinations of social/nonsocial operants and consequences.

quence of food. Ackerman & Lattal (2019, this issue) arranged a similar contingency between a social operant and food. In the Okouchi et al., (2019, this issue) experiment, key pecking of either pigeon produced food for the other pigeon, what they labeled a mutual reinforcement contingency. In Ackerman and Lattal's procedure, one pigeon could receive its next reinforcer only after its coactor received a reinforcer. By contrast, in Okouchi et al.'s procedure there was no requirement that reinforcers delivered to each co-actor strictly alternate. Results of an earlier series of experiments by Boren (1966) suggest that this additional requirement of alternating reinforcement between co-actors may be important in sustaining a cooperative response, in accord with Hake and Vukelich's (1972) suggestion that sustained cooperative responding requires equitable reinforcement.

The lower right cell is the typical preparation for investigating nonsocial operants maintained by nonsocial reinforcement such as those described by Ferster & Skinner (1957). In Yamaguchi et al.'s (2019, this issue) experiment, the choice of two food sites was a function of the number of competitors for the available reinforcer, so there was a nonoperant response and a nonsocial consequence. The interesting aspect of this experiment in relation to social behavior is that the choice responses were under the antecedent control of the number of competitors for the reinforcer. In relation to the Yamaguchi et al. (2019, this issue) experiment, this cell describes the extant experiments of discriminative stimulus control of operant responding by social stimuli (e.g., Millard, 1979; Hake et al., 1983). Social-operant experiments involving discriminative stimulus control, however, could appear in any of the matrices depending on the operants and consequences signaled by the discriminative social stimuli. Vanderhooft et al.'s (2019, this issue) experiment is the sole example of a nonsocial operant response leading to a social consequence (lower left cell of Figure 1) in the form of releasing a co-actor rat into the actor's work space (or into a workspace where the actor has no contact access to the co-actor, but still can see it has escaped its confinement, cf. Ben-Ami Bartal, Decety, & Mason, 2011).

The matrix is not intended to be a template for categorizing all instances of operant social behavior, only those in which social and nonsocial responses inter-

act with social and nonsocial consequences. The matrix is not suited, for example, to experiments in which social facilitation or suppression is investigated. Nor do the three experiments on schedule-induced aggression in this issue readily fit into any of the matrix cells, because the target social stimuli are not dependent on any response. Rather, they are continuously available and their role as social stimuli is controlled by the presence and absence of reinforcement (Pitts et al., 2019; Sakuma & Moriyama, 2019; Williams et al.,2019) and the presence and absence of an attack response by the co-actor (Sakuma and Moriyama, 2019). If the opportunity for visual or tactile access to the target organism were response-dependent, such a procedure easily could be categorized in the matrix.

Several of the experiments underline the importance of reciprocity in many, but certainly not all, instances of operant social behavior. Examples of the latter include experiments related to discriminative stimulus control of operant behavior by social stimuli (Hake et al., 1983; Millard, 1979). As was discussed above, the contrasting results of Okouchi et al. (2019, this issue) and Ackerman and Lattal (2019, this issue) may illustrate the different effects of a reciprocal reinforcement contingency in which both organisms receive reinforcement in alternating order and one in which there is a reciprocal but not an alternating requirement for reinforcement (cf. Boren, 1966). Reciprocal relations also were investigated by Sakuma and Moriyama (2019, this issue) with their observations of reciprocal pecking at one another by subject and target pigeons, suggestions that what is labeled "schedule-induced aggression" may be controlled in part not by the schedule but by the behavior of the co-actor. The extent to which this occurs in other experiments on this topic (e.g., Pitts, et al., 2019, this issue; Williams et al., 2019, this issue) is open to future analysis.

A broader question in the analysis of operant social behavior is the relation between the behavioral principles summarizing operant and nonoperant nonsocial behavior (Ackerman & Lattal, 2019, this issue; Pitts et al., 2019, this issue). Is social behavior simply the sum of the actions of individual contingencies acting on each of the co-actors, or is the social interaction greater than the sum of those individual contingencies? Based on available evidence of the sort provided in many of the present articles (see, e.g., de Carvalho et al., 2019, this issue; Vanderhooft et al., this issue), both operant social responses and operant social consequences yield at least superficially similar functional relations than do conventional reinforcers in animal experimentation like food and water. Many investigators of social behavior approaching it from a behavior-analytic perspective have extrapolated, with success, general behavior principles to operants involving the behavior of more than a single

organism and to social reinforcers of various kinds. If this approach were successful, it would seem that there is no need for additional principles or special qualifications to existing principles in accounting for social interactions. This observation stands only as preliminary analysis based on extant findings. Things could change. As the results of Lopez, Zamora, and Cabrera (2019, this issue) and Yamaguchi et al. (2019, this issue) suggest, adding additional organisms, beyond the dyads most often studied to this point in analyses of operant social behavior increases the complexity of the extant contingencies impinging on the individual organism's behavior. Open is the question of whether such complexities invite new principles or modifications of extant ones.

A final issue is the distinction between social and nonsocial environments. Although there may be some circumstances where individual behavior is truly unaffected by its social context, it seems accurate to say that most behavior is influenced by the actions of others, if for no other reason because of developmental influences. This fact alone is a good argument, and there are many others, for the continuing resurgence of the experimental analysis of social operant behavior (including operant social behavior). This special issue was constructed in the hope that it would provide an antecedent for such continuing resurgence by assembling a range of articles suggesting possibilities for future research in this heretofore largely neglected area. Although the articles are all laboratory based and experimental in nature, the possibilities of translating the findings of experiments on animal operant social behavior into activities that are advantageous to both individuals and the human condition more generally seems promising indeed.

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