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Cultural Reaction Systems: An Orientational Unit of Analysis for Cultural Relations

A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Psychology

by

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Abstract

The purpose of this dissertation is to begin construction of an orientational approach to studying cultural relations. Orientationalism can be considered a molar extension of J. R. Kantor's interbehavioral psychology that considers the orientations of organisms—described in terms of reaction systems—to be the basic psychological unit of analysis instead of psychological events. The first part of this dissertation addresses the philosophy of orientationalism. The second part addresses how orientationalism orients towards experimentation on examining cultural reaction systems that is atypical in Skinnerian behavior analysis and culturo-behavior science but highly congruent with game theory. Five such experiments are described along with their implications for future research and behavior science. In doing so, it is the aim of this dissertation to demonstrate the compatibility of principles of contemporary multi-scale molar behavior analysis are with those of interbehaviorism when an integrated field logic is used to describe not discrete psychological events but interacting patterns of functional contacts composing orientations of one or more organisms.

Keywords: *orientationalism, conventionality, molar, interbehaviorism*

Dedication

This is dedicated to:

Shannon, you are my first and oldest friend. If it was still acceptable for you to talk for me, I'd let you. I cannot imagine a world without you and your creations. You have shown me how to be myself—there is no greater gift.

Danielle, I am so happy that we have gotten closer over the years. It took me too long to realize how grateful I am to have you in my life. You are my best friend, and one day you will be my best man.

KB, you are the love of my life. You are why I wake up every morning and my last thought every night. There is no one more genuine, thoughtful, selfless, kind, or with more Quotes of the Day. You make me want to be a better man with every breath.

I love you all, so much.

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Linda, for being a great advisor, a great friend, and you;

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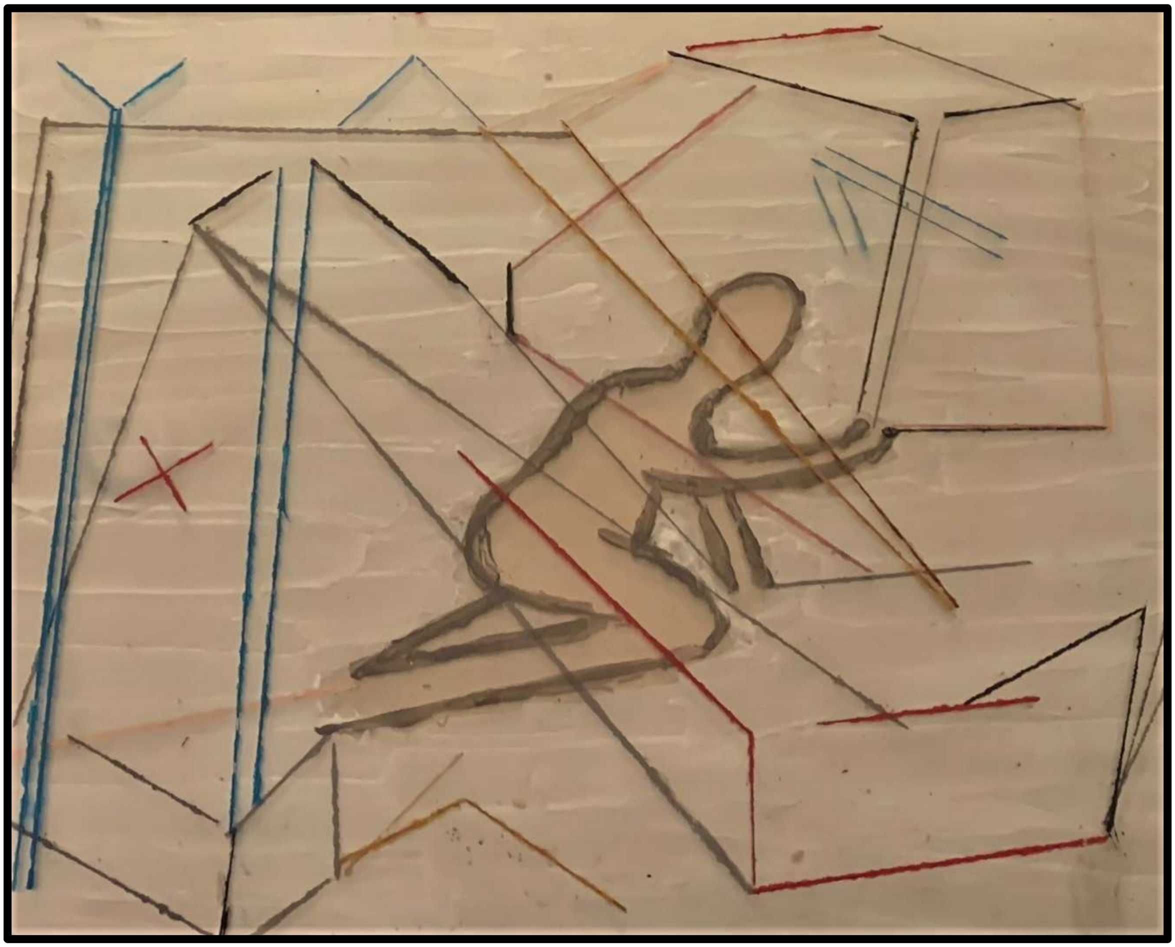

Figure 1. The hole organism.

Section I.

An Introduction to Orientationalism

The Current State of Culturo-Behavior Science

Culturo-behavior science (CuBS), an emerging science of cultural relations that integrates systems analysis and behavior-analytic contingency logic (Mattaini, 2019), has developed quickly and largely from a Skinnerian orientation. Most theory and research within CuBS assumes that cultural selection is a process distinguished from reinforcement, a position promoted often by Skinner (1981, 1986, 1987) throughout the later part of his career. Whereas reinforcement refers to the process by which behavior is selected by its immediate, contiguous consequences, cultural selection has been thought to refer to the process by which socially mediated contingencies of reinforcement are selected by group consequences (Skinner, 1981). In line with this distinction, Glenn (1986) proposed that cultural selection occurs through metacontingencies rather than through contingencies of reinforcement. In its contemporary use (see Zilio, 2019 for a historical discussion), a metacontingency describes a relation between a culturant class of interlocking behavioral contingencies or IBCs having the same aggregate effect on the environment and contingent selecting events or conditions that increase the probability of that culturant reoccurring (Glenn et al., 2016). This differs from a contingency of reinforcement, which describes a relation between an operant class of behavior having the same effect on the environment and contingent reinforcing events that increase the probability of that operant reoccurring.

From a Skinnerian perspective, this distinction is crucial. Cultural selection cannot operate through contingencies of reinforcement because IBCs are, appropriately, contingencies of reinforcement; it would be a category mistake to suggest that contingencies of reinforcement—through which operants are selected—are selected through themselves. But differentiating units of analysis does not necessarily rationalize the recognition of a different process by which such units are selected, a point that both Skinner (1984) and Glenn (2004) acknowledge. It is at this point where there must be criteria for differentiating between the processes of cultural selection and reinforcement that issues arise. Since culturants comprise in part the behavior of multiple individuals and reinforcement produces discriminative stimulus control, cultural selection can always be described as operating through coordinated operant contingencies in which common consequences contingent on the interrelated behavior of multiple individuals reinforce, or are correlated with, all of their behavior (Fleming & Hayes, 2021).

For Glenn (1986), a major rationale for differentiating between behavioral contingencies and metacontingencies was the immediacy requirement of reinforcing events. As conceptualized by Skinner (1938), reinforcing events are discrete, contiguous events contingent on the behavior that produces them. If a potentially reinforcing event does not occur immediately after the behavior upon which it is contingent, it is thought to be less likely to reinforce that behavior. Selecting events are not thought to be restricted by this feature. As Glenn et al. (2016) describe, only events that are contingent on culturants—in which different, more temporally-restricted events reinforce the behavior within IBCs—can have selective functions for culturants; reinforcing events are distinguished from events that select culturants, in part, by a temporal proximity requirement. Selecting events often refer to features of patterns of events; the most common example is consumer demand (Glenn & Malott, 2004; Houmanfar et al., 2010; Houmanfar et al., 2020), a value that characterizes a complex array of regular consumer practices. This allows the metacontingency construct to be used to describe the organization of cultural practices on more extended temporal scales, as well as criteria for distinguishing cultural selection from reinforcement. However, this difference only holds if a Skinnerian conception of reinforcement is maintained for the behavior that occurs within IBCs. If it is not, adequate empirical criteria for differentiating a metacontingency from coordinated operant contingencies may not be found.

Additionally, the current trajectory of behavior science suggests that reinforcement (as a strengthening process) is not a sufficient principle to account for operant behavior. For some time now, people have recognized inconsistencies and limitations concerning reinforcement. Reinforcement describes how individual consequences contiguous with and contingent on an occurrence of an operant strengthens that operant, but functional constructs—like the matching law (Baum, 1974; Herrnstein, 1970), disequilibrium (Jacobs et al., 2019; Timberlake, 1980), and reinforcer value (Hursh & Roma, 2013)—describe relations in terms of patterns of events, not relations between discrete response and stimulus events. Baum (2020) points out that reinforcement cannot wholly account for avoidance because avoidance is not maintained by contingent stimulus occurrences. Reinforcement is an applicable construct only when describing positive correlations between patterns of events; reinforcement is a poor description of a process that maintains avoidance because no event or stimulus object contingent on an avoidance response maintains avoidance responding. Kantor (1970) states that reinforcement obscures factors interrelated as psychological events, thereby reducing such events to only some of their factors even though they are relevant for their prediction and control. Jacobs et al. (2019) contend that reinforcement is to be accounted for through the disequilibrium of time spent engaged in various activities, not by relations between responses and stimuli. Ribes-Iñesta (2018) states that measures of operants (i.e., the probability or rate of operant emissions) do not represent the complexity of behavioral contingencies well because other dimensions of the analysis are not represented by response rate. In contrast with Skinner's dichotomization of operant and respondent conditioning (Skinner, 1935), Delgado and Hayes (2014) argue that reinforcement does not describe a process different from respondent conditioning, only one involving the substitution of different functions. Hayes and colleagues (1996) state that reinforcement attributes hypothetical causal properties to events so that other events may be explained by them. As Baum (2021b) states, "The molecular view based on discrete events has outlived its usefulness and should be replaced by a multiscale molar paradigm" (p. 578). While there are certainly some in behavior analysis who ascribe to a more molecular, reinforcement-as-strengthening-based approach to understanding behavior (see Shimp, 2020 and related commentary), a growing number of behavior analysts seem to be describing behavior in more molar terms.

The inconsistent use of the term "reinforcement" within CuBS suggests that at least some people participating within the enterprise recognize benefits of a molar orientation towards understanding behavioral events. The crucial pivot from a molecular to molar orientation towards behavior is when one abandons recognizing effective contingencies as those that relate contiguous, discrete events in favor of correlations or covariance between temporally-extended patterns of events (Baum, 1973, 2018, 2020; Rachlin, 1992, 2013, 2017). When operant responses are considered patterns of behavior or activities that occur with respect to a correlated pattern of environmental events, contiguity is not necessary to explain why operant behavior reoccurs (Rachlin, 2017). Glenn et al. (2016) describe a potential metacontingency variant that implies that correlation can be an organizing principle when they stipulate that selecting events can have reinforcing functions, although most of their analysis suggests that reinforcing events are more "local" (p. 13) than selecting events that cannot maintain the behavior of individuals participating within culturants due to issues of contiguity or lack of contact. In describing experimental analyses, metacontingency researchers typically differentiate between selecting events (for culturants) and reinforcing events (for operants) by how many individuals must contribute to their production, not by contiguous relations (e.g., Sampaio et al., 2013; Vichi et al., 2009), and some have focused on this procedural difference as a defining characteristic of metacontingency processes[1] (Baia & Sampaio, 2013). Despite this, most descriptions of metacontingencies position reinforcement as a process occurring within the unit selected through metacontingencies (Glenn et al., 2016). How prisoners' dilemma experiments are structured by metacontingency researchers so that "individual" and "cultural" consequences can be differentiated (e.g., Ortu et al., 2012; Morford & Cihon, 2013, Costa et al., 2013; Sampiao, 2020) further suggests that the molecularity of the metacontingency construct is not recognized by scientific workers within CuBS. A basic iterated prisoners' dilemma game can be described in terms of a metacontingency without any modifications to the game if cultural interactions are conceptualized in terms of functional integrations of interrelated patterns of the behavior of multiple individuals and environmental events (Fleming & Hayes, 2021). So, while it is likely that some scientific workers within CuBS may be thinking about behavior in more molar terms, most seem to ascribe to a Skinnerian perspective.

Reinforcement, as an organizing principle, is not coherent with contemporary molar orientations towards understanding cultural relations, so molar orientations cannot be coherent with variants of CuBS built on constructs that assume reinforcement. Interbehavioral orientations (Hayes, 1992; Hayes & Fryling, 2018; Kantor, 1924, 1959; Parrott, 1984) are also not compatible with the concept of reinforcement, but these approaches are also not wholly compatible with molar orientations, either. Although they diverge in several respects, two fundamental issues concern causal constructs and how regularity should be accounted for in an analysis of behavior. First, whereas molar behaviorists promote understanding determinants of

[1] It should be noted that, from the current orientation, considering metacontingencies as procedures rather than as units of analysis is ill-advised because *obtained* rates of selecting events are held to be functionally related to patterns of behavior involving two or more individuals; the environment is part of the unit of analysis. For further discussion, see Fleming & Hayes, 2021.

behavior in terms of final or distal causes (Rachlin, 1992, 2017), interbehaviorists reject causal explanations in favor of integrated fields (Hayes & Fryling, 2018) unless the functional integration of the entire field is taken to be causal (Kantor, 1959; Ribes-Iñesta, 1997). And second, whereas interbehaviorists contend that reinforcement should be accounted for as a setting factor within an integrated field (Fryling et al., 2021), some molar behaviorists prefer alternatives to reinforcement like induction (Baum, 2020). Some have argued that reinforcement may be reinterpreted in terms of correlated patterns of events rather than contiguous relations among their elements (Baum, 1973; Fleming et al., 2021a; Rachlin, 1992), but such a transformation is tantamount to inventing a new construct. Even if such a transformation were to be universally accepted, interbehaviorists do not have a unit of analysis that is compatible with that of molar behaviorists, namely relations between temporally-extended patterns of behavior and environmental events. If they did, a molar and interbehavioral construct capable of describing both behavioral and cultural relations may be possible and advantageous across enterprises, including in CuBS if behavior analysts continue to question the suitability of describing events in terms of reinforcement.

These issues are compounded by how Skinnerian reinforcement logic has obscured the role of language in studying culture. Verbal behavior is said to facilitate cultural selection occurring through metacontingencies, as aggregate products are not necessarily conditional on indirect responding. However, in most contemporary behavioral theories on language and cognition (e.g., Barnes-Holmes et al., 2020; Hayes et al., 2001; Sidman, 2000), verbal behavior is not only how individuals interact with one another but how they interact at all. Whether people are responding with respect to stimuli participating within equivalence classes, relational networks, or some other set of verbal stimulus relations, human behavior is linguistic (Ribes-Iñesta, 2006). Any comprehensive model of cultural relations—or human cultural relations, if one argues that non-human organisms can participate in metacontingencies (e.g., de Carvalho, 2016; Glenn et al., 2016; Velasco et al., 2017)—should be constructed with and integrate features of a behavioral theory of language because to study culture is to study language. Even Skinner (1981) appealed to cultural selection to account for what contingencies a verbal community maintains; he just did not conceive of what it means to speak with meaning or listen with understanding (Hayes, 1996). Some metacontingency models do recognize the derived relational nature of language (Houmanfar et al., 2020;

Rehfeldt et al., 2021), but they also typically incorporate reinforcement and other constructs that are incompatible with molar and interbehavioral approaches.

The purpose of this dissertation is to describe cultural reaction systems as a new unit of analysis for cultural relations that is specifically molar, interbehavioral, and referential. In doing so, this paper will elaborate on a reconceptualization of a construct first introduced by Kantor (1924)—reaction systems—to build on functional relations described by the metacontingency construct in a framework we refer to as orientationalism. To appropriately detail the molar and interbehavioral nuances of the cultural reaction system construct, this paper will outline (1) what an integrated field is from a Kantorian approach, (2) a molar orientation towards behavioral events influenced mostly by the works of Rachlin and Baum, and (3) how a Kantorian integrated field is not descriptive of the units of analysis molar behaviorists are concerned with so that the reaction system construct can be differentiated from both integrated fields and temporally-extended patterns of behavior. After doing so, the cultural reaction system construct will be defined and described, along with derivative constructs that may be systematically interrelated with the cultural reaction system construct with the aim of beginning the systematization of an orientationalist science of cultural relations. Then, several experiments conducted from an orientational perspective will be outlined. Throughout the text, important terms will be underlined. A glossary of underlined terms is located in Appendix A.

Kantorian Interbehaviorism

Before describing orientationalism or a cultural reaction system, orientation towards a Kantorian unit of analysis for psychological events is warranted. The integrated field construct (Hayes & Fryling, 2018; Kantor, 1959) is a naturalistic description of psychological events that does not rely on causal constructs; all factors composing the field are interrelated, constituting a functionally-integrated whole. From a Kantorian perspective, such factors include (1) stimulus functions, (2) response functions, (3) interbehavioral history, (4) medium of contact, and (5) setting factors. Understanding why these factors are differentiated within an integrated field requires recognizing psychological events as segments of an ongoing, continuously evolving whole organism-environment interaction. Organisms are always interacting with respect to stimulus objects, stimulus events, and their properties within an environment. This is not to say that organisms, stimulus objects, and stimulus events themselves interact in psychological events but participate as loci of continuously evolving response functions—which are actions on the part of organisms (Kantor, 1959, p. 15)—and stimulus functions—which are actions on the part of stimulus objects and events (Kantor, 1959, p. 16)—mutually coordinated with respect to media of contact, setting factors, and histories of interaction. An integrated field is represented in Figure 2.

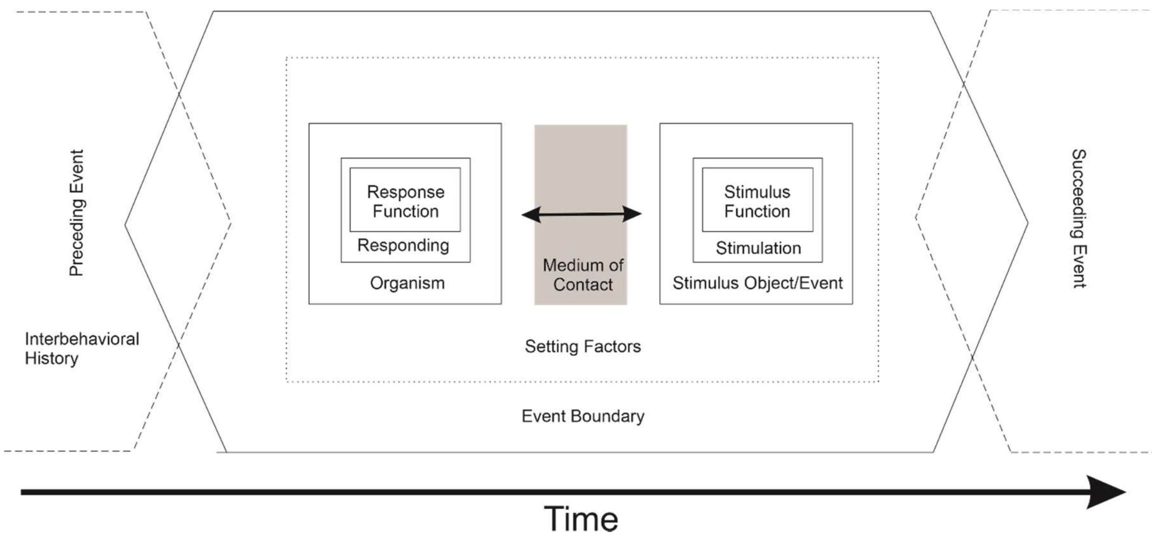

Figure 2. An integrated field depicting a psychological event. This figure is a recreation of one of Kantor's representations (1977, p. 47).

The rest of this paper will progressively deviate away from a Kantorian orientation towards psychological subject matter represented in Figure 2, as can be seen to some extent in Figure 3. With respect to differences between Figures 2 and 3, first notice that delimiters of the organism and stimulus object or event (i.e., the boxes around them) are the same as setting factors. In the current orientation, properties of participating organisms (e.g., biological composition), stimulus objects (e.g., hardness), and stimulus events (e.g., brightness) are considered setting factors. Kantor (1959) acknowledges that such properties can participate as setting factors, but his typical integrated field representations suggest that participating organisms, stimulus objects, and stimulus events are different from setting factors. Second, unlike in Figure 2, preceding events participate as setting factors in present events in Figure 3. Kantor situates interbehavioral history and setting factors as different factors, but given how interbehavioral history operates through formal similarity and spatio-temporal proximity, interbehavioral history will be discussed as a setting factor here, as denoted in Figure 3 by the dotted arrows moving from the boundary of the preceding event into the setting factors of the present event. Third, Figure 3 does not represent overlap between events like Figure 2. This is purely aesthetic; Figure 3 represents continuity of events and their overlap by the arrows between events.

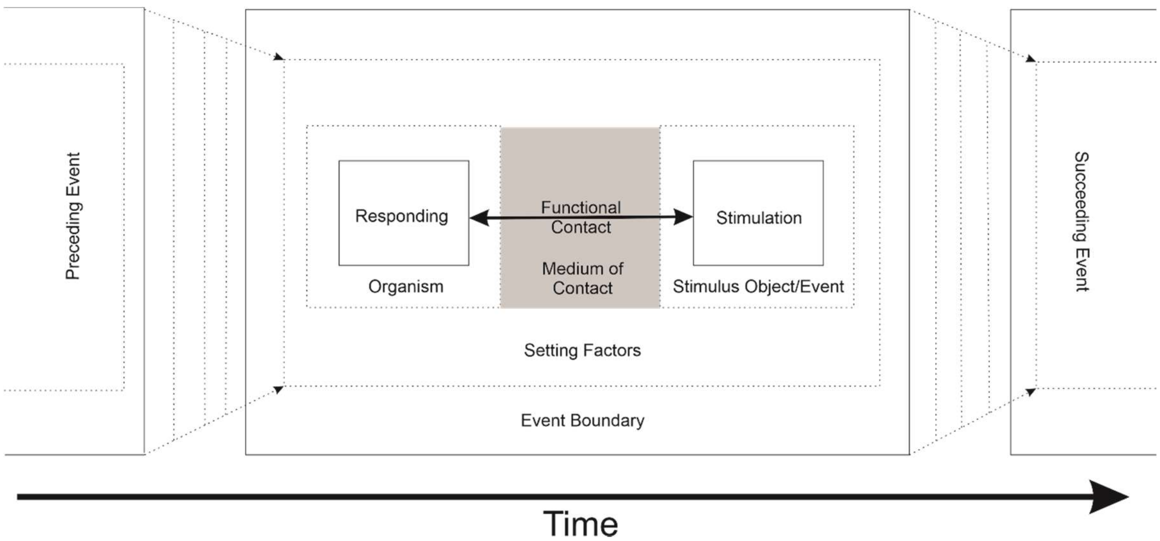

Figure 3. A modified integrated field depicting a psychological event.

But fourth, and most importantly, Figure 2 illustrates a functional contact, not a mutual coordination of stimulus and response functions as described by Kantor and others (e.g., Fleming et al., 2021b; Hayes & Fryling, 2018; Munoz-Blanco & Hayes, 2017). Distinguishing stimulus and response functions may be analytically useful for orienting to certain regularities, such as Kantor's (1959) observation that both responses and stimuli can have multiple functions or Kantor's (1924) notion that either a response and stimulus function may be substitutional when the other is not. However, a "mutual coordination" not only implies differential actions of responses and stimuli that cannot be independently observed but that responses and stimuli *have* functions that can be isolated from one another. Likewise, to say that response or stimulus functions can be *acquired*—like *equipment*—implies that functions are like possessions or are *in* things and events. Kantor writes in these ways, as shown in Table 1.

Table 1.

Examples of Problematic Language in Kantor's Books

Citation	Excerpt
Kantor, 1924, p. 41	Additional important reactional conditions which influence desiring behavior are found in the more general behavior *equipment acquired* by deliberate training or casual past experiences.
Kantor, 1926, p. 165	Clearly what we have here is the person *endowing objects with stimulational functions* by developing reaction systems to them.
Kantor, 1929, p. 5	For the most part, however, objects and actions introduced into the new group are *invested with entirely new functions* which represent an attempt at the domestication of the objects by making them conform to the general civilizational system of the new collectivity.
Kantor, 1936, p. 24	The individual living among people who speak a certain language gradually *acquires* certain types of adjustmental acts, so that under a given familiar circumstance—say when he needs a tool—he will say "Please hand me the saw".
Kantor, 1958, p. 13	Wherever there is a scientist there is an interbehavioral history—namely, a detailed basis for his development, his problems and techniques, and the interpretations of what he observes. Examining this interbehavioral story we discover how the individual *acquires* and justifies his scientific interest, how he adjusts himself to traditional ways of thinking, or, quite otherwise, sometimes initiates, at least suggests, a revolution in conventional practice.
Kantor, 1959, p. 93	Stimuli and response must be differentiated from the action of organisms and objects which constitute their *vehicles or carriers*.
Kantor, 1959, p. 131	Learning processes and results indicate changes in a complex situation as well as in organisms. Changes take place *in* stimulus objects as well as *in* organisms. Excluded is the notion that only the organism *acquires, retains, and performs* behavior.
Kantor, 1959, p. 236	It is to be noted, too, that all the so-called natural surroundings are infused with cultural characteristics. This is because all objects and events have been *endowed with stimulus functions* of individual and group types.
Kantor, 1977, p. 77	When a person interacts within a symbolic situation, there are two distinct objects interacted with in turn, each *with its own stimulus function*.

Italics not in original texts. The authors urge readers to go through Kantor with a fine-toothed comb. Kantor does not always write in these ways, but he often does; this list is not exhaustive.

Obviously, Kantor is not a mentalist and does not mean to imply so by using possession-based terms in these ways; acquisition occurs when functions are coordinated with organisms and objects, just as equipment refers to an aggregate of response functions developed over an organism's lifetime. Kantor (e.g., 1959, 1977) goes to great lengths to emphasize these points and the singularity of stimulus-response functions from a non-mentalistic, naturalistic perspective, but some of his constructs not only seem to work against that pursuit but engender metaphorical characterization of event factors. Even if a stimulus-response function is viewed as one interaction, it is still considered an interaction between two functions: a response function and a stimulus function. A functional contact is an interaction between a responding whole-organism and a stimulating (stimulus) object or event (c.f., Ribes-Iñesta, 2018[2]). The interaction referred to is a singularity; there is no need to distinguish between functions of an organism and those of stimulus objects and events because to distinguish them—in any way, even as response and stimulus functions—is to suggest that this singularity can be divided and isolated. Both response and stimulus function refer to an interaction between a responding organism and a stimulating environment, so neither term is necessary. The observation that similar organismic acts participate in different events (e.g., raising a hand when asking a question as well as when blocking the light from the sun) does not require recognition of different response functions because one can recognize that responding is similar in different situations; all one needs to do is distinguish them as different functional contacts. For these reasons, functional contacts will be described here instead of mutually coordinated stimulus and response functions or stimulus-response functions. Kantor himself uses the term "contact" in part to highlight these issues and the singularity of organism-environment interactions, but his use of the term among other more problematic constructs like those detailed above is inconsistent.

Kantor had other valid reasons to distinguish between stimulus and response functions. Given that psychological events concern continuous organism-environment interactions, functional relations always involve forms of organismic activity and environing stimuli that can each be analyzed in their own right. On the side of organismic activity, response functions can be described as <u>reaction systems</u>. When Kantor

[2] While Ribes-Inesta's (2018) definition is similar, it extends this definition in ways the current orientation views as problematic. While his framework is similar to orientationalism, it diverges in some other key aspects, including (1) how molarity is conceptualized, (2) how reference is conceptualized, (3) how medium of contact is conceptualized (4) what field factors are considered, and (5) the role of contingencies. Further elaboration is outside the scope of this paper, but readers are encouraged to use Ardila Sánchez et al. (2021) to compare the two approaches.

uses the term, he refers to a set of anatomico-physiological systems that participate in a given act. As Kantor writes in *Psychological Linguistics* (1977):

> Reaction systems constitute the units of action irrespective of the stimuli or the setting factors. They consist of a grand synthesis of muscular, glandular, neural, receptorial, and other anatomico-physiological movements of the organism. (pp. 49-50)

As such, a reaction system constitutes a coordinated set of discriminable organismic participants in a psychological event that can be partitioned for particular scientific aims. None of these participants alone can substitute for or characterize an entire reaction system; a reaction system itself constitutes an integrated set of interactions composing particular whole-organism movements or acts.

In *Principles of Psychology, Vol. 1* (1924, pp. 37-38), Kantor recognizes that complex psychological events (i.e., those other than simple reflexes) involve multiple reaction systems, an orientation he maintains throughout the rest of his work. All complex psychological events involve a precurrent phase in which attending and perceiving reaction systems occur first, followed by a final phase in which a consummatory reaction system may actualize. Other reaction systems may also participate in complex psychological events, such as auxiliary reaction systems, but they necessarily involve attending, perceiving, and consummatory reaction systems. These three reaction systems are important because, from an interbehavioral orientation, consummatory reaction systems of complex psychological events are conditional on attending to and perceiving stimulus objects and events. In differentiating these reaction systems, though, Kantor not only acknowledges that complex psychological events constitute patterns of activity–which he explicitly states (p. 37)—but differentiates between acts and patterns of acts. Since a simple reflex only constitutes one reaction system, it is not considered a pattern of acts, even though every reflex occurs across time and constitutes a continuous change in form as an organism adapts to an environmental circumstance. Reaction systems for Kantor, thus, can both constitute the entirety of an act or its constituent parts, depending on whether the act can be divided into multiple reaction systems.

Orientationalism seeks to extend the logic of reaction systems. In this preliminary step, the reaction system construct is extended to describe the entirety of anatomico-physiological interactions with respect to stimulus objects and events participating as a <u>pattern of functional contacts</u>. The fact that a simple reflexive response can constitute a whole reaction system suggests that, for Kantor, reaction systems and response functions are sometimes synonymous, unless a response function involves multiple reaction systems. But one can also state that any response function–as well as any functional contact–involves certain anatomico-physiological interactions, not more, not less. Just as a functional contact cannot be reduced to any of its parts, neither can the synthesis of interactions that constitute it. They can be distinguished from one another and scaled for the sake of analysis, but, at this point, reaction systems cannot only be seen as defining the totality of all interactions composing the response side of a functional contact but the functional contact itself. Even more, entire patterns of functional contacts participating within a psychological event can be described as a reaction system. Given that responding does not occur in the absence of stimulation and that the properties of organisms, stimulus objects, and stimulus events restrict anatomico-physiological interactions of responding, a pattern of functional contacts can simply be considered a reaction system at its broadest scale within the confines of a psychological event. We will broaden the scope of the reaction system construct later, but this preliminary step will be useful moving forward.

Kantor delimits psychological events–as well as reaction systems–by formal properties of organismic acts with respect to stimulus objects and events. Complex psychological events involve precurrent and final reaction systems because behavior segments have definite phenomenological beginnings and endings, however arbitrary; they begin with attentional and perceptual responses and end with a consummatory response that characterizes the event (Kantor, 1924, p. 38). This is tantamount to saying that psychological events are discrete and momentary, occurring for a set period of time bounded by formal properties of a whole organism-environment interaction. In *Interbehavioral Psychology* (1959), Kantor states this explicitly:

> Psychological events are momentary, though they may be duplicated more or less closely. But in that case similarities of performance are owing to similarities of field structurization, the momentary coincidence of a number of factors, and not because of any cellular organization. (p. 225)

Although there is a degree of molarity—as conceptualized by Broad (1925)—alluded to by not ascribing causality of psychological events to "cellular organization," this passage clearly outlines <u>molecular</u> features of Kantor's systemization of interbehavioral psychology. A molecular orientation is one that assumes (1) that changes in how an organism interacts with stimulus objects and events must be accounted for, in part, by contiguity and formal similarity of discrete, continuous events and (2) that functional relations are bounded by the point-of-view of the organism whose behavior is under analysis. To say that functional relations are bounded by the point-of-view of the organism is not to say that an organism's perspective or verbal interactions determine what is functionally related to their responding or that descriptions of behavior are not generalizable across organisms. Rather, it is to delimit boundaries of functional relations by direct contacts involving stimulus objects and events composing an organism's immediately perceived surroundings. The circumstance that is relevant to understanding an organism's behavior at a given moment in time is the entirety of stimulus objects and events with formal or physical properties that the organism is concurrently interacting with at a particular moment of time (i.e., those that an organism is seeing, hearing, smelling, etc., at a specific point in time). If an organism is interacting with a stimulus object or event in a way that is not based on its formal or physical properties or only on the basis of its relation with other, previously contacted[3] stimulus objects or events, stimulus substitution is fundamental to understanding the current evolution of that organism's participation within a psychological event. Stimulus substitution refers to both (1) the actualization of a functional contact involving a non-directly contacted stimulus object or event through one that is directly contacted (Kantor, 1924) and (2) the process by which one stimulus object or event acquires functions of another through physical likeness (i.e., formal similarity) or spatio-temporal proximity of events (i.e., contiguity; Delgado & Hayes, 2014). In Kantor's (1924) words:

> It is only because an object and its connection with other objects are coordinated with the responses of persons that they become of interest to the psychologist. This means to say that from a psychological standpoint it is because the proximity of and similarity between reactions are induced in the person by the proximity and similarity between objects, that the latter are admitted into the psychological domain. (pp. 817-818)

For Kantor, there is a definite moment in time in which an "organism has…acquired a reaction system to a [given] stimulus object" (Kantor, 1926, p. 5). As such, stimulus substitution–like the psychological event

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[3] The term "contacted" is being used here as short hand to describe functional contacts. A contact is a unitary interaction, something an organism's responding participates in, not something an organism does. To say that an organism "contacts" or "contacted" a stimulus object is not to deny that the stimulus object "contacts" or "contacted" the organism as well.

itself–is an inherently molecular construct, as functions transfer from one stimulus to another on the basis of spatio-temporal proximity of direct contacts in addition to formal similarity between stimulus objects or events. Arguably, formal similarity can even account for contiguity (Hayes, 1992), especially if one allows a series of events to be formally similar to other series.

Limitations of molecular orientations like Kantorian interbehaviorism are well-illustrated when considering psychological events in which contacts involving stimulus functions originally coordinated with non-present stimulus objects or events at a particular moment in time are conditional on contacts involving other stimulus objects or events, as in the case of direct contacts between a rat and food in an operant chamber being contingent on lever pressing. Figure 4 depicts different ways of conceptualizing this relation, including in terms of stimulus substitution (*bottom panel c*). As Delgado and Hayes (2014) explain, operant conditioning–as well as respondent conditioning and verbal relations–can be accounted for by stimulus substitution as a process in which stimuli bidirectionally acquire partial stimulus functions of one another on the basis of contiguity between events in which they participate. When considering a rat pressing a lever in an operant chamber, their account stipulates that the rat comes to do so because, given other factors composing each lever pressing event, pressing the lever and eating food are contiguous with one another. This contiguity describes a circumstance in which each stimulus object can acquire functions of the other as those stimulus objects are interacted with in succession. Their account also implies the importance of formal similarity given that, as in the case of eating food, each food object is only interacted with once; while the lever remains constant, lever pressing is always contiguous with eating different pieces of food that share formal properties. Contacting each piece of food after pressing the lever participates in the rat's subsequent contacts involving the lever because each eating interaction alters functions with respect to the lever, just as lever pressing reciprocally alters those of food objects. Through contiguous interactions, stimulus objects and events–as well as those formally similar to them–acquire substitutional functions of that with which they have been contiguously related, and such substitutional functions participate in complex psychological events when organisms interact with such objects and events again at the time in which they do. But this account does not accurately describe the psychological event of eating food contingent on lever pressing in an operant chamber from a more molar perspective.

The lever and food have not acquired functions of one another–pressing the lever has *become a part of eating food*. Like other functional contacts involved in the complex pattern of eating food, such as seeing the food, moving towards the food, and smelling the food, pressing the lever also constitutes part of the activity of eating food. This conceptualization is illustrated by the top two panels of Figure 4 that do (*middle panel b*) and do not (*top panel a*) emphasize the constituency of lever pressing in the event of eating food.

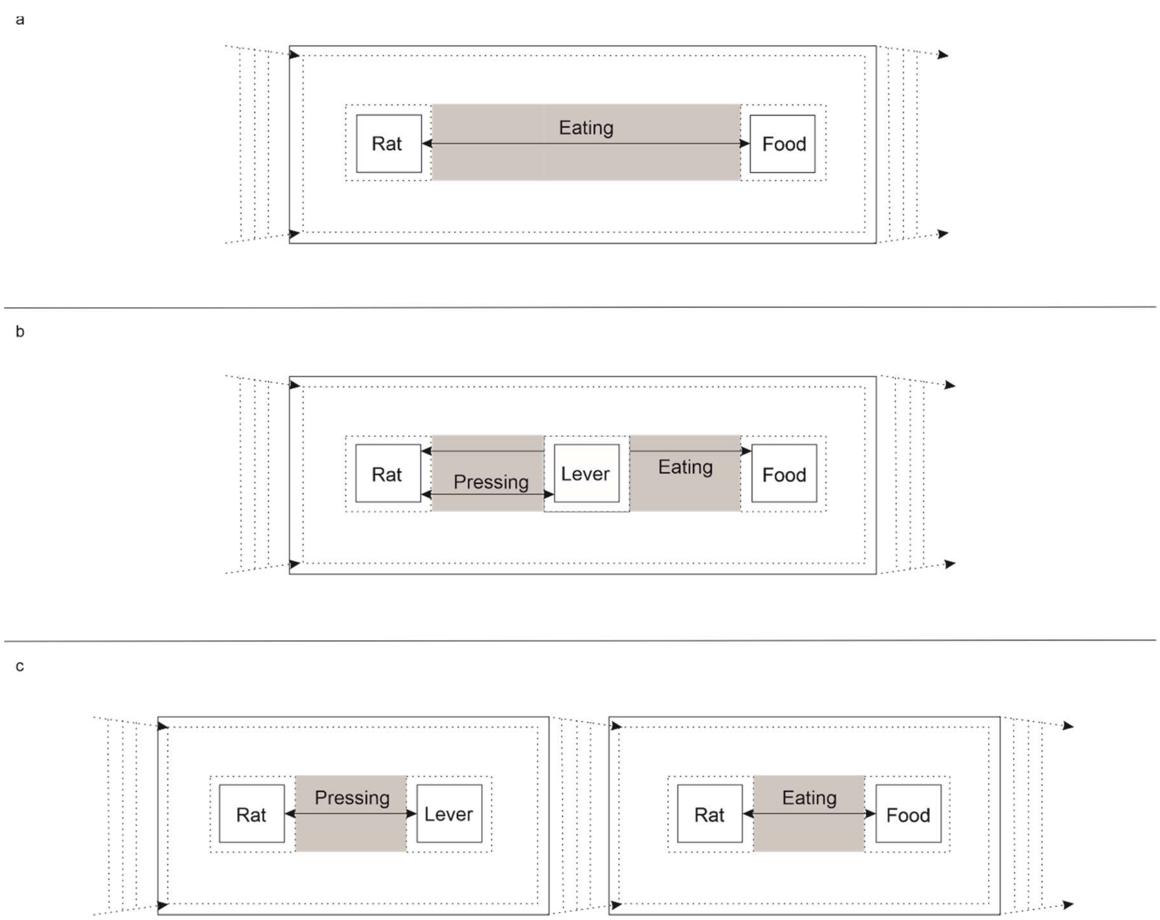


Figure 4. Different ways of representing eating food within an operant chamber as it is related to lever pressing. Some features of Figure 2 have been left out for simplicity.

If one restricts a psychological event to a particular pattern of direct and substitutional functional contacts involving a single stimulus object or event, one runs the risk of not identifying factors that are functionally related to particular contacts when it is considered as a constituent within more extended patterns. In the above example, if a rat pressing a lever is described without recognizing that lever pressing constitutes part of eating, then the description may not include factors relevant to eating and not necessarily relevant to just pressing a lever, such as deprivation from food. Kantor (1924) does not restrict the boundaries of psychological events to only single organismic acts but to "the most conveniently isolated response to a stimulus, or series of responses to stimuli, which can be said to represent a definite specific adaptation" (pp. 36-37). As discussed above, complex psychological events always involve multiple functional contacts and, thus, always involve a pattern of functional contacts. However, up to this point, the only complex patterns of functional contacts that have been described have all pertained to the same stimulus object or event, namely those that involve attending, perceiving, and consummatory responses to the same stimulus object or event. In an example in which an experimental participant clicks a button in response to a light turning on (p. 37), Kantor makes it clear that a consummatory response to one stimulus can be responding to another, a psychological event that involves sequential interactions with multiple stimulus objects and events. This conceptualization of such an event somewhat deviates from substitution accounts of reinforcement and generalization based on the partitioning of events put forth by Delgado and Hayes (2014), Hayes, (1992), and Parrott (1984) but only because of a difference in theoretical aims. Substitution accounts of such processes aim to describe *how* functional contacts become organized so that more complex behavior segments may be established, not the entirety of an established adaptation. How Kantor's (1924) perspective aligns with these accounts is clear in his discussion of association:

> When the organism has acquired responses sufficient to connect it with a larger number of surrounding objects, then we consider it as oriented to those surroundings, since it will then be able to perform behavior serviceable to itself in the given situation. In more complex situations, that is to say, when responses must be prepared for before their actual operation, and when the response must be delayed and in consequence aroused by substitution stimuli, then we must also have our surrounding objects and events themselves so related as to form interconnected stimuli. (pp. 316-317)

Here, meaning is being characterized in terms of substitution and delay. For Kantor (1924):

> Meaning responses constitute specific reaction systems which do not themselves comprise adjustments to stimuli objects but function to condition the specific operation of other reaction systems or the final adjustments to the object arousing a meaning response. (p. 388)

What is meaningful from a Kantorian perspective are reaction systems that serve to condition other reaction systems; not all reaction systems are meaningful, as those that are “constitute [specific] reaction systems”. Such reaction systems are often linguistic, but they are only necessarily substitutional in the sense that meaning responses occur with respect to acquired properties of stimulus objects and events and not solely their formal or physical properties; a meaning reaction system “anticipates a reaction that is to follow by implying or pointing to conditions and situations not discoverable in the natural object” (p. 390). In the case of operant conditioning, an operant response can be said to be meaningful in the sense that it constitutes a reaction system that anticipates another (i.e., a functional contact involving stimulus objects commonly denoted as reinforcers) that is necessarily delayed–because it is conditional on operant responding–and, through historical, contiguous contacts with formally similar objects, the stimulus object with respect to which operant responses are made has acquired or been attributed with substitutional functions from that which is anticipated. Kantor addresses this point directly when he states that, “[Overt performative] meaning reactions here function as prior movement or manipulation performances which condition the later operation of other reaction systems” (p. 391). As such, substitution allows for the establishment of more complicated behavior segments in which stimulus objects and events or properties thereof at a given point in the segment are substitutionally interacted with until they are directly contacted at a subsequent point in the segment. Like in some behavior-analytic orientations, the meaning of a meaning reaction system is to be found in how it conditions subsequent whole organism-environment interactions, even if such reaction systems simply provide the opportunity for other reaction systems to occur in a more proximal timeframe.

Molar Logic

Kantor’s orientation towards meaning is similar to Rachlin’s (1992, 2013, 2017) take on final causes. Based on Aristotle’s taxonomy of causal relations, Rachlin (2017) identifies two types of final causes. A narrow final cause refers to what is normally considered in mainstream behavior-analytic vernacular as the function, consequence, or purpose of behavior. In an operant chamber where food is contingent on lever pressing, a rat does not just press a lever—it presses a lever *to eat food*; the narrow cause is eating food because it explains why the lever is pressed. While Kantor (1924, 1959) does not discuss psychological events in terms of efficient causes, the consummatory reaction system that a meaning reaction system conditions can be said to serve as the final cause for such conditioning; meaning reaction systems cannot be understood without respect to reaction systems they condition. Whereas narrow final causes point to consummatory reaction systems that explain meaning reaction systems, wide final causes refer to the totality of a pattern comprising interrelated events. To say that events have a wide final cause is to say that events are explained by describing the patterns in which they are constituent elements. To borrow a favorite example of Rachlin's (1992), consider a symphony. A symphony may contain notes shared with other symphonies; understanding the occurrence of any discrete behavioral event (any note played) requires understanding its constituency within a pattern by which it is organized (playing the symphony). As such, the wide final cause construct is similar to an integrated field. Explaining psychological events in terms of wide final causes is to describe the entirety of an event in which interactions are organized, although fields incorporate factors that behavioral patterns do not describe because patterns only constitute or imply a portion of factors that compose the field. And, to the extent to which a reaction system is considered to describe the totality of a pattern of functional contacts of a particular psychological event, certain consummatory contacts of such systems may be conceptualized as narrow final causes.

However, the psychological event construct places arbitrary limits on what can be considered a wide final cause that effectively prevents the consideration of certain factors and processes relevant to understanding psychological subject matter. According to <u>molar</u> orientations, especially those of Herrnstein (1970), Rachlin (1992), and Baum (2020), patterns of behavior are functionally related to patterns of environmental events. Such patterns are mutually interrelated and interdependent; patterns of behavioral and environmental events covary together as an integrated whole. Even though a psychological event typically describes a pattern of functional contacts (and necessarily does from the current orientation because an organism always participates in more than one functional contact concurrently), that pattern is always restricted to only functional contacts that constitute a single occurrence of an event that could otherwise be said to participate in a more temporally-extended pattern. While such events are typically continuous, they need not be from a Kantorian orientation; consummatory reaction systems may be delayed, as in the case of remembering events (Kantor, 1924, p. 48). In every case, psychological events constitute definite adaptations with respect to a circumstance occurring at a particular moment in time from a Kantorian orientation, not functional relations between patterns of events.

This prevents molar behavioral patterns from being described as psychological events. Differences between conceptualizing organism-environment functional relations in terms of events and patterns of events are illustrated by comparing Figures 5 and 6. Figure 5 represents how one can utilize the integrated field construct to describe the relations among several psychological events (a through e) that, in this example, can be characterized as two distinct types (1 or 2) based on differences in form. Across time, an organism participates in the actualization of functional contacts with various stimulus objects and events that can be delimited from one another to partition behavior segments of a continuous, ongoing organism-environment interaction. Each of these functional contacts occurs with respect to particular setting factors and is bounded by characterization of its form, or a change in form that is recognized as a definite adaptation or adjustment. The unidirectional arrows denote that all previous interactions participate as interbehavioral history in each forthcoming psychological event, an event that is always transforming into what can be identified as another event as an organism continues to interact with its environment. Each psychological event is bounded arbitrarily in the sense that there is no inherently “correct” way to divide an organism-environment interaction into analyzable parts; the way organism-environment interactions–and even the fact that organism-environment interactions are partitioned from the rest of a monistic event–are divided is conventional. Interbehaviorists isolate distinct psychological events which may be characteristically similar to one another at a certain scope but are always distinct from one another; the individuality of organisms is largely accounted for by their interbehavioral histories, continuous and relentlessly compounded as a participating factor in each observed event.

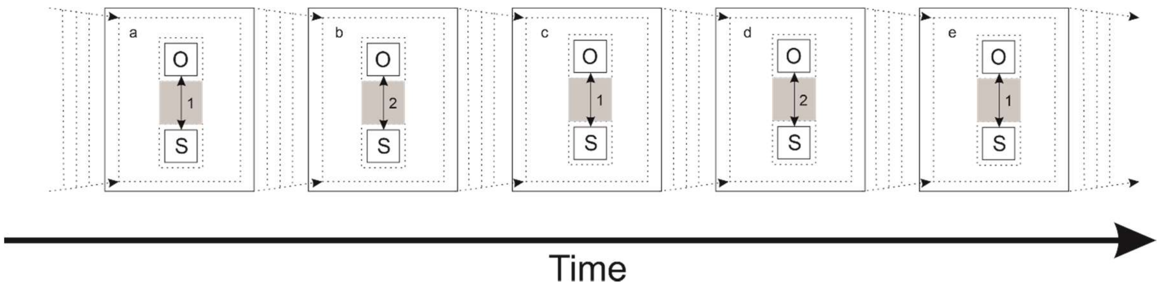


Figure 5. A series of psychological events. O = responding of organism, S = stimulation of a stimulus object or event, a-e = different psychological events, 1-2 = different types of functional contacts, solid boxes = event boundaries, dotted boxes = setting factors, unidirectional arrows = participations of past events in the current event as interbehavioral history, bidirectional arrows = functional contacts, gray area = medium of contact.

This differs from the molar conceptualization detailed in Figure 6. In Figure 6, what characterizes a type of interaction is not formal similarity across *different* events but the participation of functional contacts within the *same* pattern (a or b). Not only is responding of an organism functionally related to stimulation of stimulus objects or events that it interacts with, but the organization of contacts and which contacts occur are functionally related to environmental regularity by which such contacts can occur. Said differently, a pattern of functional contacts is related to a correlated pattern of circumstantial reconfiguration–if not more–which participates not only as a setting factor for each contact but *all* contacts that constitute the pattern to the extent that such contacts are recognized. Patterns of functional contacts are always correlated with patterns of circumstantial reconfiguration because the configuration of a circumstance—comprising physical, physiological, and biological relations between and of organisms, stimulus objects, and stimulus events and their properties with respect to one another—changes as an organism interacts with it. With respect to both time and space, patterns of circumstantial reconfiguration constitute more or less stable conditions that participate in the integration of contacts within patterns as they maximize with respect to contacts involving particular stimulus objects and events. The problem of which patterns to examine is an old one (Levin, 1992) and typically explained away in behavioral thinking as adjustment towards more precise, specific, or reliable orientation (e.g., Kantor, 1959), effective action (e.g., Skinner, 1957), or coherent effective action (e.g., Hayes et al., 2012), but here patterns to be considered are (1) those that are congruent with a particular theoretical orientation within a behavioral, non-mentalistic, monistic, and empirical scientific system, (2) those that can be demonstrated to be functionally related to other factors through conventional means of a scientific system, particularly experimentation, and (3) those with identifiable homogeneous elements (i.e., patterns demonstrate regularity across space and time, even though the functional contacts that constitute it change with correlated changes in the configuration of the circumstance).

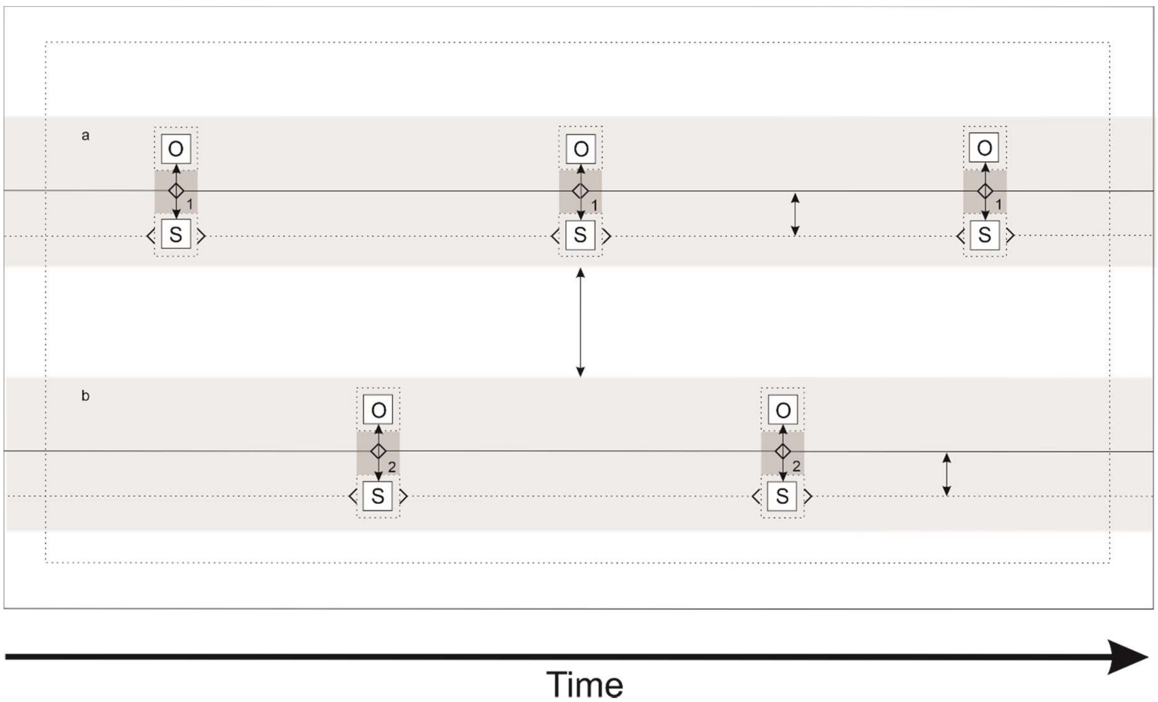


Figure 6. An orientationalist's representation of patterns of functional contacts and stimulus objects and events. O = responding of organism, S = stimulation of a stimulus object or event, a-b = different patterns of functional contacts, 1-2 = different types of functional contacts, solid exterior box = event boundary, dotted boxes = setting factors, solid bidirectional arrows = various forms of interaction (i.e., functional contacts, interactions between patterns), horizontal lines = patterns of functional contacts (solid) and circumstantial reconfiguration (dotted), gray area = medium of contact

The logic of accounting for correlation represented by Figure 6 is different from accounting for correlation between patterns of functional contacts and circumstantial reconfiguration by isolating it within a history of interaction. For Kantor (1924), certain conditions, such as the frequency of or recency by which a stimulus-response function has occurred, contributes to the formation of a stimulus-response association that is present within every interaction because an organism's interbehavioral history is a contributing factor to each psychological event. Skinnerian accounts (e.g., Skinner, 1957) are similar insofar as accounting for what an organism is likely to do in a current situation is predictable based on that organism's history of reinforcement contributing to the strength of the next forthcoming response. In relational frame theory (Hayes et al., 2001), with its self-attributed influences from radical behaviorism and interbehaviorism, it is the history of contiguous stimulus contacts–including reinforcers as discrete stimulus events–ever-present in the current interaction that contributes to the occurrence of particular forms of relational responding. From the current orientation, however, such correlations in part constitute the circumstance–which is, by definition, constant and ongoing–described as setting factors. An organism is always interacting and, thus, has participated within interactions, but the integrated field represented in Figure 6 illustrates functional relations identified on the basis of distributions of interactions within a circumstance, not from the point-of-view of the organism. The accounts referenced do not deny the role of the current situation in the establishment of functions or responding; in fact, they explicitly distinguish its importance. But they also attest that correlations between stimuli and responses participate in a given organism-environment interaction because that organism *has experienced them*; a stimulus context contributes to the increased likelihood of interactions reoccurring because such an interaction was likely to occur in a similar, past context *and* that interaction has now occurred in a context that is similar to the present one. When patterns of functional contacts replace discrete psychological events as a focal point of analysis, an organism *is always participating within a functionally integrated whole of correlated, ongoing patterns.* As Baum (2021a) states, an organism is a medium of behavior, that which allows patterns of environmental and behavioral events to be correlated.

This does not mean that molar orientations deny the importance of history. Melioration (Herrnstein & Prelec, 1991), maximization (Rachlin et al., 1981), and equilibrium (Timberlake, 1980) all rely on the assumption that the present value of an activity relative to others adjusts towards an average–determined by observing how time is allocated across activities–as an organism does or does not engage in that activity. However, this is not the only way to conceptualize history or account for what is typically attributed to it from a molar perspective. When the circumstance with respect to which an organism interacts is viewed as temporally-extended, functional contacts are not restricted to what more molecular orientations posit as an immediate circumstance. Stimulus objects and events that would otherwise only be considered to be present in the immediate circumstance from molecular orientations by their functions operating substitutionally or relationally through other stimulus objects and events that are being directly contacted can still be considered to be contacted across wider timescales without appealing to stimulus substitution which, in turn, requires an appeal to an interbehavioral history. What is “here-and-now” for an organism are the stimulus objects and events it is interacting with in functional contacts—that are always constituents within patterns—extended across various spatio-temporal scales.

How to account for the participation of history as a factor within behavioral interactions is fundamentally related to how scientific workers orient towards events. Assuming monistic interrelatedness of everything participating within a single event (Hayes, 1993, 1997), an event refers to any interaction or change in relation between two or more objects on a particular spatiotemporal scale. A system is a particular type of event in which a relation between interacting objects is consistent but discontinuous across time. Objects are sub-systems that interact with one another as events and can do so due to their consistency. Not only can organisms and stimulus objects be said to participate within events as objects, but patterns of functional contacts and circumstantial reconfiguration can be said to do so as well; environmental regularity contacted by an organism is functionally related to regularity in the way that an organism orients to it. Since patterns of functional contacts are also related to one another (i.e., organisms consistently allocate time towards different activities), an organism’s orientation towards its environment–*how* an organism interacts or the form of functional contacts an organism participates in–is described as interrelations between the patterns of functional contacts it participates in. As such, an organism’s history of interaction is relevant insofar as it describes how an organism-environment interaction organizes, stabilizes, and changes over time. This type of stability or organization cannot be observed within a single response, act, or functional contact, nor can it be accounted for by a history of interaction ever-present in each of an organism’s interactions. An organism’s orientation is with respect to the whole environment it interacts with, not just a particular aspect of it at a particular point in time, even if that orientation is said to be historical or a participating factor within each event it itself participates in. An organism’s orientation to its environment cannot be captured within a single act because its whole environment is not present within a single act; the circumstance in which an organism participates is not only found within what it has contacted but what it continues to contact across time. An organism's orientation is not its personality or "the sum total of response equipments which the individual accumulates throughout his interbehavioral history" (Kantor, 1982, p. 233); an orientation is how an organism *is* participating within a circumstance extended across time, space, and the orientations of other organisms, not an individual's propensity to act in this or that way as a confluence of their history. This pivot in perspective is depicted in Figure 7.

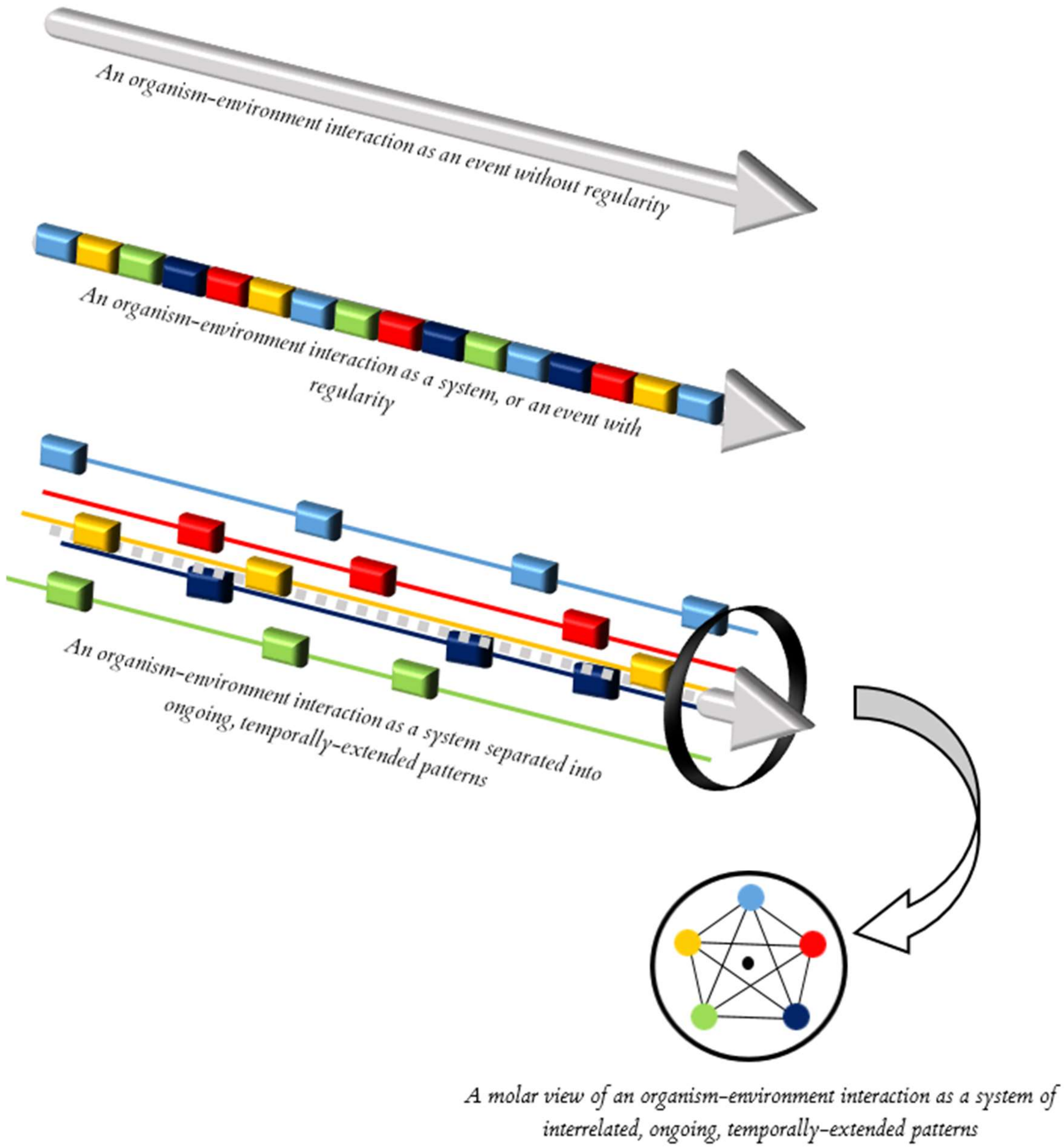


Figure 7. A molar pivot towards understanding events as systems of interrelated patterns.

Accordingly, a history of interaction primarily participates in an organism's orientation in two ways: (1) with respect to the relative value of participating in a given pattern at a given time and (2) the transversality of functional contacts across patterns. The first type of participation is well described in terms of maximization (Rachlin et al., 1981); time spent participating in particular functional contacts that characterize patterns is constrained by environmental regularity and the relative value of participating within other patterns. The second type of participation is described in terms of formal similarity with respect to maximization. When one assumes the participation of everything within a single event (Hayes, 1997), all events share some degree of formal similarity with all other events (because everything is of the same event) and a given localized event is different from all other events (because any part of one event is different from its entirety). Every functional contact constitutes a unique interaction between an organism and a unique event, but each such event shares properties with other unique events to varying degrees across various dimensions. In other words, each event constitutes a unique collection of properties shared with other events. Generalization refers to the degree to which an organism's orientation has adjusted with respect to particular properties of a circumstance, an adjustment that is constrained by other properties contacted across time and space at each moment of an organism-environment interaction. The degree of similarity between such events constitutes points within a circumstance for interacting in particular patterns in a particular way, but how an organism interacts with respect to such properties–the form of the interaction or functional contact–is also related to the extent doing so maximizes participations within patterns. Formal similarity across aspects of a circumstance with respect to a myriad of properties contributing to the form of each functional contact explains how similar functional contacts can be integrated within a given pattern, but a process like maximization is necessary to explain how particular functional contacts are organized as a pattern.

While a process like maximization is necessary to account for the organization and directionality of patterns of functional contacts through a reconfiguring circumstance, a relation between organisms and stimulus events like induction is not. Induction in molar frameworks like Baum's (2018, 2020, 2021a) refers to an act of a stimulus object or event–a phylogenetically important event–upon an organism; for example, food can be said to induce an organism to eat. This logic is useful for accounting for the interdependence of patterns of instrumental and phylogenetically important events (or reinforcing events), but it is unnecessary in the current framework because a functional contact is already an interaction. An organism always responds with respect to stimulation; stimulation does not cause a response that then causes stimulation in a continuous cycle. The quality of activities or patterns of functional contacts—the form in which organism-environment interactions take—is that equally of responding organisms and stimulating stimulus objects and events. Exploring a wall of an operant chamber, pressing a lever, and chewing food pellets can be said to be different events insofar as they constitute interactions with different stimulus objects, but all are unified as ways in which an organism interacts with food in a reconfiguring circumstance in which pellets are contingent on lever pressing. One does not need to say that an event induces an activity that produces another event—by closing the loop (Baum, 2018)—which induces more activity because a relation between a pattern of functional contacts and a pattern of circumstantial reconfiguration itself can be seen as a continuous, ongoing interaction between patterns rather than interdependencies among their elements. Kantorian logic runs all the way through because it is a logic of interrelations among constituencies and between wholes. Functional contacts—the events of a pattern of functional contacts—and environmental events—the events of a pattern of circumstantial reconfiguration—are necessarily correlated because they constitute two sides of a single interaction.

Orientations *as* Interacting Patterns in Reaction Systems

At this point, we can expand upon the reaction system construct introduced earlier from an orientationalist's perspective. Kantor's (1924) reaction system construct is inherently molar in the sense that it describes a complex of anatomical-physiological interactions that compose a whole organism response; each response, in itself, comprises a set of events that function together as a whole. Appreciating the fact that responding is constantly ongoing and cannot be divorced from stimulation, the reaction system construct cannot only be expanded to include patterns of functional contacts but the entire integrated field, as the same logic applies. Here, a reaction system will be redefined as an integrated field comprising (1) a focal pattern of functional contacts occurring serially and concurrently, (2) other interrelated patterns of functional contacts participating organisms participate in, (3) setting factors composing a circumstance, including (3.1) an organization of organisms, stimulus objects, stimulus events, and their properties relative to one another, (3.2) patterns of circumstantial reconfiguration correlated with patterns of functional contacts, (3.3) a history of interaction of participating factors, and (3.4) media of contact (4) with respect to boundary conditions (i.e., self-constraining and observational). Self-constraining boundary conditions refer to how an organism's access to the environment is restricted by its own participation within functional contacts and patterns thereof. This includes constraints described as the stability or equilibrium of the system as an organism participates within the maximization of functional contacts within patterns; participation within each pattern constrains participation within other patterns. Observational boundary conditions refer to limitations imposed on a system through its relation with an observer. When observational boundary conditions are only based on formal delimiters of the beginning and end of a pattern, the reaction system is said to be closed and is essentially comparable to Kantor's (1959) conception of a psychological event because the focal relation is non-repeating. When observational boundary conditions are based on the temporal window and patterns of events are appreciated as ongoing and stable through time in a given circumstance, the reaction system is said to be open, integrating features of contemporary molar thinking with interbehavioral logic. As such, the reaction system construct is an orientationalist's construct amenable to both molecular and molar conceptualizations of psychological events but adds utility by integrating molar and Kantorian perspectives into a non-causal unit of analysis that appreciates differences in the spatiotemporality of events across time.

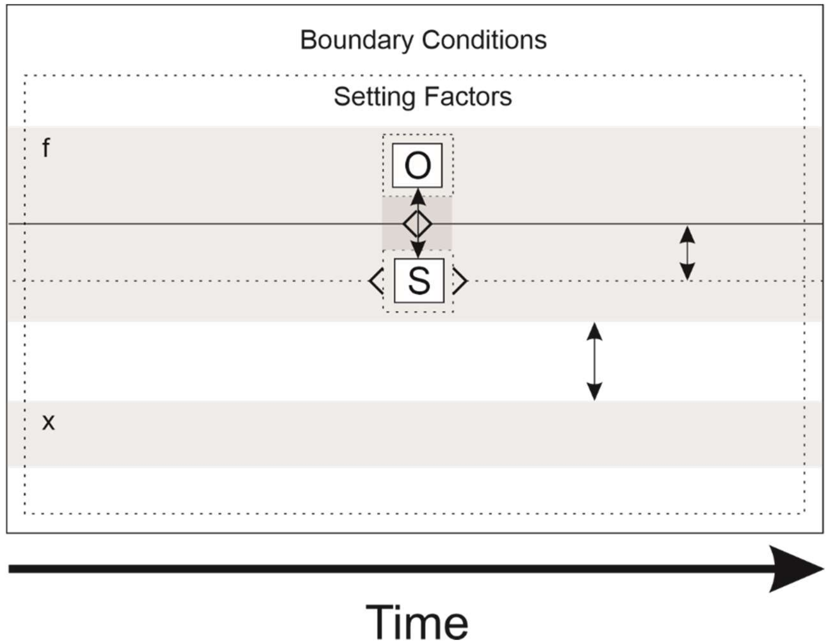


Figure 8. A reaction system. f = a focal pattern of functional contacts, x = a representative different pattern of functional contacts, O = an organism participating in one or more patterns composing the system, S = stimulus objects and events interacted with by organisms in functional contacts, solid exterior box = boundary conditions, solid interior boxes = responding/stimulation, dotted boxes = various setting factor boundaries, solid bidirectional arrows = interactions between various factors, horizontal lines = representations of a pattern of functional contacts (solid) and a pattern of circumstantial reconfiguration (dotted), gray shaded area = media of contact.

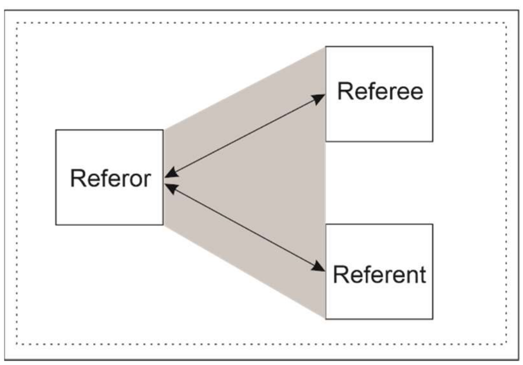
It is important to note that setting factors are being described differently here than how Kantor (1924, 1959) uses the term. For Kantor, a setting factor is a factor that facilitates or impedes a stimulus-response function. From an orientationalist perspective, setting factors do not facilitate or impede any interaction; they simply describe features of a whole circumstance—its whole environment—that one or multiple organisms are interacting with across space and time; reaction systems are not restricted to describing the orientation of a single organism. When a whole organism-environment interaction is perceived from a non-causal molar perspective, an organism participates in functional contacts with every stimulus object and event that it interacts with, just at different points in space and time and across different scales of integration. Any change in the composition of stimulus objects and events composing a circumstance constitutes a reorganization of the circumstance and, thus, the whole system. A circumstance describes the potential of functional contacts (as certain contacts would not be possible with certain stimulus objects and events), but this participation is not facilitative—only interactional. Medium of contact and history of interaction are considered types of setting factors rather than factors in their own right because they describe features of a circumstance.

The reaction system construct may be considered an ontological construct, but it should not be considered a realist description of the way the world actually is. As several behaviorists have argued (Baum, 2017; Hayes, 1993; Hayes et al., 2012), behavior science should not be grounded in realist philosophy because nothing can be shown to exist outside of our observing and perceiving; we cannot comment on a proposed way the world 'actually' is because we cannot step outside our interactions with the world. However, not committing to a science based on realism does not prevent us from constructing ontologies. Orientationally, an ontology is simply a tool that describes functional relations to orient effective scientific activity. As having recognized that scientists arbitrarily—yet determinably—delimit the world into various subject matters for their own aims, Kantor's (1959) integrated field construct is similar. The integrated field construct derives its naturalism from orienting scientists to things and events rather than mentalistic, imaginary constructs, but it still explicates that individuals interact with what he refers to and arbitrarily delimits as things and events. This point is often overlooked even by interbehaviorists who distinguish between constructs and events (Fryling & Hayes, 2009; Smith, 2007); to recognize things and events is to construct, and these constructions constitute the basis of scientific discourse. Aligned with Baum's (2017) pragmatic molar ontology, the orientational reaction system builds on Kantor's (1959) constructs by recognizing patterns as another fundamental, functional unit of behavior science that cannot be reduced to other factors, not something that exists beyond our interactions. Accordingly, the ontology described using the reaction system construct "refer[s] merely to explicit specification of conceptualizations, and about that no objection can be made" (Hayes et al., 2012, p. 4).

Shared Orientations *as* Interacting Patterns in Cultural Reaction Systems

At this point, a cultural reaction system—a particular type of reaction system—can be described. A cultural reaction system refers to a reaction system with particular characteristics, including (1) a focal pattern of <u>referential functional contacts</u>, (2) two or more human individuals, (3) conventionality as a property of such patterns, and (4) the system is established through <u>culturalization</u> and <u>diffusion</u> processes.

Before further elaborating on these characteristics, it will be useful to reorient to Kantorian formulations of linguistic events. For Kantor (1977), referential events are a special type of event in which concurrent stimulation occurs between a referor (i.e., a speaker), a referee (i.e., a listener), and a referent (i.e., a stimulus object or event referred to). In a genuine referential event, a referor refers a referee to a referent, and then the referee responds with respect to the referent (which necessitates responding with respect to the referor, as stimulation of a referent is conditional on the referor). Such events necessarily involve shared modes of responding because, for a genuine referential event to occur, a referor must behave in a way that is meaningful to a referee. Said differently, responding of a referor must condition the orientation of a referee towards the same referent. Although Kantor acknowledges that referential events involve acts of both the referor and the referee, he illustrates referential events as two segments—one for response functions of the referor and one for those of the referee—given his molecular psychological perspective towards linguistic phenomenon, as shown in Figure 9:



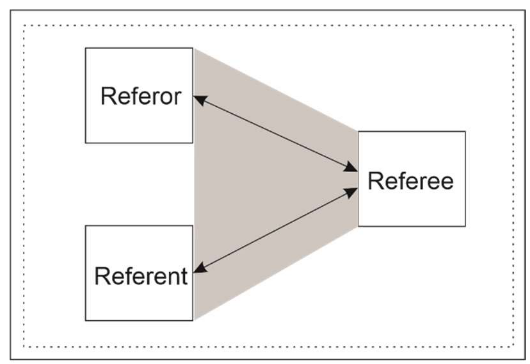


Figure 9. Referential fields depicting referor-centric (*left*) and referee-centric (*right*) vantages of a referential interaction.

Other conceptualizations of such events, like Ghezzi's (2020) and Ardila Sánchez et al.'s (2020), have demonstrated these interactions in a similar way but within the confines of the same event (or verbal episode in more Skinnerian terms; Skinner, 1957). When orientation shifts from observation of discrete events to how functional contacts participate in patterns, though, such interactions can be represented in terms of a cultural reaction system, as shown in Figure 10:

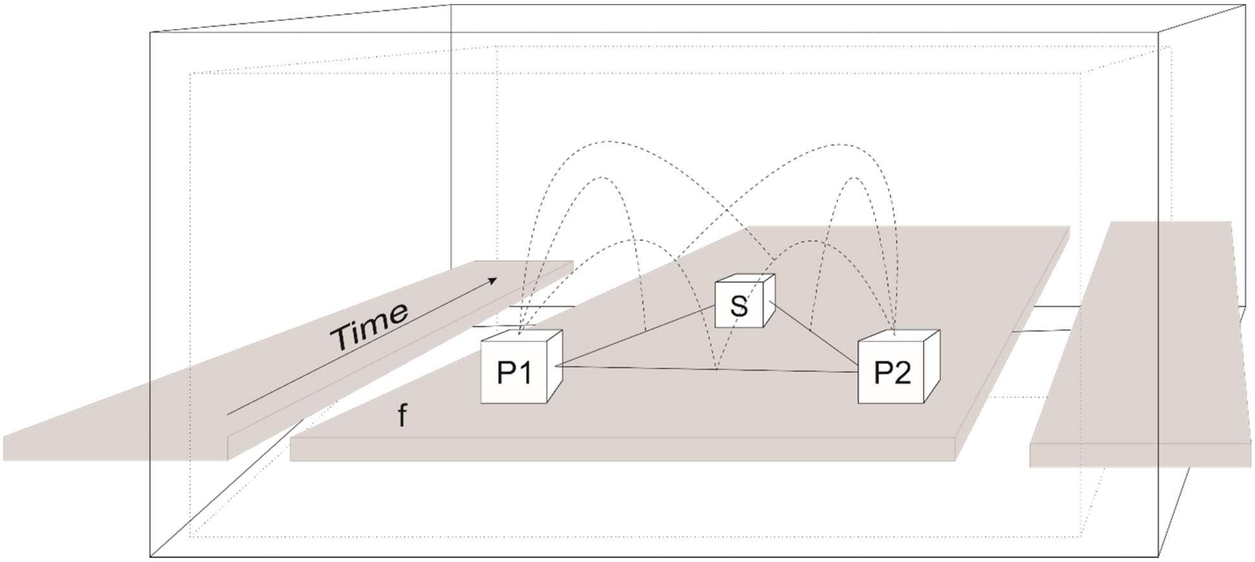


Figure 10. A cultural reaction system portrayed in 3D. P1 and P2 are participating individuals and S is a stimulus object or event. Solid lines between P1, P2, and S = direct functional contacts based on formal properties, dotted lines between P1 and P2 and functional contacts they are participating in = referential functional contacts, f = focal pattern of referential functional contacts, solid box = boundary conditions, dotted box = setting factors. For simplicity, lines used to show interactions between patterns of functional contacts and circumstantial reconfigurations have been left out.

Illustrative differences between Figures 8 and 9 are slight, but they represent substantial differences in conceptualization. When functional contacts are seen as participating within patterns, all individuals who participate in a pattern of referential functional contacts participate as both referor and referee across time. This dual participation does not only occur when individuals speak to and then listen to others, but it is also apparent when one considers the maximization of <u>coherence</u>. While any type of system may be said to have coherence (Derrida, 1978), coherence in a cultural reaction system refers to recognizing consistency and not deviations from participation within one's orientation and is maximized on the basis of referring to one's own participation within functional contacts. When an individual recognizes contacts they are participating in as being inconsistent with or deviating from part of their orientation, when an individual recognizes the way in which they are interacting with respect to their environment threatens the maximization of or constrains one or more patterns they participate in, that individual reorients (i.e., participates in a functional contact they recognize as more consistent with what they are doing) towards consistency in their orientation. Reorientation towards recognizing consistency is itself refers to abstract, referential functional contacts that can transcend patterns because they serve to maximize particular functional contacts across patterns; not only does it do so by virtue of reducing delay to contacts with particular stimulus objects and events, but it is a functional contact that readily occurs across patterns. The maximization of coherence through referential functional contacts within a cultural reaction system is a naturalistic, non-mentalistic orientation towards cognitive dissonance and equilibrium within a lingusitic system (Lewis, 1969).

This definition of coherence is similar to others found in behavioral science but differs largely on the basis of its molarity. For example, consider a relational frame theory definition of coherence offered by Bern et al. (2021):

> *Coherence* refers to the extent to which derived relational responding is generally predictable based on prior histories of reinforcement. (p. 280, italics in original)

In earlier works (Hayes et al., 2001), coherence is more explicitly discussed as a reinforcer:

> Coherence or sense-making appears to function as a powerful reinforcer for relational activity. (p. 70)

Relational frame theory and other theories with strong Skinnerian influences typically frame coherence molecularly in terms of histories of reinforcement rather than an ongoing system of interaction between an individual and a circumstance in which one adjusts towards a consistent orientation across temporally-extended patterns of functional contacts (or behavior). This is likely related to how they orient to behavior as a linear stream-like process in which motivation is to be found in the current status of an organism or with respect to historical variables or factors rather than within interactions between how an organism *is* interacting with its environment across time; refer back to Figure 7 for a representation of this pivot. Coherent actions of an organism are certainly predictable based on histories of reinforcement, but to restrict coherence to a relation between what an individual is currently doing and what they have done is to restrict an organism's orientation to a momentary act and to deny interactions of pattern participations across time. Said differently, an organism is always in contact with the *whole* environment, even if what is meant by environment is restricted to what an organism has contacted or if an organism's perception of it is restricted to what they can sense and perceive at a particular point in time. Delay discounting (Frank et al., 2022) is a hallmark of molar orientations because it describes relations between behavioral patterns in terms of indifference that generically characterizes equilibrium of an organism-environment interaction with respect to contacts involving particular stimulus objects occurring across various temporal scales; the same can be argued for social discounting (Rachlin & Locey, 2011) with respect to patterns occurring across various scales of social integration. The integration of patterns of functional contacts with respect to maximization is an ongoing reconfiguration of the system. Coherence cannot be a reinforcer because there are no reinforcers, especially when one conceives of one's own verbal behavior as reinforcers; what are referred to as "reinforcers" are just momentary events encountered in a linear stream of organizing factors. A history of the reconfiguration of an organism-environment interaction is going to have predictive utility, but it is no mere replacement for *how* an organism *is* contacting a circumstance because the how—an organism's orientation—is extended across time and space with respect to the whole environment in which an organism interacts, constrained by the activities that it is and other organisms are participating in.

This is not to say that there is no room in an orientationalist approach for relating, but there is no room for considering relating to be an operant characterized by a history of reinforcement. Relating is a behavior-analytic way of describing functional contacts including (1) perceiving a stimulus object or event *as* X and (2) orienting with respect to X. This is how Kantor describes meaning in *An Objective Psychology of Grammar* (1926):

> The technical description of a meaning reaction is any response which determines what a following reaction is to be. For example, in case of the pronunciation of a printed word the perceptual response of the word determines the form of the later vocal utterance. Thus in the type-setter's illusion, if he perceives *phenomena* as *pneumonia*, he will then press down on a different set of keys from those he would have used had he perceived the words as they were actually written. (p. 122, italics in original)

If there is any conventional medium of contact (Ribes-Iñesta, 2006, 2018), it is with respect to how individuals perceive a circumstance in this way, the same way referentially. Non-human organisms can perceive formal properties of stimulus objects and events such as a stimulus object's redness or coldness, and they can even respond with respect to relations among stimulus objects, but, unlike humans, they do not perceive anything *as* something, *as* a referent. Humans not only see the color of stimulus objects, but they see stimulus objects *as* stimulus objects that are red. This difference is difficult to describe because the difference itself is something that can only be contacted referentially. Being able to perceive stimulus objects and events as the same referent as another individual is necessary for any linguistic interaction between individuals, but it is not correct orientationally to refer to this necessity as a medium because conventionality is a transversal property of patterns that multiple individuals participate in, the quality of such patterns being shared. Individuals either do or do not share an orientation with others, and to share an orientation is to participate in the same patterns of referential functional contacts. This much is clear by the conditions under which an individual is integrated into such patterns; patterns of referential functional contacts already compose the system an individual is born into. The way in which an individual perceives referentially is integrated across patterns of functional contacts they participate in through formal similarity with respect to maximization; the rigidity of languaging in a certain way is a characteristic of constant reorganization with respect to all the patterns interacting individuals participate in. Perceiving stimulus objects and events in a different way constrains maximization of one's participations across patterns of functional contacts because other individuals—as well as oneself—can recognize such deviations as incoherent with the patterns they are participating in.

There are other features of referential functional contacts recognized in the current orientation that differ from how Kantor (1977) described reference. First, there are no "attributed" (p. 149) or "acquired" (p. 253) properties to stimulus objects or events. This is tantamount to saying that conventionality is a medium of contact or that there are properties of stimulus objects and events that can only be contacted linguistically. Such terms can be useful for orienting to the linguistics of human interaction, but they obscure perceptual functional contacts that occur when one is interacting linguistically. Referential functional contacts require reflexivity in which one interacts with their own participation within other functional contacts. To see something as a chair not only involves contact between an organism and a stimulus object through a formal medium of contact (i.e., light) but it involves contact between an organism and what is being seen *as* a chair. Functional contacts between an organism and what an organism is participating in does not require any other medium of contact, but it does constitute specific forms of interaction that share formal similarity with other forms across abstract dimensions. This does not mean that an individual covertly says "Chair!" in their head every time they see a corresponding stimulus object, but it does mean that there is an important difference between properties of stimulus objects and events and the ways in which they are interacted with referentially. If there are any linguistic properties, they refer to relative qualities of an organism-environment interaction—abstract relations among interactions between organisms, stimulus objects, and stimulus events themselves—that characterize how an individual recognizes referentially or recognizes an aspect of a circumstance *as* X.

A second deviation is with respect to proposed differences between referential and symbolic interactions. Kantor (1977) claims that symbolic events are not referential because there is no bistimulation with respect to a referor, a referee, and a referent, only recognition of what a symbol stands for and appropriate reorientation with respect to that. As Kantor (1977) states:

> The central feature in symbol situations is that the individual interacts with a codified object, that is, one that has been made to substitute for something else by the present actor, or by someone else. (p. 108)

As such, in a given psychological event, an individual may simply (1) contact a symbolic object, (2) orient to that object as a substitute for something else, and (3) respond with respect to what the object stands for. Such events do not necessarily involve other individuals, so such events can be distinguished from referential events. From the current orientation, though, what is referential is how one interacts with one's own participations within functional contacts (i.e., referentially perceiving what is formally perceived), which necessarily implies the capacity to orient others—as well as oneself—referentially. To say that an interaction is linguistic is the same as saying that an interaction is referential. This is not to say that there are no important differences between interactions that Kantor (1977) referred to as symbolic and referential, but it is to say that (1) all symbolic events involve referring oneself or others and (2) that the difference he recognized amounts to differences among factors participating in a given pattern of referential functional contacts. Consider an example provided by Kantor (1977, p. 109) of a non-referential symbolic interaction: encoding and decoding symbols. Not only do symbolic interactions involve coding a referent *as* X and decoding X *as* a referent, but it can even be described as a referential event when one individual encodes and another decodes. The "referee" of an encoding event may not be any particular person but people in general, as is the case when an individual or group of individuals create a sign to orient individuals who live in a city to behave in this or that way. Such referential functional contacts are temporally-extended, persistent (i.e., the referential stimulus object is long-lasting), and indiscriminate (i.e., involves multiple, non-specific individuals), but they constitute forms of reference nonetheless. No symbol is ever created for no one to see.

How one participates in patterns of referential functional contacts is always related to participations within other patterns of social interaction. In more behavior-analytic terms, social interactions can constitute valued or preferred patterns of behavior, and the myriad of possibilities of such patterns is paramount for explaining how generative forms of linguistic interactions are organized in accordance with maximization. When one talks in terms of detachment or contingency substitution (Ribes-Iñesta, 1991), one is referring to how one participates in a given linguistic pattern is derived from or formally similar to their participation within other patterns. Formal similarity operates as the reconfiguration of the functional properties of a circumstance that allows for individuals who already participate in patterns of referential functional contacts to interject meaning (i.e., interact with respect to particular referents) into patterns of functional contacts that other individuals participate in. Consider a parent trying to get their child to say "ba-ba" by only giving them spoonfuls of applesauce contingent on the child saying "ba-ba". It might seem like the parent is imposing an arbitrary contingency (they could just as easily try to teach the child to say "la-la"), but the quality of their interaction is organized in terms of the patterns they are participating in on more temporally-extended time scales. Patterns of referential functional contacts that compose regularity in society (e.g., economic and political practices) require individuals who can participate in certain functional contacts (or "have certain skills," in more colloquial terms), including speaking with respect to a circumstance in certain ways. This requires culturalization (Kantor, 1982), or processes by which individuals become integrated into patterns of referential functional contacts through contacting how one another referentially interact with stimulus objects and events. Teaching others to do X constitutes a definite form of social interaction through which (1) referential contacts between an individual and stimulus objects/events stabilize through maximization with respect to situational outcomes so that (2) individuals that were not participating in certain patterns of referential functional contacts now participate in them (and can likely participate in others sharing formal similarity across abstract dimensions). Given that organisms are always participating within patterns of functional contacts, this involves the conventionalization of non-conventional patterns of functional contacts or the integration of non-conventional patterns of functional contacts into patterns of referential functional contacts. In our example, the child's eating (a non-initially conventional pattern of functional contacts) is as much of the pattern of referential functional contacts (i.e., teaching the child to speak) as participating in the conventional pattern is a part of how the child eats; unitary interactions between the orientations of different individuals occur as shared orientations, even if individuals participate differentially. All patterns of functional contacts related to survival become conventional as an individual's orientation adjusts to those of others. It is through such individuals participating in the same functional contacts as others that functional contacts in which individuals perceive stimulus objects and events *as* objects and events across abstract dimensions—for example, objects and events that an individual can name, entities that can be earned, achieved, or possessed—diffuse across the orientations of individuals as their orientations become shared, and it is through formal similarity of abstract dimensions of referential interaction that they are integrated into other patterns. Individuals orient to a circumstance *as* situations in which they can participate in different patterns because one perceives situations (or a composite of referentially recognized differences in the potentiality of participation) based on formal similarity of the circumstance with respect to their participation in ongoing patterns. Doing so is necessarily related to properties of stimulus objects, stimulus events, and patterns of circumstantial reconfiguration comprising a temporally-extended circumstance but also that which is referentially perceived based on functional contacts between the orientations of participating individuals.

When one participates in a pattern where they recognize a situation as one that can be interacted with in different ways (i.e., participate in different, mutually exclusive sub-patterns of referential functional contacts within the constituency of the recognized situation), one may not be participating in a pattern characterized by contacts that survival or reproduction is conditional on (e.g., a game of chess). While participation in such patterns may always be related to increasing fitness over the long-term (e.g., when functional contacts occurring in such patterns occur in other patterns through formal similarity, when patterns of play are integrated into other patterns), such patterns may be called play given their indirect or temporally remote relevance to survival or reproduction, if any. Play among humans is not necessarily goal-based; play can involve functional contacts with respect to how stimulus objects and events are perceived referentially without such interactions being related to achieving particular objectives, but in every case play with humans constitutes interacting referentially with respect to other people, stimulus objects, and/or stimulus events. Play often occurs concurrently with other patterns (e.g., listening to music while driving to work, having a conversation while eating dinner), and is thus pervasive throughout human life. Among humans, play often involves exploration in which one participates referentially in novel ways in accordance with the maximization of certain functional contacts occurring within patterns play as well as in other patterns, including those directly pertinent to an organism's survival. This is observed when an individual masters simpler games (e.g., tic-tac-toe) and starts playing more difficult ones (e.g., chess); fluency is a description of a pattern in which an organism is no longer participating in exploratory contacts. Exploration is more than the degree to which a functional contact involves responding with respect to novel properties of stimulus objects and events or how an organism adjusts to such properties. Rather, exploration also refers to a definite pattern of functional contacts characterized by interacting with stimulus objects and events in novel ways.

The question arises as to what extent exploration occurs outside of the participation of other patterns. Does novelty have value outside of being potentially discriminative of stimulus objects and events that participate in other patterns? The short answer is yes, but exploration like other patterns is also constrained in multiple ways. The extent to which an organism participates in exploration is minimally related to (1) physical constraints of a circumstance (e.g., a rat who has spent its entire life only inside a locked operant chamber can only interact with what it perceives in the chamber unless it can unlock the chamber and interact with the outside world), (2) participation among other patterns of functional contacts (i.e., the maximization of participation within other patterns limits the extent to which an organism participates in any single pattern, including exploration), and (3) properties of an individual organism, such as the degree to which the functional contacts they participate in are sensitive to temporal and social integration. The only property that defines exploration is novelty, and functional contacts involving novelty become progressively scarcer in a circumstance.

When an individual recognizes differences with respect to their own participations, there is much more novelty to be found. When one recognizes a situation, stimulus objects and events—separated in time and space—are recognized as different aspects of the same activity for a given temporal duration, interrelated to but differentiated from one another. Given that an organism responds with respect to such recognitions, perceiving the same stimulus objects and events in different ways constitutes the basis of referential exploration. Any functional contacts that occur within a recognized situation constitute exploration to the extent that one recognizes differences in how one can interact (e.g., responding with respect to what one perceives they can do with interrelated stimulus objects and events), but all such functional contacts—even those that are perceived as different from one another—follow the same logic as long as there is not a change in how a situation is perceived. Changes in how an individual perceives referentially not only occur when individuals—and, thus, their orientations—interact and adjust with respect to one another, but they also occur as an individual participates in functional contacts with stimulus objects and events that they did not initially recognize as part of a pattern they are participating in. Someone may explain how to play chess to an individual so that they recognize how to play chess as a pattern involving certain stimulus objects (i.e., chess pieces, the board, another person, and oneself) that can be interacted with in a certain way with respect to one another in accordance with how they are perceived (i.e., with respect to abstract stimulus relations), but that does not mean an individual will automatically recognize all possible combinations of moves or an optimal strategy before ever playing. The extent to which an individual recognizes that such objects can be interacted with in *particular* ways with respect to one another is "discovered" in the course of playing chess. Each object is not recognized just as an object but as a *piece* that an individual can use to make moves with, moves that become more complex as one recognizes different ways in which they can move them. The evolution of how one recognizes stimulus objects and events differently not only describes maximization with respect to objectives of the pattern one is participating in (e.g., winning a game while playing chess) and other patterns across time, but a genuine form of exploration in which one explores different ways of perceiving stimulus objects and events.

When considering the degree to which exploration occurs within a cultural reaction system, one must consider different types of novelty. Novel properties of stimulus objects can be contacted, as can novel values of such properties. Novel stimulus objects and events can be contacted and differentiated from one another. An organism can respond with respect to the same stimulus objects and events in novel ways. But there are some forms of novelty that are only contactable within patterns of referential functional contacts because they are contacted *as* being different from other referents along preferred, abstract dimensions for some duration. Art is not art if it is perceived as being the same as other stimulus objects or events, just as the degrees to which an intellectual construct is recognized *as* a contribution and a joke is recognized *as* funny are related to how similar and different they are perceived to be from other constructs and jokes. Such novelty constitutes forms of social interaction that can only participate in patterns of referential functional contacts because they constitute qualities of difference that must be recognized *as* such. An individual may look back at art and continue to recognize it as such, but only because one can refer to it *as* what one initially recognized as art or continue to explore novel attributes that were not initially recognized.

The utility of the cultural reaction construct is not only derived from orienting analysis of what constitutes a functionally integrated whole system of interaction to interacting patterns of abstract exploration, such as creating art and constructing science through which individuals contact novelty referentially, but also from how individuals constrain the participation of others within particular patterns. Just because individuals can share an orientation with respect to the same referents, such as objectives like making money by producing products together, does not mean they participate in the exact same way as other individuals. Recognizing a cooperative situation involves recognizing differences in what individuals can do to maximize contacts with objectives that characterize the pattern, or at least a part of the pattern that involves other individuals. Work not only constitutes part of how individuals can earn money so that they may maximize participations within other patterns, such as eating and play, but it also constitutes a constraint on other patterns. Alleviating such constraints while maximizing participation within other patterns often involves imposing constraints on others, such as by limiting an individual's access to objectives through physical arrangements (e.g., centralizing who money is accessible to and from), training (e.g., individuals are only trained to perform highly specific tasks, prohibiting them from participating in patterns of functional contacts necessary for contacting more money), and, more nefariously, through the construction and perpetuation of values (e.g., referentially orienting individuals to recognize themselves as good people—people who other people would want to interact with—when they participate towards objectives in particular ways). Said differently, cultural reaction systems are characterized in terms of power. Similarly to Foucault's (1978, 1982) conception, power is not merely a capacity to control (c.f., Skinner, 1953) but a composite of interactions between the orientations of multiple individuals participating within a cultural reaction system. When one recognizes that the way in which we perceive ourselves—referential functional contacts with respect to oneself *as* a particular person—can be integrated into patterns characterized by objectives for others that we ourselves may never even contact, understanding power relations does not only become important but crucial. How is behavior-analytic research and practice integrated with economic and political patterns? How is our science used as a tool within such patterns? These are questions behavior analysts should be asking themselves, questions that are oriented to with constructs like cultural reaction systems.

Experimental Viability of Orientationalism

As compared with more Kantorian approaches, the molarity of orientationalism and the cultural reaction system construct is highly compatible with experimentation. This is not to say that Kantorian interbehaviorism is incompatible with experimentation; Kantor (1959) specifically describes experimentation as part of the investigative sub-system of interbehavioral psychology, and several interbehavioral experiments have been conducted (e.g., Fryling & Hayes, 2014; Meyer, 2022; Munoz-Blanco & Hayes, 2017). However, in each of these studies, a Kantorian unit of analysis—psychological events described in terms of integrated fields—does not easily align well with the functional relations described. While each discrete functional contact observed in these experiments can be described in terms of particular integrated fields, differences in aggregate measures of different activities that constitute the empirical bases of interpretations and claims are difficult to describe using Kantor's (1959) integrated field construct.

To exemplify this, consider Fryling and Hayes's (2014) study on remembering. In the first condition of their study, participants could earn points by typing particular sequences of letters when they saw particular non-compound stimuli (i.e., a single heart or star shape) on their screen. In the second condition of their study, participants could earn points by typing different sequences of letters when they saw particular compound stimuli (i.e., one of two four specific sets of shapes). To describe differences in remembering interactions involving compound and non-compound substitute stimuli, they report differences in the total number of accurate (i.e., typing a given sequence of letters in the presence of the appropriate shape or shapes) and false positive (i.e., typing a given sequence of letters not in the presence of the appropriate shape or shapes) remembering responses with respect to compound and non-compound stimulus objects. On average, participants engaged in twice as many accurate remembering responses with respect to non-compound stimulus objects than with compound stimulus objects and more than forty times as many false positive remembering responses with respect to compound stimulus objects than non-compound stimulus objects. The functional relations Fryling and Hayes describe when they refer to their data in this way are relations between sub-patterns of functional contacts (i.e., typing particular sequences of letters in the presence of certain stimulus objects) composing the pattern of earning points and patterns of circumstantial reconfiguration (i.e., particular stimulus objects appearing in front of participants), but these relations are not captured well by Kantor's (1959) integrated field. It can be used to describe specific remembering functional contacts between an individual and different substitute stimulus objects, but given that participants (1) typed sequences of letters in the presence of both appropriate compound and non-compound stimulus objects and (2) typed sequences of letters in the presence of inappropriate compound and non-compound stimulus objects, there was neither an interbehavioral history nor a setting exclusive to accurate or inaccurate responding with respect to either compound or non-compound stimulus objects. There was, however, a circumstance in which participants—more often than not—participated in accurate rather than inaccurate remembering, and that circumstance is characterized in terms of different patterns of circumstantial reconfiguration (i.e., patterns in which different shapes appeared and different instructions were presented). The cultural reaction system construct is outfitted to describe these relations. Kantor's (1959) integrated field construct is not.

Although orientationalism was vastly underdeveloped, difficulties in using Kantor's (1959) integrated field construct to describe functional relations based on experimentation were realized by Fleming et al. (2021b). Fleming et al. sought to construct an experiment in which the establishment of shared stimulus-response functions (i.e., conventional conduct; Kantor, 1982) could be examined and factors that contributed to their persistence (i.e., how could a circumstance rearrange in which the same shared stimulus-response functions would be examined). In their study, dyads of participants completed a turn-based matching-to-sample procedure (TBMTS) in which they worked together to earn points across a series of trials. In a trial of TBMTS, (1) one participant first selects a comparison stimulus object from Set B in the presence of a sample stimulus object from Set A, (2) the other participant then selects a comparison stimulus object from Set A in the presence of a sample stimulus object identical to that selected by the first participant to respond, and (3) then both participants receive points. Points are differentially earned (1) when the second participant to respond selects a stimulus object identical to that presented to the first (i.e., correspondence) and (2) when the second participant to respond selects a stimulus object non-identical to that present to the first (i.e., non-correspondence). To maximize points in the first condition when more points were earned for correspondence than non-correspondence, participants needed to make consistent selections in the presence of each sample stimulus object that were different from those made in the presence of each other sample stimulus object; differentiation (de Saussure, 1918) was required to maximize points. Unlike experimental procedures used to study metacontingencies (Ardila- Sánchez et al., 2021; Costa et al., 2012; Sampaio et al., 2013) and symbolic reference with non-human animals (Epstein & Skinner, 1981; Epstein et al., 1980; Savage-Rumbaugh et al., 1978), TBMTS allows for examination of both culturalization and diffusion of shared stimulus-response functions specific to dyad members because which shared stimulus-response functions were established were related to their interactions, not just decided by experimenters prior to investigation. While the use of terms like “shared stimulus-response function” and the explanatory value placed on substitution highlight the molecularity of their approach, Fleming et al. (2021b) recognized that effective strategies in TBMTS involved “the establishment of both reaction systems comprising [stimulus-response functions] and their symmetrical counterparts through substitution of functions across circumstances” (p. 59) that were more accurately defined in terms of “patterns of [stimulus-response functions]” (p. 50) than just individual stimulus-response functions.

Patterns of referential functional contacts observed in TBMTS can be described in terms of cultural reaction systems. In each experimental session of TBMTS, two participants participate in an objective-based pattern of referential functional contacts (i.e., earning points) that is correlated with several patterns of circumstantial reconfiguration (i.e., those in which different aspects of trials appear, including points and stimulus objects). Earning points can be separated into several distinguishable interrelated patterns (i.e., selecting particular stimulus objects in the presence of particular sample stimulus objects) in which different, exclusive functional contacts participate (i.e., only selecting particular stimulus objects in the presence of particular sample stimulus objects) can be understood as an organization that maximizes points earned. The stability of cultural reaction systems observed in TBMTS are easily measured and described in terms of cumulative correspondence and non-correspondence outcomes across trials and represented using figures that depict consistent trial outcomes. Scaling out from experimental cultural reaction systems to societal patterns, earning points can be said to be integrated with other objective-based patterns that scientists participate in, such as experimentation and the dissemination of experimental findings. One may argue that selections in TBMTS are not referential and, thus, cannot be described as participating within a cultural reaction system because similar interactions have been observed with non-verbal organisms (e.g., Epstein et al., 1980) and are somewhat dissimilar in form to referential interactions Kantor (1977) describes (i.e., participants may be expected to participate in similar functional contacts even if they were not interacting with another participant). However, given that what stimulus objects participants should select in the presence of particular sample stimulus objects is not determined by experimenters, the meaning of each sample stimulus object—how perceiving each sample stimulus object orients towards selecting a particular stimulus object—is derived in part by interactions between dyad partners. TBMTS is useful for examining how such conventionality evolves and stabilizes, and the cultural reaction system construct is useful for describing it.

Considering that TBMTS can be used to study cultural reaction systems, it is not surprising that TBMTS can be considered a behaviorally-sensible Lewis signaling game. Lewis signaling games refer to games involving a sender and a receiver in which (1) given a state of the world, a sender sends a message to a receiver, (2) the receiver makes an action with respect to the sender's message, and (3) both the sender and receiver receive a shared payout based on whether or not the receiver acted in accordance with the state of the world (Lewis, 1969). Lewis signaling games were constructed to understand why individuals share conventional beliefs (Lewis, 1969) and have been extensively studied using computerized simulations and experimentation to understand factors and processes involved in the evolution of conventional systems from a selectionist orientation (Skyrms, 2010). The game theoretical approach of studying circumstances in which shared beliefs are established is inherently molar and naturalistic. Games describe relations between differential choices and outcomes that can be described in terms of correlated patterns of behavior and environmental events when played in an iterative fashion. Said differently, it should not be surprising that molar behavior analysts have often utilized game theoretical arrangements to study choice (e.g., Efferson et al., 2007; Locey & Rachlin, 2015; Rachlin et al., 2000) or that the most accurate models of Lewis signaling game performance are based on the matching law (Huttegger et al., 2014). However, it also should not be surprising when considering the information theory underlying how Lewis signaling game theorists explain how multiple individuals can *have* the same arbitrary belief that most Lewis signaling games are not designed to demonstrate that all participating individuals can effectively interact as both sender and receiver in the same conventional way or revert to responding in such a way when points can once again be maximized for correspondence after being maximized for noncorrespondence. By having participants take turns going first and second on trials and alternating between conditions in which points are maximized for correspondence and noncorrespondence, TBMTS addresses these concerns in a way that allows for valid interpretation not only from an orientational perspective but a Lewis signaling game perspective as well. Like in Ribes-Iñesta's contingency framework (which was constructed with deference to Hull's (1943) molarism, Kantor's (1958) interbehaviorism, and Wittgensteinian (1953/2009) language games), orientationalism shares a general affinity with game theory, even if functional relations are discussed in non-causal terms.

One limitation of both TBMTS and Lewis signaling games, though, is the delivery of points for both interacting individuals. Not all Lewis signaling games involve senders and receivers receiving the same payouts for each receiver action (Bruner et al., 2018; Skryms, 2010), nor do they all involve senders and receivers receiving the same payouts as each other. However, no version of TBMTS or a Lewis signaling game has investigated whether or not individuals participate in communicative functional contacts when points are not contingent on doing so. Communicative functional contacts in both TBMTS (i.e., a participant selecting a stimulus object on the first turn) and Lewis signaling games (i.e., the sender's selection) are forced; points cannot be earned in either arrangement until the first communicative interaction occurs. Forcing communication in these types of studies is useful for studying the establishment of conventional patterns because it guarantees observation of arbitrary functional contacts if objectives maximize, but functional contacts in which one individual refers another to particular stimulus objects and events may not always be related to shared rewards. Theory on intersections between social discounting and altruism (Rachlin & Locey, 2011) leaves open the possibility that helping others receive rewards is itself a pattern of referential functional contacts that individuals participate in that is not necessarily a part of other patterns like earning rewards for oneself. Many studies support the notion that individuals valuing rewards for others over oneself is related to reciprocity in which rewards are gained over the long-term (e.g., Costa et al., 2012; Rachlin et al., 2000), but individuals may also participate in objective-based patterns in which recognizing their own interactions *as* helpful to others maximizes. Investigating this possibility is impossible in both TBMTS and Lewis signaling games because participants necessarily earn rewards delivered by experimenters.

This limitation is not limited to TBMTS or Lewis signaling games. Few if any metacontingency experiments, behavior-analytic group contingency experiments, or prisoner's dilemma experiments have examined the functionality or persistence of communicative functional contacts that do not participate in maximization of earning points or money for oneself. To some extent, Ribes-Iñesta and colleagues (Avalos et al., 2019; Rangel et al., 2015; Ribes-Iñesta et al., 2006, 2008) have investigated this in a series of experiments utilizing a puzzle procedure developed to study partial-altruism and reciprocity. The typical primary features of their puzzle procedure are that (1) two individuals—usually one participant and one confederate—are able to place pieces to solve their own or the other individual's puzzle at separate computers, (2) both individuals receive points if either one places a piece to solve the other's puzzle but only the piece placer receives points if the piece is placed on their own puzzle, and (3) participants receive more points (if points are available) for placing pieces to solve the other individual's puzzle than their own puzzle. Utilizing this procedure, Avalos et al. (2019) found that participants' allocation of pieces placed on each puzzle nearly identically matched that of confederates placing 100%, 50%, or 0% of their own pieces on a given puzzle in conditions where placing pieces did and did not produce points. Participants were likely not to place pieces to help solve the confederate's puzzle even though they could have earned more points for doing so. While they claim that this finding is not consistent with point maximization, it is not clear if they considered how participants perceiving what the other "participant" would do if they finished their puzzle first may have been related to puzzle piece allocation. Placing a piece on the confederate's puzzle always produced more points than placing a piece on the participant's puzzle when points were available, but participants were also able to prematurely end their sessions after they completed their puzzle. Considering that experimental instructions oriented participants towards believing they were interacting with another participant, it is plausible that they may have also believed that, if they helped confederates finish their puzzle well before they finished their own, the session may be terminated before they could finish their own puzzles. Despite this, studies like Avalos et al.'s (2019) and others using this puzzle procedure certainly demonstrate how communicative interactions—even those as remedial as an individual showing others their own interactions—participate in complex patterns that cannot simply be reduced to maximization, even if maximization is also a factor that must always be considered. This is most evident in puzzle experiments where contacts with points were maximized only when multiple non-confederate participants were able to communicate with one another prior to solving puzzles (Rangel et al., 2015; Ribes-Iñesta et al., 2006, 2008).

Another limitation of TBMTS is that participants are only involved in what may be referred to as first-order economic interactions. Described by Ribes-Iñesta (2018) as exchange relations, society largely consists of economic patterns in which multiple individuals interact by exchanging goods and services with one another. In TBMTS, Lewis signaling games, and most other behavioral experimental arrangements, experimenters and participants interact with one another in a similar way. When individuals participate in an experiment, two objective-based patterns of referential functional contacts are typically integrated with one another: earning course credit or money on the side of participants and producing data on the side of experimenters. As such, interactions between experimenters and participants are always economic because their shared orientation—experimenters and participants both participating in patterns referred to as experiments—constitutes sub-cultural reaction systems in which objectives for different individuals maximize through interactions with one another. In TBMTS and Lewis signaling games, though, the extent to which participants interact with one another in this way is minimal. While how much course credit and money participants can make participating in experiments with one another can be related to one another's performance, they are typically unable to interact with one another by giving each other course credit, points, money, or other objectives. Experimental participants typically only participate in first-order economic interactions with experimenters and not second-order interactions with one another in which they use stimulus objects (e.g., points) received from experimenters to further maximize objectives.

To some extent, second-order economic interactions have been observed in metacontingency experiments. In the very first experiment on metacontingencies, Vichi et al. (2008) were able to maintain how a group of participants divided tokens earned each round in a betting game (i.e., either equally or unequally) by making cultural consequences (i.e., halving or doubling tokens betted by the group) contingent on equal or unequal sharing in the round before. Other metacontingency experiments that amend prisoner's dilemma games (Morford & Cihon, 2013; Ortu et al., 2012) often allow participants to "fine" one another or prevent other participants from earning points to punish their non-cooperative responding. Allowing participants to give and remove tokens and points from one another was incorporated within these studies to allow researchers to differentiate between consequences functioning as reinforcers and cultural consequences (Fleming & Hayes, 2021), but they also allow researchers to examine second-order economic interactions between participants.

In a paper that reconsidered metacontingencies explicitly from a more molar perspective, Fleming et al. (2021a) propose an experimental arrangement that can be used to examine second-order economic interactions between participants that is more analogous to experimenter-participant and employer-employee pay-for-performance interactions and extends the TBMTS paradigm. Suppose that three participants are instructed to work together across a series of trials to earn points that substitute for money or course credit. During each trial, two of the three participants select one of three stimulus objects. After both participants complete their selections, their selections are shown to the third participant along with what they should have selected to earn points. If both participants select correctly the group earns points, and if either selects incorrectly the group loses points. Regardless of the outcome, the third participant is able to take points from the group's point bank and allocate them among the group. Such an arrangement would allow researchers to examine clear and persistent second-order economic interactions when the third participant effectively reinforces correct responding and does not reinforce incorrect responding by the other two participants. While interactions in the experiment Fleming et al. (2021a) propose are difficult to describe in terms of metacontingencies (because the cultural consequences that maintain group interactions—points delivered to the group for two correct selections on a single trial—occur in the middle of the "culturant" they would be said to be contingent on), they are easily describable in terms of correlated, interacting objective-based patterns of referential functional contacts participants participate in.

An experimental arrangement like that described by Fleming et al. (2021a) may be particularly useful for studying power relations within a cultural reaction system. Orientationally, power relations refer to differences in how two or more individuals participating in objective-based patterns of referential functional contacts restrict and constrain maximization of each other's orientations by arranging circumstantial reconfiguration with respect to one another. An individual's strategic positioning within a cultural reaction system is measured by the extent to which their orientation changes—how patterns they participate in reorganize and which patterns they participate in—transform as they interact with other individuals. To the extent to which the group interaction persists when the third participant allocates points only for correct responding in the experiment Fleming et al. propose, the third participant is more strategically positioned than the other two individuals because how they allocate points restricts how points are maximized in patterns the other two participants participate in (i.e., selecting stimulus objects). As some adjustment in orientation always occurs when individuals interact with one another, no individual interacting with others within a pattern of referential functional contacts is powerless. Power is differential within a cultural reaction system and distinguished between individuals on the basis of how they differentially participate in the same pattern with respect to one another. This conceptualization of power is not entirely different from Skinner's (1953) or Goltz's (2003) conceptualization of power as the capacity to control behavior, but it is substantially different in recognizing that power is not something or an ability that someone has but a characterization of an ongoing interaction between individuals participating in objective-based patterns.

Section II.

Orientational Experiments

The rest of this document outlines experiments conducted from an orientational perspective. The purpose of these experiments generally was to demonstrate the myriad of socially-significant experimental procedures and analyses orientationalism and the cultural reaction system construct orient to that are not always validly integrated together in mainstream culture-behavior science orientations that are less molar and interbehavioral. These procedures and analyses include:

1. *Stability criteria*. Cultural reaction systems are characterized by patterns in which functional contacts are organized sequentially and concurrently to maximize objectives (e.g., points). Variability in such patterns should decrease as they adjust with respect to circumstantial consistency across different timescales. Stability criteria allow for functional relations between patterns of functional contacts and circumstantial reconfiguration to be delineated based on observation of consistent covariation during recognized stability and analyzed in terms of visual differences in stable levels of data and/or statistical differences between aggregate measures using tests that assume normality. All of the experiments below incorporate one or multiple forms of stability criteria to enable these analyses to be performed. In accordance with single-subject methodologies (Sidman, 1960), experiments in the more molecular CuBS utilize stability criteria and describe functional relations in terms of stable differences observed across conditions (e.g., Morford & Cihon, 2013; Ortu et al., 2012). However, it is not typically clear or explicated how stable patterns of data refer to culturants or if interpreting such stability in terms of culturants is appropriate given its reliance on reinforcement logic.

2. *Establishment of Conventional Communication*. Considering that verbal behavior is thought to facilitate cultural selection but not be necessary for it to occur (Glenn et al., 2016), CuBS experiments are not typically constructed to observe consistent communicative interactions between individuals (with one notable exception; see Sampaio et al., 2013). Accordingly, CuBS experiments have not examined how novel forms of communication evolve and persist as constituent functional contacts within a shared pattern involving interacting individuals. The experiments below were designed to observe consistent communication established through interpersonal interactions during experimentation rather than prior to

experimentation (i.e., either forms decided by experimenters or those already common in cultural auspices participants participate in) to observe the evolution of cultural reaction systems characterized by linguistic conventionality multiple individuals participate in within shared patterns but not necessarily across patterns involving different individuals.

3. *Non-Causality*. Describing experimental findings in terms of functional relations between patterns of functional contacts and circumstantial reconfigurations does not require appeal to causality, nor does it rely on contingency logic. Relations between the organization of functional contacts within patterns and regularity in circumstantial reconfiguration can be described without implying or interjecting linear or final causality in which responses produce stimuli or stimuli produce responses. Although an orientational approach—like Kantorian interbehaviorism—recognizes the utility in causal analysis (Kantor, 1959), it is not necessary to describe functional relations orientationally and, therefore, is not done for the experiments below. Although independent and dependent variables are used to describe analyses below, independent variables should not be considered to cause dependent variables. Independent variables simply quantitatively refer to features of experimental circumstances arranged by experimenters whereas dependent variables quantitatively refer to features of patterns of functional contacts participants participated in.

The specific purposes of each experiment are described before outlining methods and results in each section below. In addition to the procedures and analyses described above, some general features were relevant to all studies unless specified differently:

1. All experimental sessions were completed in a computer lab at the University of Nevada, Reno.
2. All participants were undergraduate students enrolled in a psychology course and recruited through the Department of Psychology's SONA system.
3. All participants completed an IRB-approved consent process prior to participation.
4. Each participant sat at a different computer that they used to complete the study. View of other participants' screens was restricted by placing interacting participants apart from one another, placing participants at computers where they faced one another, and/or the use of tri-boards or other barriers.

5. Participants were instructed to silence their electronic devices and stow them and their other belongings under their computer for the duration of the session.
6. Participants were instructed not to talk during the session.
7. Brown-noise was played over a loudspeaker to drown out auditory distractions.
8. Participants interacted with virtual stimulus objects and events programmed into a custom website (https://webtbmts1.azurewebsites.net) that allowed them to interact with one another during the session. It also allowed an experimenter to monitor participant interactions from a fourth computer.
9. An experimenter directly monitored participants as they participated.
10. Each session began by the computer prompting each participant to type their age into a textbox. This was done to ensure compliance with inclusion criteria and IRB regulations (i.e., to ensure participants were 18 years of age or older, able to use a computer, and understood English prior to contact with the experimental task).
11. If a technical or programming error occurred during a session, that session was excluded from analysis and is not discussed below.
12. A participant was not allowed to participate in more than one study (including all other studies utilizing TBMTS); all study participants were naïve to experimental arrangements particular to an orientaitonal approach.
13. All statistical analyses were performed using GraphPad Prism 9. Parametric tests were used in each case unless specified otherwise. Alpha for all statistical tests was 0.05.

Power Relations in a Second-Order Economic Interaction Task

The purpose of these experiments was to examine circumstances with respect to which (1) individuals persistently interact with one another economically (i.e., labor for payment/payment for labor) within a cultural reaction system and (2) individuals were more or less likely to unevenly distribute payment to themselves than others. To this end, several experiments based on the model proposed by Fleming et al. (2021a) were conducted.

Pilot Experiments

Two pilot experiments were conducted to explore features necessary in order to stabilize participation in patterns of economic functional contacts within a cultural reaction system. Given that the differences between these experiments are minor and only one triad participated in each experiment, these experiments will be discussed together.

Method

Subjects, Setting, and Apparatus

Two triads of participants (Triads 1 and 2) completed sessions in pilot experiments. Recruitment materials and consent forms indicated that participants could earn both SONA credit and up to $30 by participating. Experimental software randomly assigned each participant within a triad a particular role prior to starting the experimental task. Two participants were designated as selectors and one was designated as the allocator.

Experimental Task

The experimental task started with presenting each participant with instructions about the task for 2-m. Instructions were different for selectors and allocators (see Table 2.1 in Appendix B). Importantly, participants were told that (1) they would be working with the other participants to earn points substituting for money, (2) they would either be earning points for the team by making selections or allocating points to other team members, (3) only a correct selection by both selectors would add points to the team's point bank (an incorrect selection by either selector would remove points from the team's point bank, (4) whoever earned the most points would receive a $20 bonus, and (5) if the team's point bank ever ran out, the study would be over and no one would receive any money. After 2-m, participants could click a Continue button. Once all participants clicked the Continue button, the task began.

The experimental task consisted of a series of trials. Each trial began with selectors choosing one of three comparison stimulus objects (from Set A; see Table 1.1 in Appendix A). Comparison stimulus objects appeared simultaneously in a row in a randomized order. After both selectors selected a stimulus object, their selections were shown to the allocator along with the correct stimulus object (i.e., what they should have selected to earn points for the team). The allocator was then shown a message indicating whether or not their team earned or lost points from their team's bank; the team's point bank was simultaneously adjusted accordingly. If both selectors selected the correct stimulus object, 10 points were added to the team's point bank. If either selected an incorrect stimulus object, 5 points were removed from the team's point bank. The triad's point bank began with 300 points. Only the allocator could see how many points were in the team's point bank and in their personal point bank; selectors could only see how many points were in their own personal point banks. Following the message, the allocator was able to allocate up to 10 points among all participants. The most that could be allocated to a single individual was 10 points and the least was 0; total allocation was only required to be 10 points or less. Once the allocator indicated how many points were to be allocated to each participant and the total allocation was equal to 10 points or less, the allocator was able to submit their allocation.

After submission of point allocation, the selectors were shown one of two forms of feedback depending on what condition their team was in. In Differential Contact conditions, selectors were only shown how many points the allocator had allocated to them and what their own selection had been. In Similar Contact conditions, selectors were shown what the other selector selected, how many points were earned or lost on that trial, and how points had been allocated to all participants. The first and third conditions were Differential Contact conditions, and the second and fourth were Similar Contact conditions; a reversal design was used to demonstrate repeated, stable differences in the organization of patterns of functional contacts with respect to differences in circumstantial configurations. During point allocation, allocators were told what kind of feedback selectors would be given using different colors. From the allocator's perspective, these different color messages were the major differences in conditions. Figures 2.1 through 2.5 in Appendix B depict trials from the perspectives of all triad members.

In order to complete a condition, point allocation had to be stable according to certain criteria. For each selector, points earned on the last nine trials in which they selected the correct stimulus object were aggregated into thirds (e.g., points earned on the previous correct trial, the one before that, and the one before that were added together). If a positive or negative trend was detected (first third aggregate > second third aggregate > final third aggregate; first third aggregate < second third aggregate < final third aggregate), point allocation for correct selections was not considered stable. Additionally, if the absolute difference in any two of the three aggregates was greater than two, point allocation for correct selections was not considered stable. No stability criteria were applied to incorrect selections. Each selector was required to make at least nine correct selections to complete a condition. Each condition lasted for a minimum of 36 trials and a maximum of 72 trials regardless of stability criteria.

During the experimental task, the correct stimulus object alternated pseudo-randomly. In every block of nine trials, each stimulus object was the correct stimulus object for a sub-block of 3, 4, or 5 consecutive trials. Which stimulus object was correct for either 3, 4, or 5 trials was randomly determined, as was the order of sub-blocks. Prior to starting the experimental task, the correct stimulus object was determined in this way for 216 trials. No session lasted 216 or more trials.

Post-Questionnaire

Once participants completed the fourth condition or their team's point bank ran out of points, each participant completed a post-questionnaire. The post-questionnaire comprised demographic questions and questions related to the task. These questions are listed in Table 2.2 in Appendix B, and how participants responded to them in all triads are described in Table 2.3 in Appendix B. If participants did not answer a question on the post-questionnaire, the program prompted them to respond until they did.

The above description describes the experimental session for Triad 1. The session for Triad 2 was identical except for a few deviations. Sessions for Triads 1 and 2 were identical except (1) that the speed at which stimulus objects were presented on trials (e.g., selection options for selectors, notifications of what selectors selected for allocators) was twice as fast for Triad 2 than Triad 1, (2) that points in the team's point bank were reset at the start of each condition to make conditions more similar and decrease the probability of that the team's point bank would be completely depleted, (3) that the minimum and maximum number of trials in a single condition were 18 and 36, respectively, instead of 36 and 72, and (4) that the team's point bank started out with 200 points and reset to 200 points at the start of each condition instead of 300. These modifications were made to increase the probability that triads could complete all four conditions in 90 minutes.

Results

Triad 1

Figure 11 shows how points were allocated for each participant and points in the team's point bank across trials in Triad 1's session. Visual analysis of Figure 11 shows that, in the first Differential Contact condition, the number of points allocated to selectors for both correct and incorrect selections generally decreased as the number of points in the team's point bank decreased. This observation coheres with statistical analyses. The number of points in the team's point bank was found to be significantly positively correlated with the number of points allocated to Selectors 1 and 2 for both correct (Selector 1: $r = 0.648$, $p < .01$, $n = 15$; Selector 2: $r = 0.652$, $p < .01$, $n = 15$) and incorrect (Selector 1: $r = 0.689$, $p < .001$, $n = 21$; Selector 2: $r = 0.853$, $p < .0001$, $n = 21$) selections. In other conditions, this was not the case. In the first Similar Contact condition, the number of points in the team's point bank was not found to be significantly correlated with either the number of points allocated to Selectors 1 and 2 for correct (Selector 1: $r = 0.078$, $p > .05$, $n = 23$; Selector 2: $r = -0.002$, $p > .05$, $n = 20$) or incorrect selections (Selector 1: $r = -0.188$, $p > .05$, $n = 13$; Selector 2: $r = -0.003$, $p > .05$, $n = 16$). Likewise, in the second Differential Contact condition, the number of points in the team's point bank was not found to be significantly correlated with either the number of points allocated to Selectors 1 and 2 for correct (Selector 1: $r = 0.174$, $p > .05$, $n = 11$; Selector 2: $r = 0.314$, $p > .05$, $n = 12$) or incorrect selections (Selector 1: $r = -0.061$, $p > .05$, $n = 18$; Selector 2: $r = -0.281$, $p > .05$, $n = 17$).

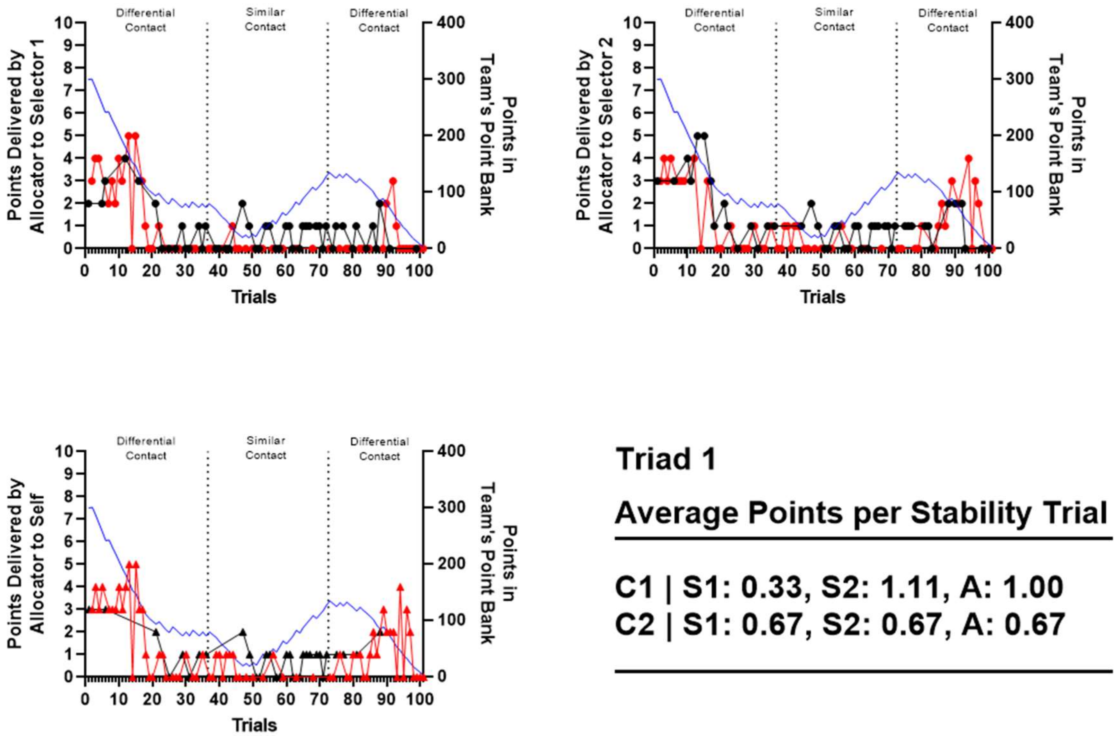


Figure 11. Point allocation for each participant and points in the team's point bank across trials in Triad 1's session. Black circles denote trials in which a selector selected the correct stimulus object. Red circles denote trials in which a selector selected an incorrect stimulus object. Black triangles denote trials in which the triad earned points. Red triangles denote trials in which the triad lost points. The blue line denotes the number of points in the team's point bank. C1 and C2 denote the first and second conditions, respectively. S1 = Selector 1, S2 = Selector 2, and A = Allocator.

Statistical analyses were performed to compare how points were allocated to selectors and the allocator during stability trials across conditions. In these analyses, values for stability trials for selectors were combined ($n = 18$) and compared to self-allocations on the same trials ($18 \geq n \geq 9$) using *t*-tests. Only the first two conditions were considered because only the first two conditions were completed, although stability criteria were not met in either condition. No significant difference was found between mean points allocated to selectors ($M = 0.722$, $SD = 0.826$) and the allocator ($M = 0.722$, $SD = 0.817$, $n = 13$) during stability trials in the first Differential Contact condition ($t(29) = 0.928$, $p > .05$), nor was a difference found between mean points allocated to selectors ($M = 0.667$, $SD = 0.485$) and the allocator ($M = 0.667$, $SD = 0.500$, $n = 9$) during stability trials in the first Similar Contact condition ($t(25) = 0.000$, $p > .05$). Analyses were also conducted to compare how the allocator self-allocated points across different conditions. No significant difference was found between mean points self-allocated in the first Differential Contact and Similar Contact conditions ($t(20) = 1.087$, $p > .05$).

Triad 2

Because Triad 1's team point bank was completely depleted, the session ended before participants could complete the third condition. Considering that the session lasted longer than 70 minutes, the experimental task was modified primarily to allow participants to complete trials and conditions more quickly. Figure 12 shows how points were allocated for each participant and points in the team's point bank across trials in Triad 2's session.

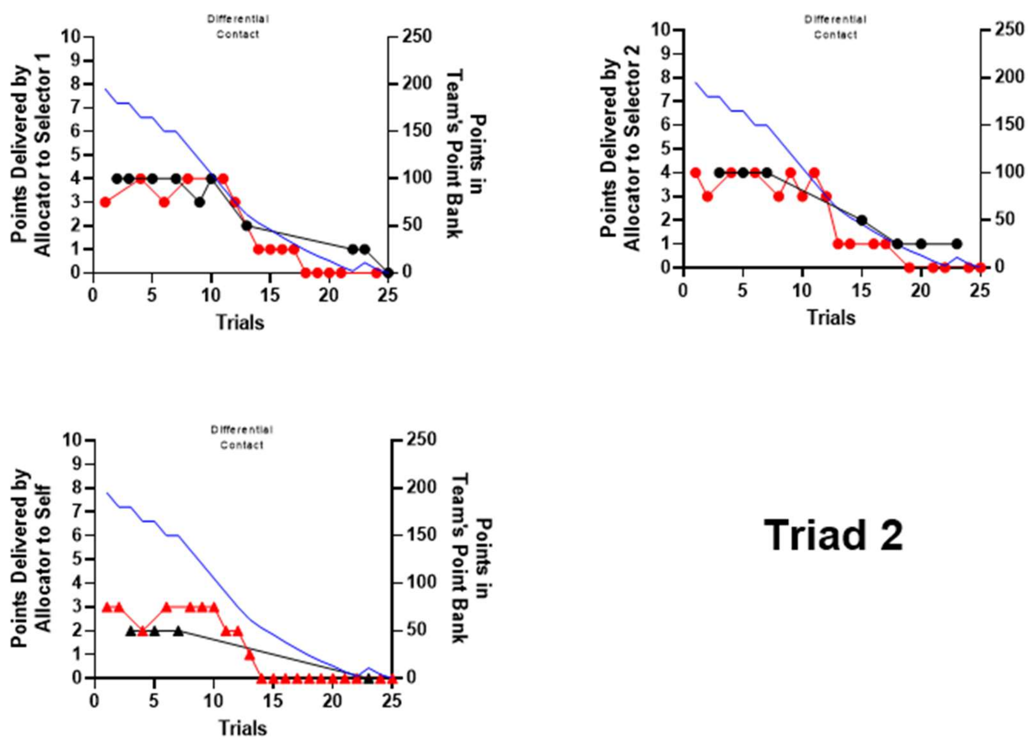


Figure 12. Point allocation for each participant and points in the team's point bank across trials in Triad 2's session. Black circles denote trials in which a selector selected the correct stimulus object. Red circles denote trials in which a selector selected an incorrect stimulus object. Black triangles denote trials in which the triad earned points. Red triangles denote trials in which the triad lost points. The blue line denotes the number of points in the team's point bank.

Despite modifications to the procedure, participants in Triad 2 failed to complete even the first Differential Contact condition. To address this, additional modifications were made to increase the probability of participants completing all conditions.

Experiment 1

Method

The procedure used for triads in Experiment 1 was identical to that used for Triad 2 except for the following changes:

1. The instructions presented to participants were modified to highlight to selectors that the allocator could use points to let them know when they selected correct and incorrect stimulus objects (see Table 2.4 in Appendix B).
2. An additional condition was added so that the order of conditions was (1) Differential Contact, (2) Differential Contact, (3) Similar Contact, (4) Differential Contact, and (5) Similar Contact.
3. Initial points in the team's point bank were returned from 200 to 300 points, and points in the team's point bank were reset to 300 after completing a condition.
4. Additional stability criteria were imposed so that a condition could not be completed if a positive or negative trend was detected in the last three trials each selector participated in a correct selection (unless the maximum number of trials for a condition, 36, were completed).
5. Means of aggregates were used instead of just aggregates to calculate blocks for stability criteria.

Triads 3-6 completed sessions with these modifications. Participants in Triads 5 and 6 were also presented with instructions visually and auditorily through headphones.

Results

In Experiment 1, the first two triads (i.e., Triads 3 and 4) completed all five conditions. Triad 5 failed to complete the first condition, and Triad 6 only completed the first condition. As such, statistical analyses were only performed for Triads 3 and 4, although visual analyses are shown for all triads. Table 2.5 in Appendix B characterizes outcomes for all triads in Experiment 1, including the number of conditions completed, the number of trials in each completed trial, points in each participant's personal point bank at the end of the study, and who earned the $20 bonus.

Triad 3

Figure 13 shows how points were allocated for each participant and points in the team's point bank across trials in Triad 3's session. Correlational analyses were performed between trials and the

number of points in the team's point bank to assess stability of the team's point bank across the task (see Table 2.6 in Appendix B). In the first Differential Contact condition, points in the team's point bank were significantly negatively correlated with trials (*p* < .0001). In the last condition, the second Similar Contact condition, points in the team's point bank were significantly positively correlated with trials (*p* = .0001), indicating task proficiency. In all conditions except the first Differential Contact condition, Triad 2 completed each condition in 18 trials, the minimum for a condition.

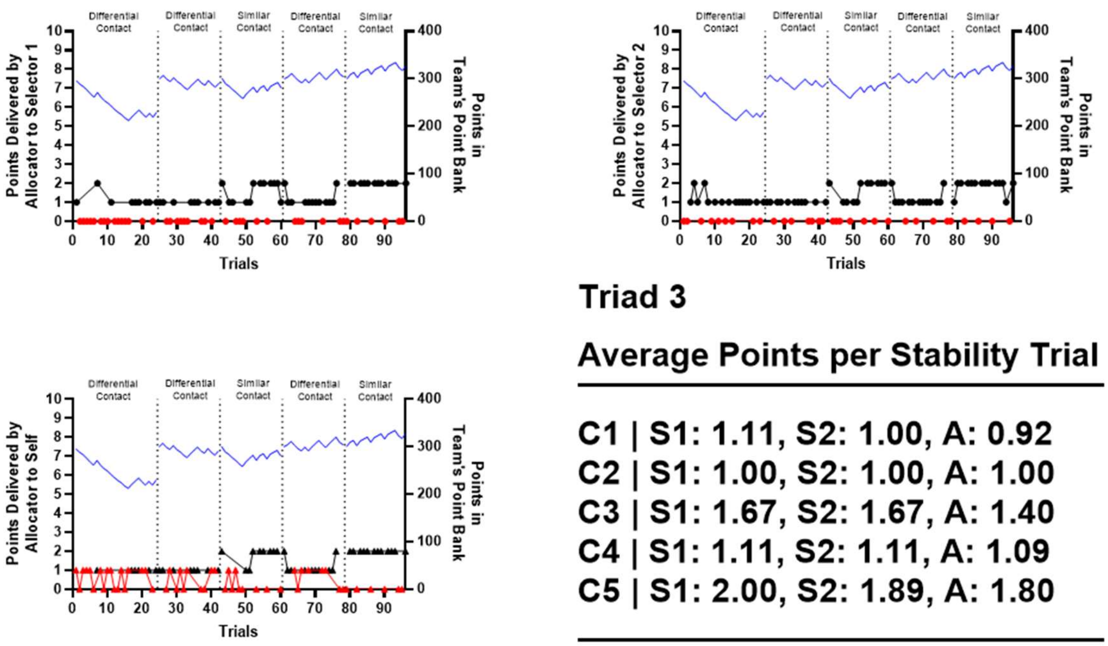


Figure 13. Point allocation for each participant and points in the team's point bank across trials in Triad 3's session. Black circles denote trials in which a selector selected the correct stimulus object. Red circles denote trials in which a selector selected an incorrect stimulus object. Black triangles denote trials in which the triad earned points. Red triangles denote trials in which the triad lost points. The blue line denotes the number of points in the team's point bank. C1, C2, C3, C4, and C5 denote the first, second, third, fourth, and fifth conditions, respectively. S1 = Selector 1, S2 = Selector 2, and A = Allocator.

Statistical analyses were performed to compare how points were allocated to selectors and the allocator during stability trials across conditions (see Table 2.7 in Appendix B). Using t-tests, no significant differences were found between mean points allocated to selectors and the allocator during stability trials in any condition. Two-way ANOVAs were performed to analyze differences in mean point allocations to

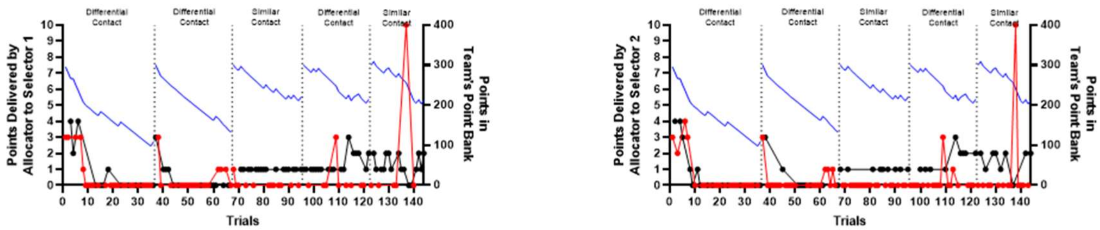
Selectors 1 and 2 for correct and incorrect selections across conditions (see Table 2.8 in Appendix B). Independent variables include selector (i.e., Selector 1 and Selector 2) and selection (i.e., correct and incorrect), and the dependent variable was mean point allocations. For this test and all future tests analyzing this relation across other dyads, non-stability trials were used due to the small number of incorrect selections often occurring within the range of stability trials. In all conditions tested, only a main effect for selections was found to be significant across all conditions ($p < .0001$); no other effects were significant. The second Differential Contact condition was not tested because both selectors were always allocated one point for correct selections and zero points for incorrect selections. Tukey's multiple comparisons tests (see Table 2.9 in Appendix B) found mean point allocations to both selectors for correct selections to be higher than those for incorrect selections in all other conditions ($p < .0001$).

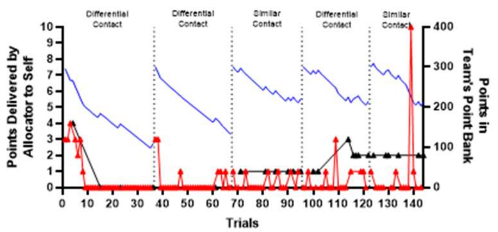
Additional *t*-tests were performed to compare how points were self-allocated on trials in which points were added to or removed from the team's point bank (see Table 2.10 in Appendix B) and how points were differentially self-allocated on point trials in which points were added and removed from the team's point bank between Differential and Similar Contact conditions (see Table 2.11 in Appendix B). In every condition except the first Differential Contact condition (and the second Similar Contact condition for which a *t*-test could not be conducted; see Table 2.10), mean points self-allocated on trials in which points were added to the team's point bank were found to be significantly higher than on trials in which points were removed ($p < .05$). Mean self-allocation of points was also shown to be significantly higher on trials in which points were added to the team's point bank in both Similar Contact conditions when compared to the preceding Differential Contact condition ($p < .001$). Conversely, mean self-allocation of points was shown to be significantly higher on trials in which points were removed from the team's point bank in the third Differential Contact condition than in the second Similar Contact condition ($p < .05$), but the difference between the second Differential Contact condition and the first Similar Contact condition was not significant.

Triad 4

Figure 14 shows how points were allocated for each participant and points in the team's point bank across trials in Triad 4's session. Correlational analyses were performed between trials and the

number of points in the team's point bank (see Table 2.12 in Appendix B). In all conditions, points in the team's point bank were significantly negatively correlated with trials ($p < .0001$).





Triad 4

Average Points per Stability Trial

C1 | S1: 0.11, S2: 0.11, A: 0.00
C2 | S1: 0.11, S2: 0.44, A: 0.18
C3 | S1: 1.00, S2: 1.00, A: 0.54
C4 | S1: 1.67, S2: 1.67, A: 1.00
C5 | S1: 1.11, S2: 1.56, A: 1.47

Figure 14. Point allocation for each participant and points in the team's point bank across trials in Triad 4's session. Black circles denote trials in which a selector selected the correct stimulus object. Red circles denote trials in which a selector selected an incorrect stimulus object. Black triangles denote trials in which the triad earned points. Red triangles denote trials in which the triad lost points. The blue line denotes the number of points in the team's point bank. C1, C2, C3, C4, and C5 denote the first, second, third, fourth, and fifth conditions, respectively. S1 = Selector 1, S2 = Selector 2, and A = Allocator.

Statistical analyses were performed to compare how points were allocated to selectors and the allocator during stability trials across conditions (see Table 2.13 in Appendix B). Using *t*-tests, mean self-allocations were found to be significantly lower than mean allocations to selectors in the first Similar Contact condition ($p = .0007$) and the third Differential Contact condition ($p = .044$). No significant differences were found in any of the other conditions. Two-way ANOVAs were performed to analyze differences in mean point allocations to Selectors 1 and 2 for correct and incorrect selections across conditions (see Table 2.14 in Appendix B). One outlying trial for each selector in which they were allocated 10 points was removed for analysis of the second Similar Contact condition; zero points were allocated to both selectors for incorrect selections in all other cases. Independent variables include selector (i.e., Selector 1 and Selector 2) and selection (i.e., correct and incorrect), and the dependent variable was mean point allocations. Only a main effect for selections was found to be significant in the last three conditions ($p < .0001$); no other effects were significant. Tukey's multiple comparisons tests (see Table 2.15 in Appendix B) found mean point allocations to both selectors for correct selections to be higher than those for incorrect selections in all three of the last conditions ($p < .01$).

Additional *t*-tests were performed to compare how points were self-allocated on trials in which points were added to or removed from the team's point bank (see Table 2.16 in Appendix B) and how points were differentially self-allocated on point trials in which points were added and removed from the team's point bank between Differential and Similar Contact conditions (see Table 2.17 in Appendix B). Again, in these tests data for an outlying trial in the second Similar Contact condition in which 10 points were self-allocated was removed for analyses. In every condition except the first two Differential Contact conditions, mean points self-allocated on trials in which points were added to the team's point bank were found to be significantly greater than means for trials in which points were removed. No significant differences were found in mean self-allocation when comparing Differential and Similar contact conditions. However, for the conditions in which a *t*-test could not be conducted due to identical values (see Table 2.17), the allocator always self-allocated zero points in the second Differential Contact condition and self-allocated one point in the first Similar Contact conditions on trials in which points were added to the team's point bank.

Triads 5 and 6

Figures 15 and 16 show how points were allocated for each participant and points in the team's point bank across trials in Triad 5 and 6's sessions, respectively. Neither Triads 5 nor 6 completed more than one condition. All conditions were characterized by a steep decline in points in the team's point bank.

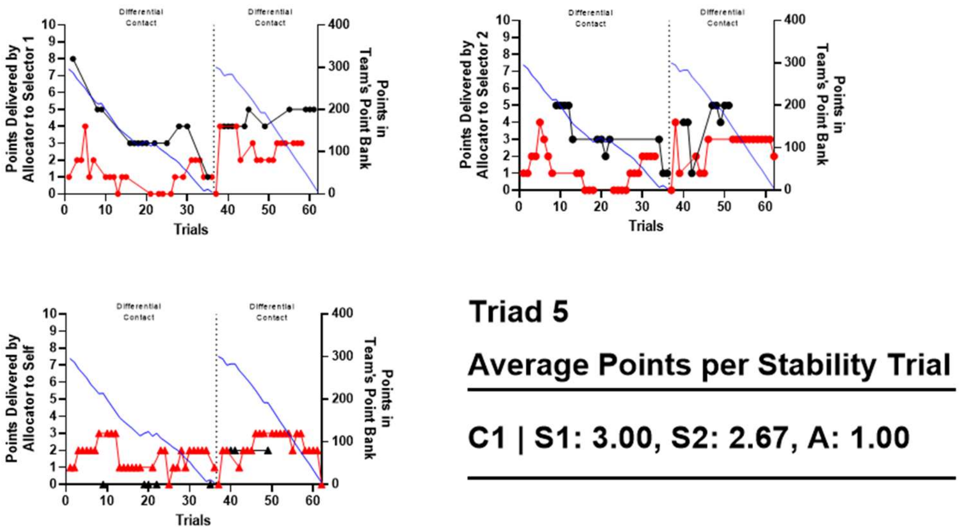


Figure 15. Point allocation for each participant and points in the team's point bank across trials in Triad 5's session. Black circles denote trials in which a selector selected the correct stimulus object. Red circles denote trials in which a selector selected an incorrect stimulus object. Black triangles denote trials in which the triad earned points. Red triangles denote trials in which the triad lost points. The blue line denotes the number of points in the team's point bank. C1 denotes the first condition. S1 = Selector 1, S2 = Selector 2, and A = Allocator.

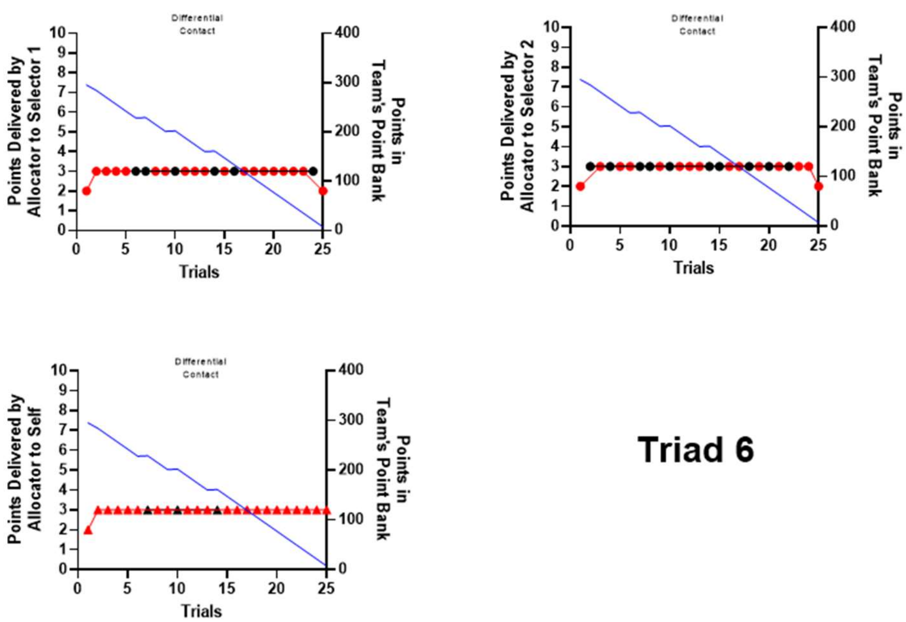


Figure 16. Point allocation for each participant and points in the team's point bank across trials in Triad 6's session. Black circles denote trials in which a selector selected the correct stimulus object. Red circles denote trials in which a selector selected an incorrect stimulus object. Black triangles denote trials in which the triad earned points. Red triangles denote trials in which the triad lost points. The blue line denotes the number of points in the team's point bank.

Discussion

Together, data from Experiment 1 suggest that the experimental circumstance is sometimes—but not always—sufficient to examine a stable cultural reaction system in which correlated patterns of correct selections and allocations organized and persisted. Low levels of point allocation observed in Triads 3 and 4 were predicted by Fleming et al. (2021a); allocating only a small number of points for correct selections not only helps maintain points in the team's point bank that serve as a buffer when selectors participate in incorrect selections, but it also allows the allocator to self-allocate more points while still allocating points to selectors. While allocators could always allocate more points to themselves in Differential Contact conditions than in Similar Contact conditions without selectors contacting that they did so, differential point allocation congruent with this was only shown in the last two conditions for Triad 3 on trials in which points were removed from the team's point bank. In cases where there was a significant difference in mean points allocated to selectors and allocators (i.e., the first Similar Contact and third Differential Contact conditions for Triad 4), allocations were higher for selectors than allocators. Out of the two triads that completed all five conditions, only the allocator in Triad 3 self-allocated more points than they allocated to selectors. These findings cohere with how allocators in Triads 3 and 4 reported how important it was for them to earn money; the allocator's answer in Triad 3 (i.e., 7 on a scale of 1 to 10 with 1 being "Not Important At All" and 10 being "Very Important") was more than double that of the allocator's in Triad 4 (i.e., 3).

After completing Triad 6's session, it was thought that variability in results may have been related to differential contact with instructions. Indeed, this was the rationale for presenting instructions auditorily to participants in Triads 5 and 6. In Experiment 2, the procedure was modified again so that participants could revisit instructions after experimental trials began.

Experiment 2

Method

The procedure used for triads in Experiment 2 was identical to that used for Triads 5, 6, and 7 except for the following change:

1. During the experimental task, participants could hover their mouse cursor over an image of a question mark in the top left corner of their screen to view their instructions. This capacity was indicated to participants in their instructions (see Table 2.18 in Appendix B).

Results

In Experiment 2, the first triad (i.e., Triad 7) completed all five conditions. Triads 8 and 9 ran out of points in their team's point banks before completing the first condition. Table 2.19 in Appendix B characterizes outcomes for all triads in Experiment 2, including the number of conditions completed, the number of trials in each completed trial, points in each participant's personal point bank at the end of the study, and who earned the $20 bonus.

Triad 7

Figure 17 shows how points were allocated for each participant and points in the team's point bank across trials in Triad 7's session. Correlational analyses were performed between trials and the number of points in the team's point bank (see Table 2.20 in Appendix B). Like with Triad 4, points in the team's point bank were significantly negatively correlated with trials in all conditions ($p < .0001$).

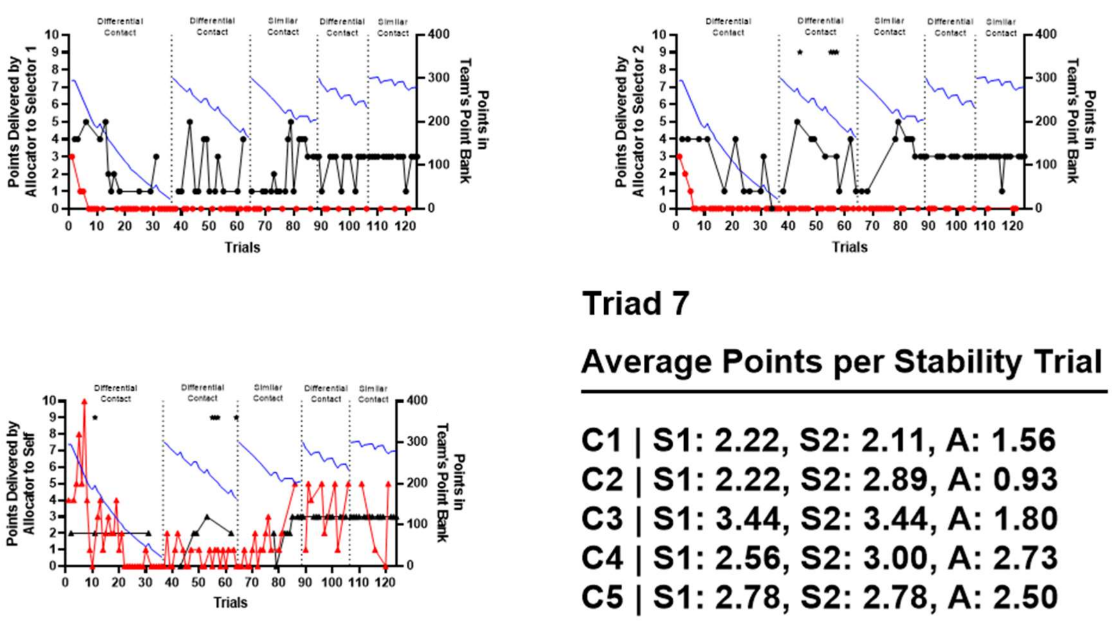


Figure 17. Point allocation for each participant and points in the team's point bank across trials in Triad 7's session. Black circles denote trials in which a selector selected the correct stimulus object. Red circles denote trials in which a selector selected an incorrect stimulus object. Black triangles denote trials in which the triad earned points. Red triangles denote trials in which the triad lost points. The blue line denotes the number of points in the team's point bank. Black stars (where $y_{left\text{-}axis} = 9$) denote trials in which a participant referred back to instructions. C1, C2, C3, C4, and C5 denote the first, second, third, fourth, and fifth conditions, respectively. S1 = Selector 1, S2 = Selector 2, and A = Allocator.

Statistical analyses were performed to compare how points were allocated to selectors and the allocator during stability trials across conditions (see Table 2.21 in Appendix B). Using *t*-tests, mean self-allocation was found to be significantly less than mean allocation to selectors in the second Differential Contact condition ($p = .002$) and the first Similar Contact condition ($p = .0009$). No significant differences were found in any other condition. Two-way ANOVAs were performed to analyze differences in mean point allocations to Selectors 1 and 2 for correct and incorrect selections across conditions (see Table 2.22 in Appendix B). Independent variables include selector (i.e., Selector 1 and Selector 2) and selection (i.e., correct and incorrect), and the dependent variable was mean point allocations. Only the main effect of selections was found to be significant across all conditions ($p < .0001$); no other effects were significant. Tukey's multiple comparisons tests (see Table 2.23 in Appendix B) found mean point allocations to both selectors for correct selections to be higher than those for incorrect selections in all conditions ($p < .0001$).

Additional *t*-tests were performed to compare how points were self-allocated on trials in which points were added to or removed from the team's point bank (see Table 2.24 in Appendix B) and how points were differentially self-allocated on point trials in which points were added and removed from the team's point bank between Differential and Similar Contact conditions (see Table 2.25 in Appendix B). Mean self-allocation on trials in which points were added to the team's point bank was found to be significantly higher than that for trials in which points were removed for the second Differential Contact condition, but no other significant differences were observed. No significant differences were found in mean self-allocation when comparing Differential and Similar contact conditions.

Triads 8 and 9

Figures 18 and 19 show how points were allocated for each participant and points in the team's point bank across trials in Triad 8 and 9's sessions, respectively. Neither Triads 8 nor 9 completed a single condition. All conditions were characterized by a steep decline in points in the team's point bank for both triads. During Triad 8's session, the allocator generally allocated more points to selectors for correct selections until trial 21, a trial in which they also began to frequently self-allocate 10 points per trial. During Triad 9's session, the allocator generally allocated five or more points to selectors for correct selections until they stopped allocating points altogether. Not allocating any points to any participant is an effective strategy for completing conditions (i.e., even if participants lose points on every trial, they can still retain 120 points in the team's point bank), but they were unable to do so before losing all points from the team's point bank by one trial.

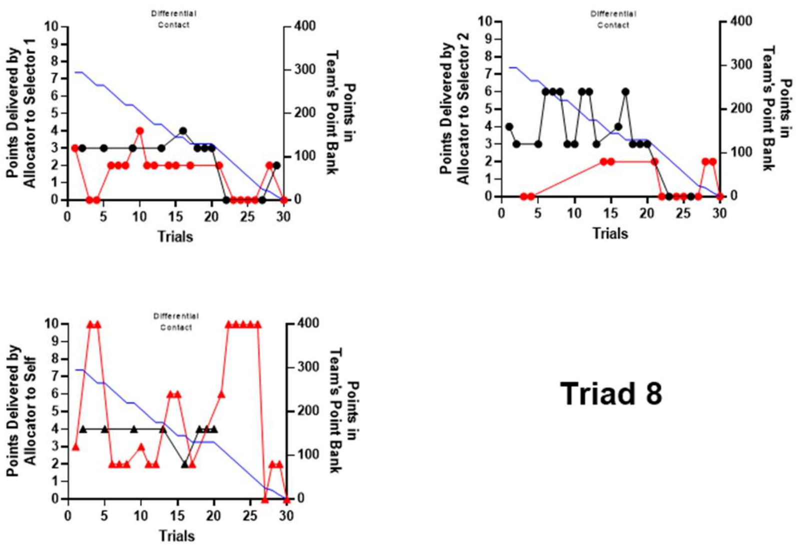


Figure 18. Point allocation for each participant and points in the team's point bank across trials in Triad 8's session. Black circles denote trials in which a selector selected the correct stimulus object. Red circles denote trials in which a selector selected an incorrect stimulus object. Black triangles denote trials in which the triad earned points. Red triangles denote trials in which the triad lost points. The blue line denotes the number of points in the team's point bank.

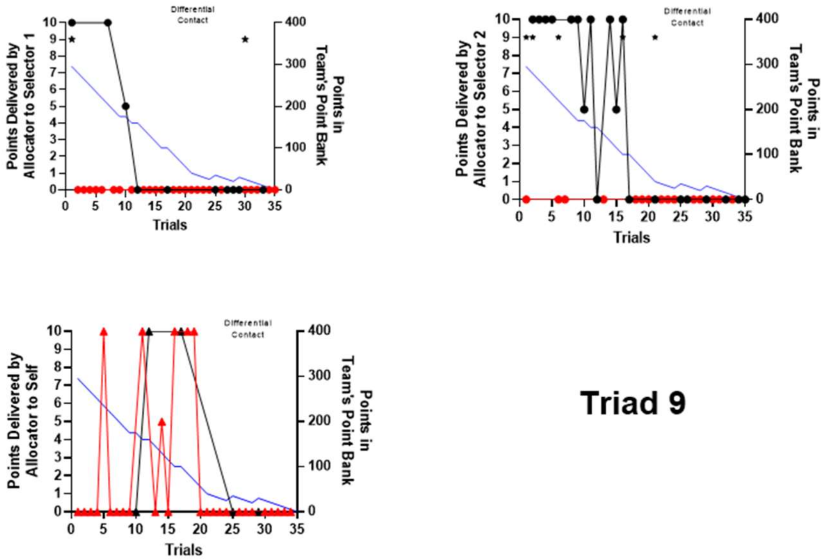


Figure 19. Point allocation for each participant and points in the team's point bank across trials in Triad 9's session. Black circles denote trials in which a selector selected the correct stimulus object. Red circles denote trials in which a selector selected an incorrect stimulus object. Black triangles denote trials in which the triad earned points. Red triangles denote trials in which the triad lost points. The blue line denotes the number of points in the team's point bank. Black stars (where $y_{\text{left-axis}} = 9$) denote trials in which a participant referred back to instructions.

Discussion

Results from Experiment 2 suggest that allowing participants to revisit instructions is not correlated with more triads completing all five conditions of the experimental task, although this feature may have been instrumental for participants in Triad 7. Triad 7 was the only triad in Experiment 2 in which the allocator revisited the instructions (or perhaps ever read the instructions at all). Doing so may have participated in the reorganization of point allocation seen in the first Similar Contact condition. At the end of the first Similar Contact condition, the allocator began to primarily allocate three points to selectors for correct selections, correlating with a marked decrease in the variability of points allocated to selectors for correct selections.

Considering triads that completed all five conditions in Experiments 1 and 2 (i.e., Triads 3, 4, and 7), it is worth noting that if allocators significantly self-allocated more points on trials with a particular outcome within a given condition, they did so on trials in which points were added to the team's point bank. This is consistent with the notion that allocators participated in the experimental task to earn money.

While this difference was observed in the last three conditions for both Triads 3 and 4, it was only observed in the second Differential Contact condition for Triad 7. In response to Question 5 on the post-questionnaire, the allocator in Triad 7 described the logic of their interaction consistent with their difference in participation as compared with the other allocators:

> "If they both got it wrong with the same answer, they got 0 and I got 5. If one got it right they got 5 point and the other got 0, every couple times I would either get 1 or 0."

As the allocator in Triad 7 received the $20 bonus based on a substantial difference in points, this strategy was effective at earning money.

One finding common across Triads 3, 4, and 7 concerned self-allocation with respect to how allocators allocated points to selectors. In nearly every condition, the allocator allocated significantly more points to selectors for correct selections than incorrect selections. However, consistent with the rule of the allocator in Triad 7, they also often self-allocated points on trials in which at least one selector selected an incorrect stimulus object. In the case of Triad 3, this pattern of self-allocation was concealed from selectors by almost doing so only exclusively in Differential Contact conditions. Although selectors could have resisted this by selecting incorrect stimulus objects after observing self-allocation in Similar Contact conditions, none did so. After the first Similar Contact condition (if not before), selectors generally participated in more correct than incorrect selections.

It is worth noting that, in two of three triads that completed all five conditions in Experiments 1 and 2 (i.e., Triads 3 and 7), the allocator received the $20 bonus by self-allocating more points than they allocated to selectors. Patterns of point allocation in which these allocators participated were similar in two important ways. First, self-allocation was greater in earlier trials than in later trials, allowing them to maintain a lead in points compared to selectors while more uniformly allocating points among all team members in later conditions. Second, both allocators rarely allocated points to selectors on trials where they selected the incorrect stimulus object, but they were likely to self-allocate points on those trials. This pattern was more common in the Differential Contact conditions in which self-allocations were not contacted by selectors.

Similarities in these patterns is not only important for analyzing regularity in patterns of referential functional contacts with respect to the experimental task but also with more temporally-extended patterns integrated with participating in the task itself. Importantly, some sessions (i.e., for Triads 5 and 6) were held on a mid-term deadline for SONA credit. While not every session lasted a full 1.5 hours, all participants were given the full amount of SONA credit. Before then, only one triad failed to complete the first condition (i.e., Triad 2). From the SONA deadline onward, only one triad (i.e., Triad 7) completed more than one condition. Answers by allocators to the question, “How important was it for you that your other team members earned money?” were mixed (see Table 2.3 in Appendix B), but it seemed plausible that study participation was more so integrated with academic objective-based patterns (e.g., achieving a particular grade in a class) than patterns in which money acquired in the task could have been used. This possibility was addressed in Experiment 3.

Experiment 3

Method

The procedure used for triads in Experiment 3 was identical to that used in Experiment 2 except for the following changes:

1. During the recruitment and consent processes, participants were made aware that their performance in the study was related to how much SONA they might earn. Before starting the experimental task, participants were told in person that, if their team’s point bank ran out of points, the study would end and participants may not receive the full amount of SONA credit, only 0.5 SONA credits for each 15 minutes they participated for. These points were reiterated in instructions integrated within the task (see Table 2.26 in Appendix B).
2. The number of trials in sub-blocks that a particular stimulus object was considered correct were increased from 3, 4, and 5, to 5, 6, and 7.

Results

In Experiment 3, all three triads (i.e., Triads 10, 11, and 12) completed all five conditions. Although completed in the semester following all other triads, participants in Triads 10, 11, and 12 completed sessions closer to the end of the semester than those in Triads 1, 2, 3, and 4. Table 2.27 in Appendix B characterizes outcomes for all triads in Experiment 3, including the number of conditions completed, the number of trials in each completed trial, points in each participant's personal point bank at the end of the study, and who earned the $20 bonus.

Triad 10

Figure 20 shows how points were allocated for each participant and points in the team's point bank across trials in Triad 10's session. Correlational analyses were performed between trials and the number of points in the team's point bank (see Table 2.28 in Appendix B). Points in the team's point bank were significantly negatively correlated with trials in all conditions ($p < .0001$).

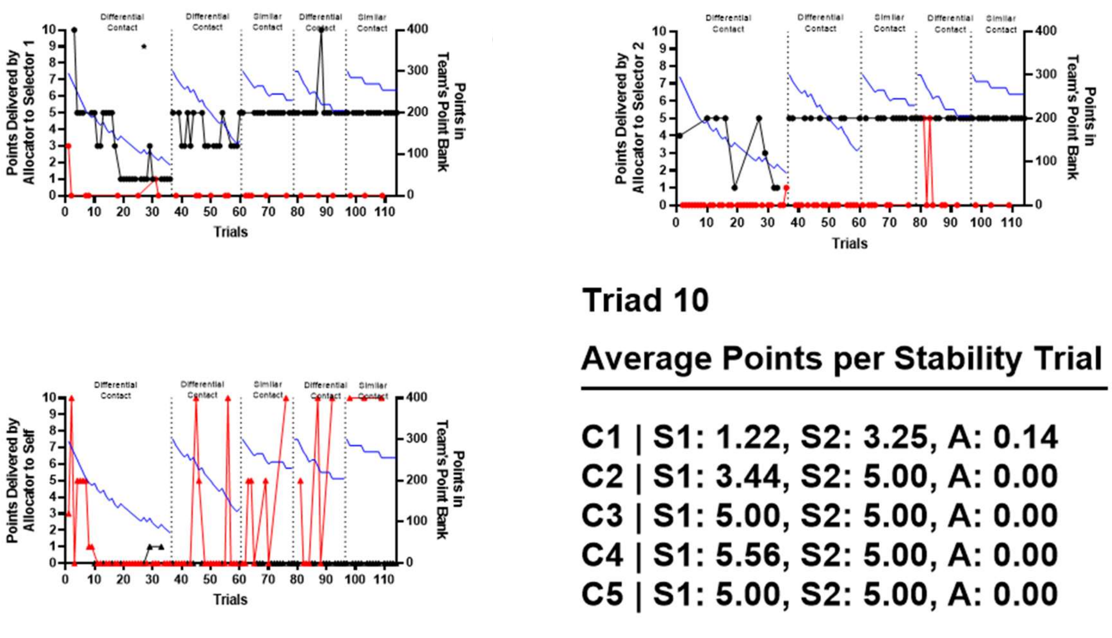


Figure 20. Point allocation for each participant and points in the team's point bank across trials in Triad 10's session. Black circles denote trials in which a selector selected the correct stimulus object. Red circles denote trials in which a selector selected an incorrect stimulus object. Black triangles denote trials in which the triad earned points. Red triangles denote trials in which the triad lost points. The blue line denotes the number of points in the team's point bank. Black stars (where $y_{\text{left-axis}} = 9$) denote trials in which a participant referred back to instructions. C1, C2, C3, C4, and C5 denote the first, second, third, fourth, and fifth conditions, respectively. S1 = Selector 1, S2 = Selector 2, and A = Allocator.

Statistical analyses were performed to compare how points were allocated to selectors and the allocator during stability trials across conditions (see Table 2.29 in Appendix B). Using *t*-tests, mean self-allocation was found to be significantly less than mean allocation to selectors in all Differential Contact conditions ($p < .001$). In both Similar Contact conditions in which all values in each set of allocations were the same, all self-allocations were higher than allocation to selectors. Two-way ANOVAs were performed to analyze differences in mean point allocations to Selectors 1 and 2 for correct and incorrect selections across conditions (see Table 2.30 in Appendix B). Independent variables include selector (i.e., Selector 1 and Selector 2) and selection (i.e., correct and incorrect), and the dependent variable was mean point allocations. For conditions in which a two-way ANOVA could be performed (i.e., the Differential Contact conditions), only the main effect of selections was found to be significant ($p < .0001$). The main effects for selectors and the interaction were also found to be significant in the second Differential Contact condition ($p = .003$); no other effects were significant. For the first and third Differential Contact conditions, Tukey's multiple comparisons tests (see Table 2.31 in Appendix B) found mean point allocations to both selectors for correct selections to be higher than those for incorrect selections ($p < .0009$). For the second Differential Contact condition, Tukey's multiple comparisons tests found mean points allocations to be significantly higher for Selector 1's correct selection than Selector 1's and Selector 2's incorrect selections ($p < .0001$). Mean points allocated for Selector 2's correct selections was found to be significantly higher than for Selector 1's correct and incorrect selections ($p < .001$) and Selector 2's incorrect selections ($p < .0001$). No significant difference was found between mean points allocated to Selectors 1 and 2 for incorrect selections.

Additional *t*-tests were performed to compare how points were self-allocated on trials in which points were added to or removed from the team's point bank (see Table 2.32 in Appendix B) and how points were differentially self-allocated on point trials in which points were added and removed from the team's point bank between Differential and Similar Contact conditions (see Table 2.33 in Appendix B). Mean self-allocation on trials in which points were added to the team's point bank was found to be significantly higher than that for trials in which points were removed in the first Similar Contact condition and the third Differential Contact condition ($p < .05$) but not in the first two Differential contact conditions. In the second Similar Contact condition, the allocator always self-allocated 0 points on trials in which points were added to the team's point bank and 10 points when points were removed. No significant differences were found in mean self-allocation of points when comparing Differential and Similar contact conditions.

Triad 11

Figure 21 shows how points were allocated for each participant and points in the team's point bank across trials in Triad 11's session. Correlational analyses were performed between trials and the number of points in the team's point bank (see Table 2.34 in Appendix B). Points in the team's point bank were significantly negatively correlated with trials in all conditions (*p* < .01).

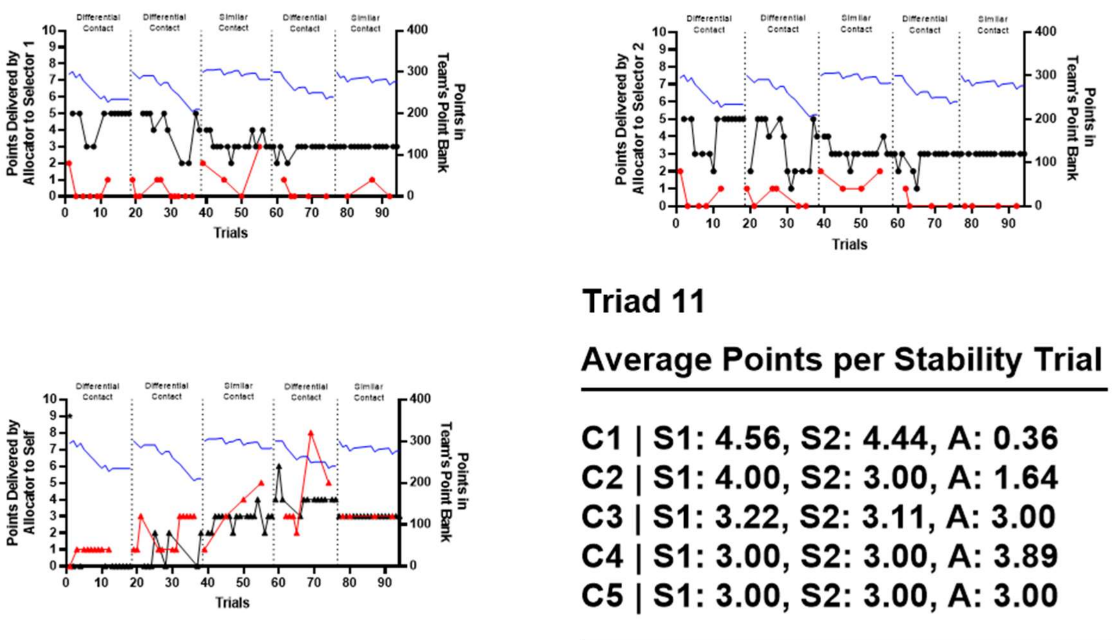


Figure 21. Point allocation for each participant and points in the team's point bank across trials in Triad 11's session. Black circles denote trials in which a selector selected the correct stimulus object. Red circles denote trials in which a selector selected an incorrect stimulus object. Black triangles denote trials in which the triad earned points. Red triangles denote trials in which the triad lost points. The blue line denotes the number of points in the team's point bank. Black stars (where $y_{left\text{-}axis} = 9$) denote trials in which a participant referred back to instructions. C1, C2, C3, C4, and C5 denote the first, second, third, fourth, and fifth conditions, respectively. S1 = Selector 1, S2 = Selector 2, and A = Allocator.

Statistical analyses were performed to compare how points were allocated to selectors and the allocator during stability trials across conditions (see Table 2.35 in Appendix B). Using *t*-tests, mean self-allocation was found to be significantly lower than mean allocation to selectors in the first two Differential

Contact conditions ($p < .001$) but significantly higher than mean allocation to selectors in the third Differential Contact condition ($p < .0001$). No significant differences were found in Similar Contact conditions. Two-way ANOVAs were performed to analyze differences in mean point allocations to Selectors 1 and 2 for correct and incorrect selections across conditions (see Table 2.36 in Appendix B). Independent variables include selector (i.e., Selector 1 and Selector 2) and selection (i.e., correct and incorrect), and the dependent variable was mean point allocations. Only the main effect of selections was found to be significant across all conditions ($p < .0001$). The main effects for selectors and the interaction were also found to be significant in the second Similar Contact condition ($p = .011$), but—as shown in Figure 21—the only actual difference between point allocations to selectors was that the allocator awarded Selector 1 one point on a single trial in which points were removed from the team's point bank and never awarded Selector 2 on any such trial. No other effects were significant. Tukey's multiple comparisons tests (see Table 2.37 in Appendix B) found mean point allocations to both selectors for correct selections to be significantly higher than those for incorrect selections ($p < .0001$).

Additional *t*-tests were performed to compare how points were self-allocated on trials in which points were added to or removed from the team's point bank (see Table 2.38 in Appendix B) and how points were differentially self-allocated on point trials in which points were added and removed from the team's point bank between Differential and Similar Contact conditions (see Table 2.39 in Appendix B). Mean self-allocation on trials in which points were added to the team's point bank was found to be significantly lower than that for trials in which points were removed in the first two Differential Contact conditions ($p < .05$). No significant differences were observed in any of the other conditions. Mean self-allocation on trials in which points were added to the team's point bank was found to be significantly lower in the second Differential Contact condition than in the first Similar Contact condition but higher in the third Differential Contact condition than in the second Similar Contact condition ($p < .0001$). No significant differences were found concerning trials in which points were removed from the team's point bank.

Triad 12

Figure 22 shows how points were allocated for each participant and points in the team's point bank across trials in Triad 12's session. Correlational analyses were performed between trials and the

number of points in the team's point bank (see Table 2.40 in Appendix B). Points in the team's point bank were significantly negatively correlated with trials in all Differential Contact conditions ($p < .05$) and significantly positively correlated with trials in both Similar Contact conditions ($p < .001$).

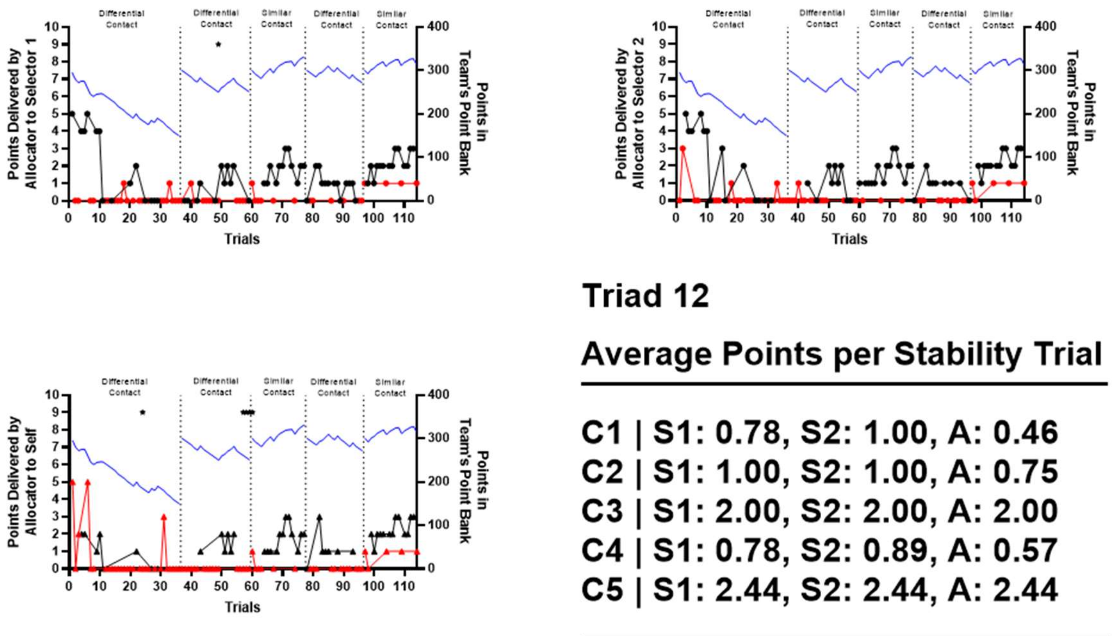


Figure 22. Point allocation for each participant and points in the team's point bank across trials in Triad 12's session. Black circles denote trials in which a selector selected the correct stimulus object. Red circles denote trials in which a selector selected an incorrect stimulus object. Black triangles denote trials in which the triad earned points. Red triangles denote trials in which the triad lost points. The blue line denotes the number of points in the team's point bank. Black stars (where $y_{left\text{-}axis} = 9$) denote trials in which a participant referred back to instructions. C1, C2, C3, C4, and C5 denote the first, second, third, fourth, and fifth conditions, respectively. S1 = Selector 1, S2 = Selector 2, and A = Allocator.

Statistical analyses were performed to compare how points were allocated to selectors and the allocator during stability trials across conditions (see Table 2.41 in Appendix B). Using *t*-tests, no significant differences were found between mean self-allocation and allocation to selectors during stability trials in any condition. Two-way ANOVAs were performed to analyze differences in mean point allocations to Selectors 1 and 2 for correct and incorrect selections across conditions (see Table 2.42 in Appendix B). Independent variables included selector (i.e., Selector 1 and Selector 2) and selection (i.e., correct and incorrect), and the dependent variable was mean point allocations. Only a main effect of selections was found to be significant across all conditions ($p < .0001$); no other significant effects were found. Tukey's multiple comparisons tests (see Table 2.43 in Appendix B) found mean point allocations to both selectors for correct selections to be higher than those for incorrect selections ($p < .05$).

Additional *t*-tests were performed to compare how points were self-allocated on trials in which points were added to or removed from the team's point bank (see Table 2.44 in Appendix B) and how points were differentially self-allocated on point trials in which points were added and removed from the team's point bank between Differential and Similar Contact conditions (see Table 2.45 in Appendix B). Except in the first Differential Contact condition, mean self-allocation on trials in which points were added to the team's point bank was found to be significantly higher than that for trials in which points were removed ($p < .001$). Mean self-allocation was found to be significantly lower for both trials in which points were added and removed from the team's bank in the third Differential Contact condition than in the second Similar Contact condition ($p < .01$). No significant differences in mean point self-allocation were found concerning the second Differential Contact condition and the first Similar Contact condition.

Discussion

Data from Experiment 3 suggest that modifications to the experimental procedure participated in the establishment and stability of cultural reaction systems observed for Triads 10, 11, and 12. No triad in Experiment 3 failed to complete all five conditions. All but two conditions (i.e., the first Differential Contact condition for Triads 10 and 12) were completed in less than the maximum number of trials. Increasing how long each stimulus object was correct for may have been an important factor in increasing the probability that triads completed all five experimental conditions, perceiving the experimental circumstance *as* possibly one in which SONA credit may not be earned seems to have been a more important factor, at least when considering patterns of functional contacts of allocators. Triads 10 and 11 were the only triads in which, during the first Differential Contact condition, allocators significantly allocated more points to selectors than they self-allocated. Unlike allocators in Triads 3, 6, 7, and 8, allocators in triads in Experiment 3 always allocated more total points to at least one selector than they self-allocated; no allocator in Experiment 3 earned the $20 bonus.

Consideration of initial patterns of point allocation during the first Differential Contact condition across dyads from different experiments bolsters the claim that the ubiquity of successful completion of all five conditions by triads in Experiment 3 was more so related to potentially not earning SONA credit than it was to increasing the number of trials stimulus objects were considered correct. Even though selectors had more opportunities to select correct stimulus objects before they changed, two of the three triads in Experiment 3 did not achieve stability criteria in the first Differential Contact condition. Within these triads, only four of six selectors ever selected the correct stimulus at least three times in a row in the first Differential Contact condition. In the three triads that completed all five conditions from Experiments 1 and 2, three of six selectors selected the correct stimulus at least three times in a row in the first Differential Contact condition. Even within the four triads that finished less than two conditions, six of eight selectors did so as well. The major difference in the first Differential Contact condition did not concern selections by selectors but allocations by allocators. Among triads that completed all five conditions, only mean self-allocation during the first Differential Contact condition in Triad 4 was lower than those in triads in Experiment 3. Triads in Experiments 1 and 2 did not fail to complete more than two conditions because selectors were not responding correctly; they failed because allocators allocated too many points to participants. Allocators in Experiment 3 were far more conservative, including one (i.e., in Triad 12) who only allocated six points on trials in which points were added to the team's point bank and seven in which they were removed in the last 20 trials of the first Differential Contact condition. Decreasing the number of points allocated to selectors does not participate in point or money maximization in the short-term, but it does participate in prolonging the task to earn SONA credit.

Results concerning differential self-allocations when selectors could contact how points were being allocated to all participants and what the correct stimulus object was and when they could not were mixed for triads in Experiment 3. No differences in mean self-allocation between Differential and Similar contact conditions were observed for Triad 10. For Triad 11, mean self-allocation on trials in which points were added to the team's point bank was higher in the first Similar Contact condition than in the second Differential Contact condition but lower in the second Similar Contact condition than in the third Differential Contact condition. For Triad 12, mean self-allocation on trials in which points were added to the team's point bank was higher in the second Similar Contact condition than in the third Differential Contact condition. While these findings do not isolate a consistency in how selectors interacting with more of the circumstance or allocators perceiving that selectors could do so participated in cultural reactions observed in this experiment, they are consistent with the notion that allocators were primarily participating in the experiment to earn SONA credit, at least until after completing the first Differential Contact condition when participants contacted a reset in points. As participants became competent at the task and sessions approached their ends, it is not surprising to have observed increases in self-allocation across conditions, especially when comparing conditions to the first Differential Contact condition.

Like in Experiments 1 and 2, selectors in Experiment 3 generally only allocated points to selectors for correct selections but often self-allocated on trials in which at least one selector selected an incorrect stimulus object. Mean self-allocations on trials in which points were removed from the team's point bank were never significantly less and sometimes significantly more than on trials in which points were added for Triads 10 and 11, the latter observation being unique to triads in Experiment 3. Similarly to triads in Experiments 1 and 2, mean self-allocation was higher or the same on trials in which points were added than on trials in which they were removed for Triad 12. However, unlike triads in Experiments 1 and 2, visual analysis of Figure 22 reveals that self-allocations almost always equaled those for selectors, particularly in the last three conditions. Allocating all participants identically may have been perceived *as* more fair and does not interfere with earning SONA credit, but such a pattern of allocation does not maximize money when earning more points than others is required to earn the $20 bonus, further suggesting that functional contacts for the allocator in Triad 12 organized more so with respect to maximizing SONA credit than money.

General Discussion

Results from Experiments 1 through 3 primarily elucidate factors relevant to establishing cultural reaction systems comprising interrelated patterns in which undergraduate participants earn points and complete the entirety of the experimental task. Some participants in Experiments 1 and 2 were shown to participate in stable correlated patterns of correct selections and point allocation, but not all. Stable cultural reaction systems were observed for all participants in Experiment 3. Evidence suggests that differences in the probability of establishing stable cultural reaction systems were more so related to potentially not earning SONA credit than increasing the number of trials in which a given stimulus object was correct. Further research can investigate this by replicating Experiment 3 with the same correct stimulus object correct orders as were generated in Experiments 1 and 2. However, it may be more useful to study other aspects of the circumstance, such as examining if stabilizing interactions occur more so when participants begin in the Similar Contact condition than the Differential Contact condition.

While one of the aims of these experiments was to understand how contacting more or less of the experimental circumstance was related to reorganizations of economic patterns, evidence of this was restricted. Visual analysis of Figures for Experiments 1, 2, and 3 reveal that consistent point production was often not achieved until the first Similar Contact condition, reasonably suggesting that seeing the correct stimulus object was related to selecting the correct stimulus object. However, differential self-allocation of points on trials with different outcomes between conditions was only clearly shown for Triad 3. As discussed above, the allocator in Triad 3 almost always self-allocated 0 points on trials in which points were removed from the team's bank during Similar Contact conditions but often self-allocated more than 0 points during Differential Contact conditions. Although this strategy suggests that this procedure may be used to examine how patterns of referential functional contacts characterized in terms of power differentials (i.e., allocators receiving points for money while selectors do so only when the allocator allocates points to them, allocators contacting achievement criteria while others can only do so indirectly through the allocation of points, allocators contacting how many points all participants receive while selectors only contact how many points are allocated to them), reconfiguration in the circumstance that restricted differential participation in patterns of earning points (i.e., by making it possible for allocators to also see how many points everyone received and what the correct stimulus object was) did not consistently correlate with changes in patterns of point allocation.

The experimental procedure used in Experiments 1 through 3 may be altered to better examine how changes in power differentials are related to changes in patterns of referential functional contacts, particularly concerning individuals who are more strategically positioned. Instead of participating together in the same room, allocations may become more differentiated between Differential and Similar Contact conditions if participants complete sessions in different rooms, are unaware of who they are interacting with, or are otherwise anonymous with respect to one another. In similar circumstances like those constructed to study choice in dictator games, increasing anonymity of participants has been shown to be related to increasing participation in patterns of selfish interactions (e.g., allocating more money to oneself than others; Hoffman et al., 1994; also see Locey & Rachlin, 2015). Although participants almost always reported not knowing other participants well, they still completed sessions in a room in which one participant would walk away with a $20 bonus. Anecdotally, in one session, a participant given the bonus asked if they could split it with the other participants. Functional relations concerning privacy in this task should be investigated, as doing so may be necessary for examining other functional relations concerning altering how participants contact economic circumstances relative to one another.

Future research should also use participants other than undergraduates earning SONA credit. If SONA credit could be earned like money, having students participate for SONA credit may not present issues or may even be ideal if SONA is more highly preferred than money, but SONA credit—per university guidelines—must be contingent on participation time, not participation performance. Said differently, different participants cannot leave a session earning different amounts of SONA credit if participants all participate for the same duration. Given that studying cultural reaction systems involves studying participants interacting with one another across time, difficulties in examining second-order economic interactions presented by SONA credit are hard to overcome. Scientists have substantially explored differences in economic patterns individuals participate in when payment is contingent on performance rather than time theoretically (Gilbert, 1978/2007; Malott, 2003), but few if any experimental studies have examined how economic interactions between participants change between conditions in which payment is based on performance or other criteria. Implications of such experiments are important, as they may be relevant to understanding differences in how individuals become strategically positioned with cultural reaction systems characterized by capitalistic and socialistic economic interactions.

Allowing participants to talk to one another during experimental sessions may also be worth exploring. Many experiments examining partial-altruism have found that mutual maximization of earnings is more likely to be observed or only observed when groups of participants who can cooperate are able to talk with one another (e.g., Costa et al., 2012; Ribes-Iñesta et al., 2008; Sampaio, 2020). In studies by Rangel et al. (2015) and Ribes-Iñesta et al. (2008), participants vocalizing explicit agreements with one another to participate in a certain way has been shown to be related to persistency in patterns of functional contacts in which participants can deviate from agreed upon participations to maximize earnings for themselves over others, at least in the short term. Using an experimental procedure like that used in Experiments 1, 2, and 3, how such agreements participate in second-order economic interactions may be investigated under different circumstances in which allocators are and are not able to deceive selectors by sending them messages describing how many points they earned while actually allocating fewer points than communicated. Deception has been studied using deception games and similar arrangements (see Murnighan & Wang, 2016 for a review) incorporating second-order interactions to some extent, typically to avoid ethical problems of deception in research (Alberti & Guth, 2013) rather than during the stabilization of prolonged economic interactions like those examined in the current experiment and in iterative prisoner's dilemma games (Rachlin et al., 2000).

Communicative Interactions in the Absence of Programmed Rewards

The purpose of Experiment 4 was to analyze factors that participate in communicative interactions when (1) no rewards for doing so are programmed and (2) individuals are not able to immediately (or simply not able to) reciprocate such interactions within an experimental task. Primary factors investigated were (1) patterns of earning points and communications, (2) patterns of circumstantial reconfiguration with respect to which some participants could earn more points than others, (3) patterns of circumstantial reconfiguration in which participants contact how they can interact with one another, and (4) patterns of circumstantial reconfiguration in which how individuals can interact with the task reverses between interacting individuals. By constructing a circumstance in which communicative interactions were not necessary to earn points or other programmed rewards for some individuals, this experiment not only examined whether rewards for others were valuable for oneself when helping others earn rewards did not maximize points for oneself but also addressed an important limitation of TBMTS, namely that it forces communicative interactions that might not otherwise occur in partial-altruism circumstances.

Experiment 4

Method

Subjects, Setting, and Apparatus

One group of six participants completed a single experimental session. Recruitment materials and consent forms indicated that participants could earn both SONA credit and up to $10 by participating. Experimental software randomly assigned each participant to a partner, resulting in three dyads within the group. Within each dyad, each participant was also randomly assigned a role (P1, the participant who was able to send messages first, or P2, the participant who received messages first). At the beginning of the experiment, participants were not instructed that they were working together with anyone or could interact with other participants during the task.

Experimental Task

The experimental task consisted of a series of trials in which participants could select one of three comparison stimulus objects (from Set B; see Table 1.1 in Appendix A) to earn points. On each trial, participants had 10-s to select a stimulus object. If no selection occurred, no points were gained on that trial. Points were only gained for selecting the correct stimulus object. The order of correct stimulus objects was randomized so that, in every block of six consecutive trials, each stimulus object was the correct stimulus object twice in a randomized order. Comparison stimulus objects appeared simultaneously in a row in a randomized order. The order of correct stimulus objects was randomized for each dyad. After 10-s had elapsed, participants were presented with text stating whether they earned 25 points (for a correct selection) or 0 points (for an incorrect selection). Trials were timed together so that every participant completed each trial at the same time, even if trials were in different conditions.

Trials occurred in five conditions organized as a multiple baseline design across dyads to allow for observation of differences in patterns of functional contacts when and only when circumstances were rearranged for some participants and not others. While all dyads completed the first two conditions simultaneously in the same number of trials, the last three conditions were staggered so that one dyad completed a condition at a time as described below. Prior to starting each condition, participants were presented with instructions that detailed changes in the configuration of trials, how they could earn the most amount of points, and how they could help another participant earn the most amount of points (see Table 3.1 in Appendix C). All instructions were presented visually and auditorily through headphones. Participants in each dyad received different instructions from each other in all conditions except the first and third conditions. Instructions necessarily remained on the screen for 3 minutes before participants could start the next condition. In situations where only some participants were shown instructions (because not all participants progressed to the next condition at the same time), all participants were required to wait until those progressing clicked a button to start the next condition.

Condition 1: Random Selection (RS). In the first condition, participants could not contact any stimulus objects differentially correlated with what they should select to maximize points. Participants were simply presented with three stimulus objects and asked to select one. Figure 3.1 in Appendix C illustrates a trial in this condition for both participants in the same dyad.

Multiple stability criteria were required to complete the RS condition before reaching the trial maximum (i.e., 60 trials). The trial minimum for the RS condition was 12 trials. For each participant, outcomes of the last twelve trials (i.e., whether points were gained or not) were aggregated into thirds (i.e., three sets of four consecutive trials with values between 0—if no points were gained on any trial in the set—and 4—if points were gained in every trial within the set). If a positive or negative trend was detected (first third aggregate > second third aggregate > final third aggregate; first third aggregate < second third aggregate < final third aggregate), point allocation for correct selections was not considered stable. Additionally, no third aggregate could have a value greater than 2; if participants participated in correct selections in half or more of stability trials, they could not complete the condition. All participants were required to meet all stability criteria at the same time in order to progress to the next condition.

Condition 2: Help for P1 (HP1). In the second condition, P1 in each dyad was shown a particular stimulus object (from Set A; see Table 1.1 in Appendix A) corresponding to the stimulus object they should select to maximize points. No change in trials occurred for P2. Figure 3.2 in Appendix C illustrates a trial in this condition for both participants in the same dyad.

While stability criteria were the same for P2s in the RS and HP1 conditions, P1s were required to earn points on every stability trial. Like in the RS condition, the trial minimum was 12, the trial maximum was 60, and all participants were required to reach stability criteria simultaneously to complete the HP1 condition before the trial maximum.

Condition 3: Message Capacity for P1 (MCP1). In the third condition, each dyad's P1 was presented with three additional "message" stimulus objects (from Set C; see Table 1.1 in Appendix A) that they could click to make an identical stimulus object appear on P2's screen. Message stimulus objects were visible and operational for the duration of 10-s interval in which participants could select a stimulus object to earn points. The order in which message stimulus objects were positioned on the screen was always the same. After a message stimulus object appeared on P2's screen, it would remain there until the end of the 10-s interval unless it was replaced by another clicked on by P1. Nothing occurred if P2 clicked message stimulus objects. P1 was not provided instructions on how message stimulus objects could be utilized. Besides being able to see message stimulus objects presented to them after P1 clicked on identical objects on their screen, no change in trials occurred for P2. Figure 3.3 in Appendix C illustrates a trial in this condition for both participants in the same dyad.

Stability criteria for the MCP1 condition slightly deviated from those in the HP1 condition. Unlike in the HP1 condition, third aggregates for P2s were not required to have any particular value; they were only required to have no trend. Additionally, progress to the next condition was staggered. After the trial minimum (i.e., 12 trials), if both participants in a dyad met stability criteria, they qualified to begin the next condition. If they were the only dyad to qualify, they began the next condition while the other participants completed at least 12 more trials. If two or more dyads qualified, one dyad was randomly selected to progress. This process repeated until all participants progressed to the next condition. Accordingly, the highest trial maximum possible was 84 trials. Participants were not allowed to progress to the fifth condition until all participants had completed at least 12 trials in the fourth condition.

Condition 4: Message Instructions and Feedback for P1 (MIFP1). In the fourth condition, P1s were instructed on how they could utilize message stimulus objects to help another participant earn points. They were instructed that, unlike them, another participant they could interact with was not able to differentiate what stimulus object they should select each trial to earn points without their help. Trials for P1s were also modified so that they could see (1) what stimulus object their P2 selected and (2) how many points their P2 earned. P2s were instructed on how their P1 could be trying to help them earn points by making message stimulus objects appear on their screen. Stability criteria, the trial minimum, and the trial maximum were identical to those in the MCP1 condition. Figure 3.4 in Appendix C illustrates a trial in this condition for both participants in the same dyad.

Condition 5: Role Reversal (RR). In the fifth and final condition, roles were reversed so that P2s could make message stimulus objects appear on their P1's screen. Both P1s and P2s were shown instructions orienting them to this change. All features of trials for P2s were the same as they had been for P1s in the MIFP1 condition, and all features of trials for P1s were the same as they had been for P2s. All participants remained in the RR condition until the last dyad to enter the RR condition met stability criteria identical to that in the MCP1 and MIFP1 conditions. Figure 3.5 in Appendix C illustrates a trial in this condition for both participants in the same dyad.

After completing the experimental task, participants were given SONA credit and instructions for receiving money they had earned the following week. Participants earned $1 for every 500 points they earned in the task. However, no participant followed up with the experimenter to receive payment.

Results

Figure 23 depicts correct and incorrect selections and messages sent by P1 and P2 in each dyad across trials. Table 3.2 in Appendix C shows descriptive statistics for the mean number of trials in which correct selections and messaging occurred.

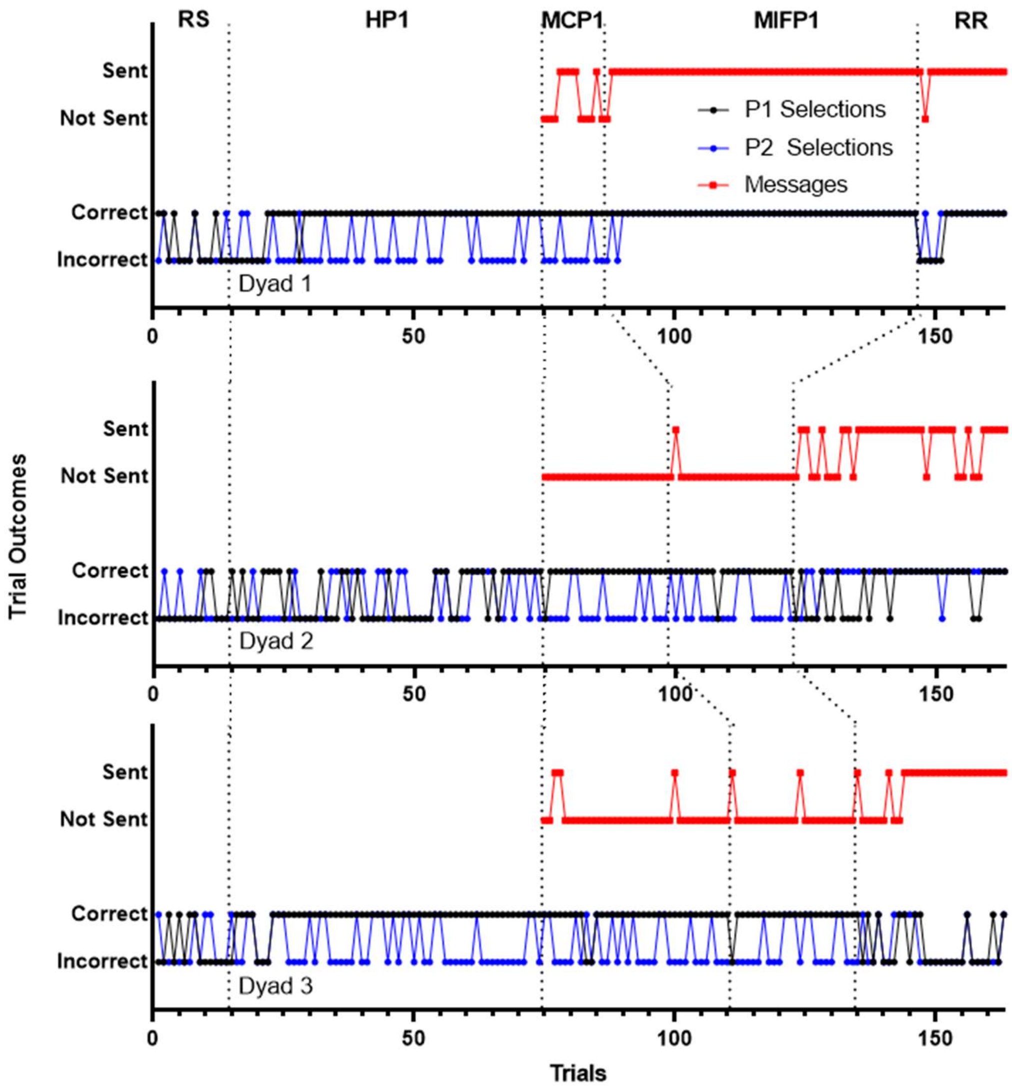


Figure 23. Correct selections, incorrect selections, and messages sent across trials for all three dyads in Experiment 4. Note that binary values are used on the y-axis.

Various features of patterns of selection and messaging are clear based on visual inspection of Figure 23 and consideration of the mean number of correct selections and messaging across participants and conditions outlined in Table 3.2. All dyads met stability criteria for the RS condition in 14 trials. Participants did not satisfy stability criteria in the HP1 condition, resulting in a condition length of 60 trials; P1 in Dyad 2 did not participate in a correct selection for 12 consecutive trials, P2's average participation in correct selections during stability trials was greater than 0.5, and third aggregates for P2 in Dyad 1 had a positive trend in the last 12 trials. All dyads completed the MCP1 and MIFP1 conditions in the minimum number of trials given staggering requirements. Although some messaging was evident when P1s were first able to participate in such contacts, stable messaging was not observed until the MIFP1 condition for Dyad 1 and the RR condition for Dyads 2 and 3.

A one-way ANOVA was performed to assess regularity in mean number of stability trials in which participants participated in correct selections during the RS condition, as trial configurations were uniform across all participants. No significant difference in means were found between participants ($F(4,55) = 0.370$, $p = .829$), suggesting uniformity in patterns of correct selections across participants leading into the HP1 condition. Two-way ANOVAs were performed for each dyad to assess both differences in mean number of stability trials in which dyad members participated in correct selections during the HP1 condition and differences in means between the RS and HP1 conditions (see Table 3.3 in Appendix C). Independent variables included were dyad member (i.e., P1 and P2) and condition (i.e., RS and HP1), and the dependent variable was mean number of stability trials in which a participant participated in a correct selection. For Dyads 1 and 3, significant main effects were found for dyad member (Dyad 1: $p = .002$; Dyad 3: $p = .012$), condition (Dyad 1: $p = .0002$; Dyad 3: $p = .012$), and their interaction (Dyad 1: $p = .012$; Dyad 3: $p = .002$). For both dyads, Tukey's multiple comparisons (see Table 3.4 in Appendix C) found means to be significantly higher for P1s in HP1 than RS (Dyad 1: $p = .0001$; Dyad 3: $p = .0007$), P1s in HP1 than P2s in RS (Dyad 1: $p < .0001$; Dyad 3: $p = .0001$), and P1s in HP1 than P2s in HP1 (Dyad 1: $p = .0007$; Dyad 3: $p < .0001$). For Dyad 2, a significant main effect was only found for condition ($p < .0001$). Tukey's multiple comparisons tests found means to be significantly higher for both P1 and P2 in HP1 than RS (P1: $p = .0008$; P2: $p = 0.040$). Observing that mean number of participations in correct selections during stability trials were differential for both P1 and P2 in Dyad 2 suggests variability in correct selections related to randomization by which such selection criteria were determined.

A two-way ANOVA was performed to assess differences in mean number of stability trials that P1s participated in messaging between the MCP1 and MIFP1 conditions (see Table 3.5 in Appendix C). Independent variables included were P1 (i.e., P1s in Dyads 1, 2, and 3) and condition (i.e., MCP1 and MIFP1), and the dependent variable was mean number of stability trials in which P1s participated in messaging. Significant main effects were found for P1s ($p < .0001$), condition ($p = .003$), and their interaction ($p = .0002$). Tukey's multiple comparisons tests (see Table 3.6 in Appendix C) found significantly higher means for Dyad 1's P1 in MIFP1 than MCP1 ($p < .0001$), Dyad 1's P1 in MCP1 than Dyad 2's P1 in both conditions ($p = .004$), Dyad 1's P1 in MCP1 than Dyad 2's P1 in both conditions ($p = .038$), and Dyad 1's P1 in MIFP1 than P1s in both the other dyads in both the other conditions ($p < .0001$). Another two-way ANOVA was performed to assess if differences in mean number of stability trials that P2s participated in correct selections between the MCP1 and MIFP1 corresponded with differences concerning P1s' messaging in the same conditions (see Table 3.7 in Appendix C). Independent variables included were P2 (i.e., P2s in Dyads 1, 2, and 3) and condition (i.e., MCP1 and MIFP1), and the dependent variable was mean number of stability trials in which P2s participated in correct selections. A significant main effect was found for condition ($p = .007$) and the interaction ($p = .0002$) but not P2 ($p = .064$). Tukey's multiple comparisons tests (see Table 3.8 in Appendix C) found significantly higher means for Dyad 1's P2 in MIFP1 than MCP1 ($p = .0001$), Dyad 1's P2 in MIFP1 than Dyad 3's P2 in MCP1 ($p = .0001$), and Dyad 1's P2 in MIFP1 than the other P2s in MIFP1 ($p < .05$), largely corresponding to the results from the two-way ANOVA describing differences in patterns of messaging P1s participated in during the same conditions.

A final set of ANOVAs was used to assess interactions during the RR condition. A two-way ANOVA was performed to assess differences in mean number of stability trials P1s and P2s participated in messaging in the MIFP1 and RR conditions, respectively (see Table 3.9 in Appendix C). Independent variables included were dyad (i.e., Dyads 1, 2, and 3) and condition (i.e., MIFP1 and RR), and the dependent variable was mean number of stability trials in which P1 and P2s participated in messaging in conditions in which they were the participant that could send messages. Significant main effects were found for dyads, conditions, and their interaction ($p < .0001$). Tukey's multiple comparisons tests (see Table 3.10 in Appendix C) found means to be significantly higher for Dyad 1 in MIFP1 than Dyads 2 and 3 in MIFP1 and Dyad 2 in RR ($p < .05$), Dyad 1 in RR than Dyads 2 and 3 in MIFP1 and Dyad 2 in RR ($p < .05$), Dyad 2 in RR than Dyads 2 and 3 in MIFP1 and Dyad 3 in RR ($p < .01$), and Dyad 3 in RR than Dyad 3 in MIFP1 ($p < .0001$). A two-way ANOVA was also performed to assess differences in mean number of stability trials P2s participated in correct selections during MIFP1 and RR conditions (see Table 3.11 in Appendix C). Independent variables included were P2 (i.e., in Dyads 1, 2, and 3) and condition (i.e., MIFP1 and RR), and the dependent variable was mean number of stability trials in which P2s participated in correct selections. Significant main effects were found for P2 and the interaction ($p < .0001$) but not condition ($p = .080$). Tukey's multiple comparisons tests (see Table 3.12 in Appendix C) found means to be significantly higher for Dyad 1's P2 in MIFP1 than Dyad 2's and Dyad 3's P2 in MIFP1 and Dyad 3's P2 in RR ($p < .001$), Dyad 1's P2 in RR than Dyad 2's and Dyad 3's P2 in MIFP1 and Dyad 3's P2 in RR ($p < .001$), and Dyad 2's P2 in RR than Dyad 2's and Dyad 3's P2 in MIFP1 and Dyad 3's P2 in RR ($p < .001$).

Discussion

Results from Experiment 4 orient to factors that are differentially related to individuals participating in communicative interactions that do not maximize points. While all P1s in the MCP1 condition participated in some messaging contacts, consistent participation was not observed until MIFP1 for Dyad 1's P1 and never observed for Dyad 2's and 3's P1s. However, all P2s participated in consistently high rates of messaging in the RR condition. In Dyads 1 and 2, messaging was shown to be functionally related to P1's participation in correct selections using a multiple baseline design in conjunction with conditions reversals. This was not the case in Dyad 3; P2 participated in messaging but neither P1 nor P2 participated in consistent correct selections. Still, utilizing a multiple baseline design with dyads in this task allowed for demonstration of functional relations concerning P2's participation in sending messages (as they only and reliably did so across staggered RR conditions in which they were first able to).

While a reasonable case can be made that messaging in Dyad 1 constituted a form of reciprocity, such an argument is more difficult to make for messaging by P2s in Dyads 2 and 3. P1 in Dyad 1 may have been participating in a pattern of earning points in which they perceived the experimental circumstance *as* one in which roles would eventually be reversed and would be less likely to earn points later if they did not send messages to P2. However, P1s in Dyads 2 and 3 never participated in messaging. Not only did P2s have nothing to reciprocate in the RR condition, but they were told through instructions in the MIFP1 condition that if they had not seen stimulus objects that could have been used to orient their selections in the MCP1 condition it was because they "were not clicked by another participant" (see Table 3.1 in

Appendix C). Dyad 3's P2's participation in messaging in the RR condition did not correlate with correct selections, but they still participated nonetheless. The case can always be made that such interactions participate in more temporally-extended patterns (i.e., in patterns in which P2s perceive another upcoming role switch) or general behavioral dispositions (i.e., individuals commonly help others as long as it is somewhat correlated with non-altruistic achievement), but given that the RR condition was the last condition in a session that surpassed its scheduled time, this is also unlikely. Future experiments should investigate the possibility of more temporally-extended reciprocity by adding additional conditions in which dyad partners continuously switch roles in an iterative fashion.

It is not clear what factors were related to all three P2s participating in messaging during the RR condition while only one P1 consistently participated in messaging during the MIFP1 condition. Additional experiments can be designed to test some possible factors. The lack of messages sent by P1s in the MIFP1 condition may have been related to not reading or listening to instructions presented to them, but this seems unlikely given that (1) participants were required to wear headphones, (2) instructions were presented to each participant for three minutes in which they could not participate in other activities, and (3) all P1s participated in a messaging contact within the first two trials of the MIFP1 condition indicative of sampling (after many trials of not doing so in the MCP1 condition in Dyads 2 and 3). Still, participants may not have understood the instructions; future experiments may utilize instructions with pictures or videos to determine if they more regularly orient participants towards sending messages to participants. P2's messaging participation in the RR condition may have also been related to how long they participated in conditions in which their participation was highly constricted. For over 100 trials, P2s in Dyads 2 and 3 could only select stimulus objects that were correlated with points only on a small proportion of trials. The reconfiguration in trial circumstances for P2 in the RR condition allowed them to interact with novel stimulus objects they had not been able to for most of the task. Additional experiments can explore how messaging may constitute a pattern of exploration that is more likely to be participated in the longer one's participation in other patterns remains constant by systematically manipulating the number of trials P2s participate in before being able to send messages relative to P1s.

While not explored in Experiment 4, it is highly likely that the interval in which participants are able to select stimulus objects is related to the probability in which they participate in messaging. This interval was set to 10-s to ensure ample time that participants could both select stimulus objects to earn points for themselves and send messages to others. However, it is reasonable to predict that shortening this interval would either bias point maximization for oneself or another, especially if the interval was decreased so that only one response could be made. A similar procedure may involve simply offering participants options between selecting a point-producing stimulus object for themselves and sending a message to another, but there is particular theoretical value to shortening the interval rather than limiting participants to mutually exclusive functional contacts. Altruistic choice refers to differences in time allocated between socially-restricted activities (e.g., interacting for the betterment of one's self and not others) and socially-extended activities (e.g., interacting for the betterment of one's self and others; c.f., Rachlin & Locey, 2011). While individuals may never truly engage in purely altruistic patterns (as patterns they participate in will always be integrated with patterns of survival for as long as they are surviving), understanding how patterns of functional contacts in which individuals do and do not help others achieve objectives that characterize their own patterns are related to temporal constraints may have implications for understanding factors relevant to large-scale social problems with ever decreasing temporal windows to adress, such as climate change.

Experiment 5

The purpose of Experiment 5 was to determine if delay and social discounting rates predict efficiency and flexibility in TBMTS. In Fleming's (2021) study, higher delay discounting rates were found among participants who did not complete the first two conditions of TBMTS (in which both correspondence and noncorrespondence maximized points in different conditions) than those who did. This finding orients to a relation between communicative interactions and sensitivity to temporally-extended stimulus objects and events. Previous research suggests that humans perform worse at prisoner's dilemma games when they are not allowed to talk to one another (e.g., Costa et al., 2012, Sampaio, 2020); communicative functional contacts may be necessary for participating in temporally-extended patterns of cooperation, just as sensitivity to temporally-extended stimulus objects and events may participate in communicative interactions. If human participants are not able to establish effective means of communication with one another during TBMTS, their poor performance may be related to how functional contacts they participate in or patterns thereof are temporally-restricted; a similar rationale was provided by Green et al. (1995) in explaining why pigeons defect in basic prisoner's dilemma games. Other research on self-control in prisoner's dilemma games with non-human animals suggests a relation between communicative interactions and integration with more temporally-extended patterns of participation; pigeons participating in defection has been shown to be overcome by allowing them to produce discriminative stimuli for cooperating on subsequent trials using tit-for-tat strategies (Baker & Rachlin, 2002; Sanabria et al., 2003). These studies suggest that individuals are unlikely to participate in more temporally-extended patterns of cooperation unless they are able to communicate or interact across trials. Additionally, given that the flexibility observed in TBMTS (i.e., deviating from patterns of communication participants participate in establishing) may be relevant to understanding circumstances in which conventional orientations of individuals adjust as they break the rigidity of their own "rules" (as such patterns are typically described in behavior analysis; O'Hora & Barnes-Holmes, 2001), isolating measures that can predict flexibility in TBMTS may warrant further exploration of their predictive utility for more temporally-extended and socially-important patterns.

Method

Subjects, Setting, and Apparatus

Thirty participants completed three rounds of TBMTS across three sessions (two with 12 participants and one with six). Recruitment materials and consent forms indicated that participants could earn both SONA credit and a $100 Amazon giftcard if they earned more points than any other participant in the study. At the beginning of each round of TBMTS, experimental software pseudo-randomly assigned each participant within a group of six to a dyad with another participant they could work with together to earn points for that round. Participants were never assigned to work with the same participant twice. This type of experimental design was used to allow for observation of the regularity that individuals participated in specific interactions with various members of the same population: undergraduate students enrolled in psychology courses.

Discounting Assessments

Prior to starting the experimental task, participants first completed a delay discounting assessment and then a social discounting assessment. Both assessments were modeled after Du et al.'s (2002) adjusting-amount delay discounting procedure. In the delay discounting assessment, participants were asked "What would you prefer?" with alternatives being "$X Today" or "$200.00 in Y" where X was a value between 0 and 100 and Y was a delay (i.e., 1 Month, 3 Months, 9 Months, 2 Years, 5 Years, 10 Years, and 20 Years). On each question, participants could click one of two buttons labeled as each alternative to indicate their preference. Six questions were asked at each delay, and X on the first question for each delay was always 100. If participants selected the smaller immediate option, X decreased on the next question. If participants selected the larger delayed option, X increased on the next question. In each block of six questions for a particular delay, changes in X were 50 from the first to the second question, 25 from the second to the third, 12.5 from the third to the fourth, 6.25 from the fourth to the fifth, and 3.125 from the fifth to the sixth. Values of X were always rounded to two decimal points. The social discounting assessment was identical to the delay discounting assessment except that (1) questions asked whether they would prefer "$X for Myself" or "$200.00 for Y" where X was a value between 0 and 100 and Y was a person of a particular social distance participants were asked to imagine prior to answering questions in the assessment (i.e., Persons 1, 2, 5, 10, 20, 50 and 100 with Person 1 being someone close to them and Person 100 being someone not close, like an acquaintance). Assessments also differed in instructions presented to them for two minutes before starting each assessment (see Table 4.1 in Appendix D).

For data analysis, results from discounting assessments were transformed into indifference points. Indifference points were calculated by averaging the value of the titrating reward, X, the last time each alternative was selected within a block of trials with the same delay. If only one alternative was selected, the value of the titrating reward was averaged with either 0 if only the titrating reward was selected or 200 if only the $200 reward was selected. This produced seven indifference points across each delay or social distance that were then fitted according to Mazur's (1987) hyperbolic discounting equation to find values of discounting rate k:

$$V = \frac{A}{1+kD} \tag{1}$$

In Equation 1, *V* is the value of a commodity with present value *A* (if it were currently accessible) obtainable after delay *D*. The discounting rate by which *V* decreases as *D* increases is represented by *k*. For correlational analyses, *k*-values were transformed using natural logs for normalization (c.f., Kirby, Petry, & Bickel, 1998).

Experimental Task (TBMTS)

After completing the discounting tasks, participants completed three rounds of TBMTS, each with a different randomized partner. Each round lasted 15 minutes. During the round, each participant worked with their partner to earn points across a series of trials. On each trial, (1) one participant selected one of three comparison stimulus objects from Set X in the presence of one pseudo-randomly presented sample stimulus object from Set Y. Then, (2) the other participant selected one of three comparison stimulus objects presented to them from Set Y in the presence of a sample stimulus object identical to that selected by the first participant to select a comparison. After both selections, (3) participants were awarded the same number of points. All comparison stimuli for each selection were presented simultaneously and arranged horizontally from left to right in a randomized order. The order in which sample stimuli from Set Y were presented was set at the beginning of each round so that each of the three stimulus objects was presented twice within each block of six consecutive trials in a random order. The stimulus objects in Sets X and Y were from Sets A and B in Round 1, Sets C and D in Round 2, and Sets E and F in Round 3, respectively (see Table 1.1 in Appendix A). Participants took turns going first and second each round so that, if a participant selected a stimulus from Set X on one round, they selected a stimulus from Set Y on the next and vice versa. Figure 4.1 in Appendix D illustrates two consecutive trials occurring during the correspondence maximization condition, described below.

Conditions. Trials were partitioned into two conditions. In Correspondence Maximization (CM) conditions, correspondence (i.e., the second participant to select on a trial selecting the sample stimulus object for the first) produced 25 points for each participant and noncorrespondence (i.e., the second participant to select on a trial selecting a stimulus object other than the sample for the first) produced 5 points. In Noncorrespondence Maximization (NCM) conditions, correspondence produced 15 points and noncorrespondence produced 45 points. All dyads began in CM conditions in each round. If dyads completed 12 consecutive point-maximizing trials, they progressed to the NCM condition. After progressing to the NCM condition, participants remained in the NCM condition until the end of the round (i.e., until 15 minutes elapsed). Before each round, participants were presented with the same instructions for two minutes before they could begin the task (see Table 4.2 in Appendix D). Each participant waited until their partner also indicated that they were ready to begin the task. Participants in each dyad completed their round together at their own pace irrespective of the speed of other dyads.

Post-Questionnaire

After completing the third round of TBMTS, all participants completed a post-questionnaire. The post-questionnaire comprised demographic questions and questions related to the task. These questions are listed in Table 4.3 in Appendix D, and how participants responded to them in all triads is described in Table 4.4 in Appendix D. If participants did not answer a question on the post-questionnaire, the program prompted them to respond until they did.

Results

Table 4.5 outlines findings from TBMTS iterations and discounting assessments. Mean points earned in the entirety of TBMTS was 2947 (*SD* = 900.2). Mean points earned was 886.3 (*SD* = 376.8) in the first round of TBMTS, 1050 (*SD* = 552.1) in the second, and 1031 (517.3) in the third. A one-way ANOVA did not find a significant difference in mean points earned across rounds. Likewise, one-way ANOVAs did not find significant differences in mean trials completed in the CM condition nor mean completions of the CM condition. Twelve participants never completed a single CM condition, five completed one CM condition, 12 completed two CM conditions, and one participant completed three. Twenty-two participants never participated in flexible patterns (i.e., deviating from the pattern established during the CM condition within the NCM condition), three demonstrated flexibility once, three demonstrated flexibility twice, and one demonstrated flexibility in all three rounds. Median R^2 of *k*-values were 0.802 for delay discounting *k*'s and 0.676 for social discounting.

Several correlational analyses were conducted to assess possible predictors of TBMTS performances (see Table 4.7 in Appendix D). Natural logs of delay and social discounting *k*-values, age, gender (i.e., male or female), languages spoken (i.e., only English or languages other than English), answers to Questions 7 and 8 on the post-questionnaire (i.e., those concerning how important it was for them or others, respectively, to earn the giftcard), and a binary understanding value (0 if participants indicated understanding that they could interact with other participants during TBMTS, 1 if they indicated a lack of understanding). Significant correlations included a negative correlation between ln(*k*) for social discounting and total CM conditions completed, a positive correlation between age and trials completed in the CM condition in the first round, a negative correlation between age and trials completed in the CM condition in the third round, a negative correlation between responses to Question 7 from the post-questionnaire and trials completed in the CM condition in the first round, and a negative correlation between understanding and trials completed in the CM condition in the second round. Additional correlational analyses found that, when Johnson and Bickel's (2008) exclusion criteria were applied to discounting rates, ln(*k*) for delay discounting significantly positively correlated with points earned in the third round of TBMTS. Figure 24 depicts this correlation. When applying the exclusion criteria, the significant correlation between social ln(*k*) for social discounting and total CM conditions completed became insignificant.

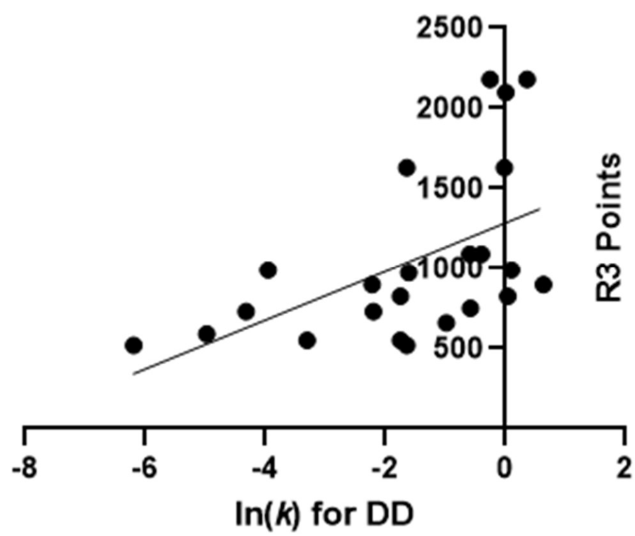


Figure 24. Correlation between ln(*k*) for delay discounting with Johnson and Bickel's (2008) exclusion criteria applied and points earned in the third round of TBMTS.

Discussion

While some measures were found to be significantly correlated with TBMTS performance, most such findings should be interpreted skeptically. R^2 values for discounting rates—especially social discounting—were low. When Johnson and Bickel's (2008) exclusion criteria were applied to *k*-values examined in the current study, sample sizes decrease from $n = 30$ to $n = 23$ for delay discounting and to $n = 16$ for social discounting. Doing so resulted in the correlation for social discounting becoming insignificant. The correlation that became significant for delay discounting is highly unexpected. It is not theoretically clear why delay discounting would predict performance in the third round of TBMTS, and it conflicts with the finding from Fleming's (2021) study in which delay discounting rates were found to be higher for those who did not meet stability criteria in the first two conditions of a much longer version of TBMTS (i.e., 45 minutes). Considering how short each round of TBMTS was in the current study, these data should be interpreted with caution.

Other significant relations are difficult to describe theoretically. Although it is easy to understand how participants indicating that they did not understand that they were participating with other participants could be related to poorer performances in TBMTS, it is less clear why that relation was not consistently significant across rounds. Age may be related to initial TBMTS performance, but, in a way similar to what Baer (1970) might state, age only orients to participating factors; age itself is not a functional participant. The only correlational finding that should be taken seriously is the negative correlation between answers to Question 7 and the number of trials completed in the CM condition of the first round of TBMTS. This finding suggests that interactions during TBMTS were differentially related to the extent to which participants were participating with respect to earning the giftcard or just SONA credit. As participants interacted with one another through random pairings, it is reasonable to expect this negative correlation to depreciate in a task as complex as TBMTS, especially if strategies fail to maximize or cohere with those of others they were randomly assigned to. Indeed, this is the pattern of correlations across rounds observed.

Although it is possible that more significant relations would be found with additional participants, significant findings other than with respect to Question 7 are unlikely due to several limitations of the procedure. Unlike Experiments 1 through 4, Experiment 5 incorporated no forced stability criteria to balance patterns across dyads. While some participants completed CM conditions, others did not, and those that did complete CM conditions often completed them in different rounds. Restricting rounds of TBMTS to 15 minutes despite instability in patterns of communication between dyad members was primarily in the service of ensuring that three rounds could be conducted within a reasonable amount of time and allow participants the opportunity to participate in flexible patterns up to three times. However, this allowance may have also restricted the extent to which interactions and outcomes of later rounds could be predicted. And, while some participants read instructions, it is clear that others did not based on reports by participants stating that they were not aware they were interacting with others despite being instructed that they would be doing so on consent forms and in the task. This finding aligns with findings from Experiments 1, 2, and 3. If participants were participating primarily in patterns of earning SONA credit, it is not only likely that their interactions would be less likely to be predicted by measures concerning monetary rewards than those participating in patterns of earning money but that their interactions interfered with participating interacting to earn money. Future research should address these concerns by (1) incorporating stability criteria for each round of TBMTS and (2) utilizing participants who do not earn SONA credit by participating.

Future experiments should also consider the utility of using automated partners rather than humans. Genuine referential interactions involve multiple humans interacting with respect to one another across time (Kantor, 1977), but enough TBMTS studies have been conducted at this point to program computers to maximize points in TBMTS like humans do. During CM conditions in TBMTS, participants are likely to participate in (1) symmetrical selections (i.e., if a selection occurs on a trial in which more rather than fewer points are earned, selecting the sample stimulus object as a comparison is more likely than not when the comparison selected appears as the sample) and (2) relatively quick deviations (i.e., if a selection occurs on a trial in which less rather than more points are earned, selecting a different comparison is more likely than not) or (3) rigid selections (i.e., a selection will continue to occur in the presence of a particular sample even if fewer points are learned; Fleming, 2021; Fleming et al., 2021b). This strategy is effective in TBMTS because, if both dyad partners participate in symmetrical selection on the same point-maximizing trials and if one dyad partner's orientation adjusts to match selections of their partner before their partner's orientation adjusts, participants can quickly coordinate in a way necessary to produce correspondence outcomes. Similar models of evolving communication have been constructed based on simulations of Lewis signaling game experiments (Barrett, 2009; Catteeuw & Manderick, 2013; Huttegger, 2014; Skyrms, 2010), but these models do not specifically incorporate these exact features because they are typically developed exclusively for senders or receivers, not interacting senders and receivers who switch roles.

Given the potential importance of delay and social discounting for not only understanding socially significant problems (i.e., those that require solutions vastly extended across time and individuals cooperating together; c.f., Chance, 2007) but understanding the organization of cultural reaction systems, more experimental work should continue to address the predictive utility of delay and social discounting assessments for interactions occurring in cultural reaction systems of interest. Experiments, *as* cultural reaction systems that are not only integrated with patterns of earning class credit and money but also other patterns of scientific activity, require an appreciation of how individuals that participate in them also participate in more discontinuous temporally and socially-extended patterns in which they interact with other individuals, stimulus objects, and stimulus events at various scales. By integrating molar logic into the cultural reaction system construct, interactions and stability among patterns of functional contacts in which organisms participate can be easily described in terms of multi-scale integration in ways that are difficult to describe in terms of participations of single discrete events. By also integrating Kantorian field logic, these patterns can also be described without ascribing causal influence to patterns of circumstantial reconfiguration or to individual functional contacts; such attributions can be described in terms of interacting patterns and transformations in their organization across time, space, and with respect to orientations of multiple organisms.

Section III.

Conclusion

Together, Experiments 1-5 begin an empirical account of cultural reaction systems. Experiments 1-3 demonstrated circumstances with respect to which largely arbitrary economic interactions between individuals participating differentially within the same objective-based pattern of referential functional contacts (i.e., earning points) stabilize. Experiment 4 demonstrated circumstances in which individuals were more likely to altruistically participate in patterns of referential functional contacts that did not serve to benefit them, suggesting that communication can evolve with respect to circumstances not characterized by shared rewards (Lewis, 1969). Experiment 5 demonstrated possible avenues to explore individual propensities to contact circumstantial reconfiguration despite their participation in the establishment of rigid and persistent patterns of arbitrary referential communication. There is certainly much more to explore, but these experimental building blocks—built on and constructed through an orientational perspective—should be advantageous for developing a natural and consistent behavior science of cultural relations.

The theoretical exposé of orientationalism and experiments coherent with it explored in this dissertation not only provide additional avenues of exploration but also constructive critique of contemporary behavior analysis. Behavior analysts are fond of saying that we have dissemination problems (e.g., Axelrod, 1992; Kelly et al., 2018; Malott, 1992), but within behavior analysis there are many perspectives that are not only incoherent with one another but inconsistent with respect to their own individualized standards for validity. Theoretical development of the cultural reaction construct largely began as an attempt to reconcile molar logic within the metacontingency enterprise, an enterprise within CuBS that largely differentiates between behavioral and cultural processes by orienting towards behavior molecularly while culture in a more molar way without recognizing how the pervasiveness of reinforcement-as-strengthening logic prevents a full and consistent molar account (Fleming & Hayes, 2021). This led to further consideration of how a molar approach orients towards different research activities and scientific constructions that, in the case of the former, are not oriented to in the metacontingency enterprise and, in the case of the latter, are not compatible with foundational assumptions of the enterprise (Fleming et al., 2021a). Perhaps pushing dissemination is not ideal until behavior analysis is more systematized, at least in the case of CuBS.

Consideration of alternatives to the general metacontingency contingency model put forth by Glenn et al. (2016) oriented towards conceptual issues in other metacontingency models, particularly Houmanfar and colleagues' (2010, 2020) five-term metacontingency model. The five-term metacontingency model is ill-equiped to understand cultural relations because it combines Kantorian field logic and Skinnerian reinforcement logic in a way that is not reconcilable. In the five-term metacontingency model, reinforcement is used to describe the reoccurrence of interlocking behaviors between individuals whereas different contingencies are used to describe the reoccurrence of socio-interlocking behaviors operating at a non-psychological scale. These contingency processes are both embedded within a field of interaction in which their organization is related to Kantorian logic-based factors, like the cultural milieu as a collection of shared stimulus functions with respect to institutional stimuli that serve as a condition for sociological organization. Although some have claimed otherwise (Ardila- Sánchez et al., 2021; Ribes-Iñesta, 2018), contingencies cannot be embedded within fields because fields describe constantly transforming current events involving interacting stimulus objects and organisms. There cannot be contingencies when there is only concurrent, simultaneous change. Contingencies are an analytically useful tool in experimental situations to describe organization of event factors (and thus events themselves), but contingencies always orient towards explaining one event or some set of events by another event or set of events. Describing relations among events in this way can be tantamount to explaining some factors of an event by other factors of the same event (or a different event, as if one event could cause another). By incorporating Kantorian constructs, the five-term metacontingency model only partially recognizes the importance of the naturalism of Kantorian logic, as it does not recognize contingency and Kantorian field logic as incompatible. Said differently, it ascribes contingencies with explanatory causal functions rather than using contingencies to describe interrelated, arbitrary partitions of interacting patterns. The cultural reaction system recognizes this distinction by discussing correlated patterns of functional contacts and patterns of circumstantial reconfiguration as patterns that interact with one another, composing a functionally integrated whole event with discontinuous regularity. This not only allows for a more naturalistic and nuanced approach to studying cultural and linguistic interactions that are often obscured by metacontingency/reinforcement logic but one that can be safely constructed given its internal consistency.

The cultural reaction system construct also has implications for how verbal behavior is investigated experimentally by behavior analysts interested in language and cognition, especially those who utilize Implicit Relational Assessment Procedures (IRAPs). In an IRAP study, participants typically complete a series of trials in which they are instructed to indicate whether a relation between two stimulus objects (i.e., a label and target stimulus; e.g., “Woman” and “Mom”) is consistent or inconsistent with a previously described rule (e.g., “All Moms are Women”) using one of two keys (e.g., the “D” key for “True” and the “K” key for “False”) within a certain amount of time (e.g., under 2 seconds). Across blocks of trials, rules are inverted so that correct responses in one block are incorrect in the next, allowing researchers to compare latencies between different derived relational responses with respect to the same stimulus objects. Those differences are transformed and summarized as *d*-scores to quantify the functional strength and rigidity of particular forms of relational responding (e.g., Barnes-Holmes et al., 2010; Finn et al., 2018; Kavanagh et al., 2018; Leech & Barnes-Holmes, 2020), although they have also been problematically used to describe implicit bias and cognition seemingly underlying relational responding (Barnes-Holmes & Harte, 2022).

However, when considered orientationally, certain assumptions underlying the IRAP are flawed. The most severe is thinking that the derived relational responding the IRAP was designed to measure does not stabilize within the IRAP. The IRAP is considered an assessment in part because derived relational responding functionally analyzed using the IRAP is thought to be at a given, determinable strength prior to assessment. Because the IRAP is thought to provide a measure of this strength and not influence it, no reinforcement contingencies are built into the IRAP to alter the probability of responding or any of its dimensions (e.g., latency). Given that the IRAP constitutes a particular circumstance of consistent reconfigurations that occur as participants interact with experimental stimulus objects and events, it should be assumed from an orientational perspective that patterns of referential or linguistic functional contacts reorganize as the orientation of individuals adjusts with respect to the IRAP. Not only is thinking otherwise somewhat naïve from a functional contextualist perspective (i.e., if relating is an operant [Hayes et al., 2001], it must always be considered as such even if reinforcing events are not programmed to occur contingent on relating), but empirical data collected in IRAP studies supports the argument that patterns of referential functional contacts stabilize during IRAPs. In a study examining the single-trial-type dominance effect in the IRAP, Finn et al. (2018) found that differences in *d*-scores across trial types within the color-shape IRAP became more statistically significant as participants completed more IRAPs. If IRAPs were considered *as* environmental regularity participating as patterns of circumstantial reconfiguration cultural reaction systems, they may be constructed to allow measure of asymptotic adjustment as latencies adjust towards stability by (1) incorporating stability criteria into the IRAP, (2) removing latency requirements, and (3) adding achievable objectives (e.g., points earned for correct responding on each trial that exponentially decrease from the start of a trial until a response option is selected). These modifications may allow researchers to quantify the stabilization with respect to relations between stimulus objects across trials and potentially overcome using the IRAP to analyze functional relations only at the sociological level (i.e., the IRAP currently cannot be used to assess a single individual's derived relational responding because the data it produces is not orderly for individual subjects). Transformations of the IRAP are already moving in this direction (Barnes-Holmes & Harte, 2022; Finn et al., 2018). However, the way IRAP researchers approach field theory (Barnes-Holmes et al., 2020) suggests that they will also need to re-conceptualize what they consider to be a field to be more congruent with a more molar experimental approach. Relating cannot be considered an operant that occurs in a field of interaction.

The metacontingency enterprise and the verbal behavior enterprise are only a few areas that may benefit from developing an orientational approach. Orientiationalism may not only be useful for reconciling logical issues within behavior-analytic enterprises but by orienting behavior analysts towards other related enterprises where collaboration is possible. This approach orients towards research on Lewis signaling games that, except in studies on TBMTS (Fleming, 2021; Fleming et al., 2021b), have largely been ignored by behavior analysts. This is somewhat discouraging; the Lewis signaling game enterprise has largely been built on the matching law (Herrnstein, 1961, 1970), yet no open lines of collaboration between behavior analysts and Lewis signaling game researchers seem to be flourishing. Perhaps this lack of interaction is strategic, but it is difficult to read studies on Lewis signaling games and not perceive them *as* fundamentally important for understanding linguistic systems, even from a behavior-analytic perspective. Likewise, it is difficult not to see how collaboration may foster constructive advances in both enterprises. Lewis signaling game theorists do not recognize the complexity of referential activity; their simulation models would be different if they did. Orientationalism may be instrumental in bringing these enterprises together for their mutual interests, if not others.

Orientationalism may be different from interbehaviorism in many aspects due to integrating molar logic, but it really should be considered a molar extension. The foundational constructs and logic are Kantor's, and its value to behavior science is similar as well. Interbehaviorism is beneficial for behavior science at large because it offers a non-causal, field-theoretical orientation towards psychological subject matter. As such, it has utility not only in orienting behavior scientists to new problems or reorienting them to old ones, but it has an internal consistency established through systemization that is useful to be familiar with when systematizing other behavioral enterprises. Kantor (1977, p. 15) was too definitive when he wrote that, "[sociologically,] language operates as a means of domination and control". The purpose of this work is not one of dominance, but extension. Orientationalism offers tools that can be used to conceptualize human interactions for one's own analytical aims when one recognizes the value of a more molar interbehaviorism. Through its construction, we hope to contribute to generating novel research and conceptual development across enterprises within behavior science, even if only by reorienting others to what it means to be oriented at all.

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Appendix A

Glossary

Arbitrary: The degree to which how a stimulus object or event is perceived *as* X, where X is a referent, in addition to its formal or physical properties.

Circumstance: The entirety of stimulus objects, stimulus events, organisms, patterns of reconfiguration, and their properties that participate as setting factors with respect to patterns of functional contacts within a reaction system.

Coherence: Referentially recognized consistency in participations within and across maximizing patterns of functional contacts.

Contiguity: Spatio-temporal proximity of events pertaining to the same organism participating in both events. Depending on one's theoretical orientation, such relations may be said to occur between behavioral events (e.g., contiguity between different organism-environment interactions) or between behavioral and environmental events (e.g., contiguity between operant emissions and reinforcers).

Conventionality: A set of properties of patterns of referential functional contacts, namely: (1) they are shared (i.e., culturalized and diffused), (2) they are, in part, arbitrary, and (3) they are bounded in form by other patterns of referential functional contacts.

Correlation: Covariation of events participating within interdependent patterns. From an orientatioanl perspective, this is described in terms of concurrent changes within interacting patterns.

Cultural reaction system: A type of reaction system (1) involving a focal pattern of referential functional contacts, (2) two or more individuals, (3) characterized by conventionality, and (4) established through culturalization/diffusion processes.

Culturalization: The integration of previously non-participating individuals into patterns of referential functional contacts. All culturalization processes constitute patterns of referential functional contacts

Diffusion: The spread of participating in a referential functional contact across individuals.

Direct contact: A functional contact occurring through a physical medium with respect to formal or physical properties of a stimulus object or event.

Formal similarity: The degree to which functional contacts, stimulus objects, stimulus events, and patterns of circumstantial reconfiguration share likeness with other functional contacts, stimulus objects, stimulus events, and patterns of circumstantial reconfiguration an organism has interacted with or is interacting with throughout a spatially and temporally-extended circumstance.

Functional contact: An interaction between a responding whole organism and a stimulating stimulus object or event.

Integrated Field: The functional interrelation of factors composing a system.

Integration: The organizing of a pattern of functional contacts by virtue of formal similarity operating with respect to maximization of particular functional contacts across patterns, given correlated patterns of circumstantial reconfiguration.

Interbehavioral history: The entirety of interactions that have occurred involving organisms, stimulus objects, and stimulus events. An organism's history of interaction is referred to as reactionary biography, whereas a stimulus object or event's history of interaction is referred to as stimulus evolution (Kantor, 1977, p. 47).

Logic: The organization of a pattern of referential functional contacts.

Maximization: The organization within and between patterns of functional contacts towards stability, indifference, or equilibria across time. While the term carries economic implications (Rachlin et al., 1981), here it is being used in a much more general way to describe the ordering within an organism's orientation, extended across space and time, with respect to particular functional contacts that characterize patterns.

Media of contact: Conditionalities of organism-environment interaction, such as light or airwaves, that make certain types of functional contacts, such as seeing or hearing aspects of a circumstance, possible. For some (e.g., Hayes & Fryling, 2018), the term is applicable only to physical conditions such as light or airwaves. For others (e.g., Ribes-Iñesta, 2018), the term is applicable to a wider range of conditions, including convention. Orientationally, because conditionalities constitutie potentialities of functional contacts within a circumstance, media of contact are considered setting factors.

Molar: A characterization of orientations within naturalistic psychology based on certain postulates, namely that (1) changes in how an organism interacts with stimulus objects and events are related to their participation in patterns of activity that are functionally related to patterns of environmental events, and (2) what is functionally related to behavior is not completely bounded by the point-of-view of an organism under analysis. Molar orientations do not deny the importance of formal similarity, but they do not endow it with the same organizational functions that are common in molecular orientations.

Molecular: A characterization of orientations within naturalistic psychology based on certain postulates, namely that (1) changes in how an organism interacts with stimulus objects and events are related to formal similarity between stimulus objects and events and contiguity between events, and (2) what is functionally related to behavior is bounded by the point-of-view of the organism.

Objective: A referentially perceived possible functional contact an individual can interact in given particular reconfigurations of a circumstance.

Orientation: How a whole organism interacts with a whole environment, temporally extended across time. Orienations are described in terms of interrelations among patterns of functional contacts a particular organism or set of organisms participates in.

Orientationalism: The molar extension of J. R. Kantor's interbehavioral psychology being described here. The subject matter of orientationalism concerns orientations of organisms described in terms of reaction systems.

Pattern of functional contacts: The entirety of concurrent and sequential functional contacts that, as a whole, participate as a factor within a reaction system.

Pattern of circumstantial reconfiguration: Interactions within a circumstance that occur concurrently with respect to a pattern of functional contacts. These changes include changes to (1) the physical and biological properties and relative organization of participating organisms, stimulus objects, and stimulus events and (2) which organisms, stimulus objects, and stimulus events participate in the circumstance.

Play: A pattern of functional contacts that is characterized by and maximizes with respect to characteristic functional contacts not necessary for survival or reproduction (e.g., novelty), even if it is relevant to survival or reproduction in the long-term.

Point-of-view of the organism: The bounding of functional contacts or psychological events to only direct contacts involving stimulus objects and events in an organism's immediate surroundings; a basic contention of molecular orientations. Interbehaviorally, non-present stimulus objects and events are interacted with substitutionally with respect to stimulus objects and events participating within direct contacts.

Reaction system: In orientational terms, an integrated field comprising (1) a focal pattern of functional contacts occurring serially and concurrently, (2) other interrelated patterns of functional contacts participating organisms participate in, (3) setting factors composing a circumstance, including (3.1) an organization of organisms, stimulus objects, stimulus events, and their properties relative to one another, (3.2) patterns of circumstantial reconfiguration correlated with patterns of functional contacts, (3.3) a history of interaction of participating factors, and (3.4) media of contact (4) with respect to boundary conditions (i.e., self-constraining and observational). In interbehavioral terms, reaction systems refer to the various anatomico-physiological systems and phases that participate in a response function irrespective of stimulus objects, events, and setting factors (Kantor, 1977, pp. 49-50).

Referential functional contact: A type of functional contact describing reflexive interaction with respect to one's own formal participation within patterns in which one perceives a circumstance *as* referents interrelated across abstract dimensions.

Response function: The participation of a particular form of responding of an organism in a psychological event; the "action of an organism" (Kantor, 1959, p. 15).

Setting factors: In interbehavioral terms, contextual features that facilitate or debilitate the actualization of particular functional contacts (Kantor, 1959, p. 95). In orientational terms, the entirety of a circumstance, including how it reconfigures, with respect to which patterns of functional contacts actualize.

Situation: A composite of referentially recognized differences in the potentiality of specific circumstantial reconfigurations when one participates in different patterns.

Stimulus event: A stimulating interaction between two or more stimulus objects that interacts with a responding organism as a whole within functional contacts.

Stimulus function: The participation of a particular form of stimulation of a stimulus object or event in a psychological event; the "action of the stimulus object" (Kantor, 1959, p. 15) or event.

Stimulus object: A stimulating entity, set of entities, or stable system that interacts with a responding organism as a whole within functional contacts.

Stimulus substitution: The actualization of a stimulus function of a non-present stimulus object through direct contact with another stimulus object within an implicit field of interaction (Kantor, 1924, pp. 50-51); the bidirectional process by which the functions of two or more stimulus objects are partially transferred to one another (Delgado & Hayes, 2014, p. 627).

Teaching: A culturalization process between two individuals (i.e., a teacher and a student) interacting with respect to one another and an objective characterized in terms of recognized regularity among functional contacts involving the student and certain stimulus objects, events, and reconfigurations of the circumstance.

Table 1.1

Sets of Stimulus Objects Used in Experiments

Set A

Set B

Set C

Set D

Set E

Set F


Appendix B

Table 2.1

Instructions Used in Pilot Experiments

Instructions for Selectors
In this task, you will be working with your team to earn points. You will earn points for your team each trial by clicking on symbols. Like you, one other participant, P2, will be clicking on symbols. The third participant, P3, will be deciding how to split the points between the three of you. Only P3 will be shown what symbol you are supposed to click. Which symbol you are supposed to click will change periodically throughout the task. When you and P2 both click the correct symbol, your team will earn points. When either of you clicks the wrong symbol, your team will lose points. The points your team earns will be put into a team bank and divided among the team by P3. Remember, points will be converted into money and given to you at the end of the study. If your team bank ever runs out, the task is over, and no one will receive any money. If you complete the task, you will receive money based on what is in your personal bank. If you earn the most points on your team, you will also receive a $20 bonus. Do not talk over the course of the experiment. When the Continue button appears, click it to progress in the study
Instructions for Allocators
In this task, you will be working with your team to earn points. Points for your team are earned and lost based on whether the other two participants, P1 and P2, select the correct symbol. If they do select the correct symbol, your team will earn points. If either do not, your team will lose points. Whether your team earns or loses points, you will get to decide how and whether each participant on your team gets any points from your team's bank. At first, only you are shown what the correct symbol is, which will change periodically throughout the task. You can use the points you do or do not give to the other participants to let them know when they have responded correctly or incorrectly, but how you allocate points each trial is entirely up to you. If your team bank ever runs out, the task is over and no one will receive any money. If you complete the task, you will receive money based on what is in your personal bank. If you earn the most points on your team, you will also receive a $20 bonus. Do not talk over the course of the experiment. When the Continue button appears, click it to progress in the study.

Text was displayed to participants using 20-point Arial font.

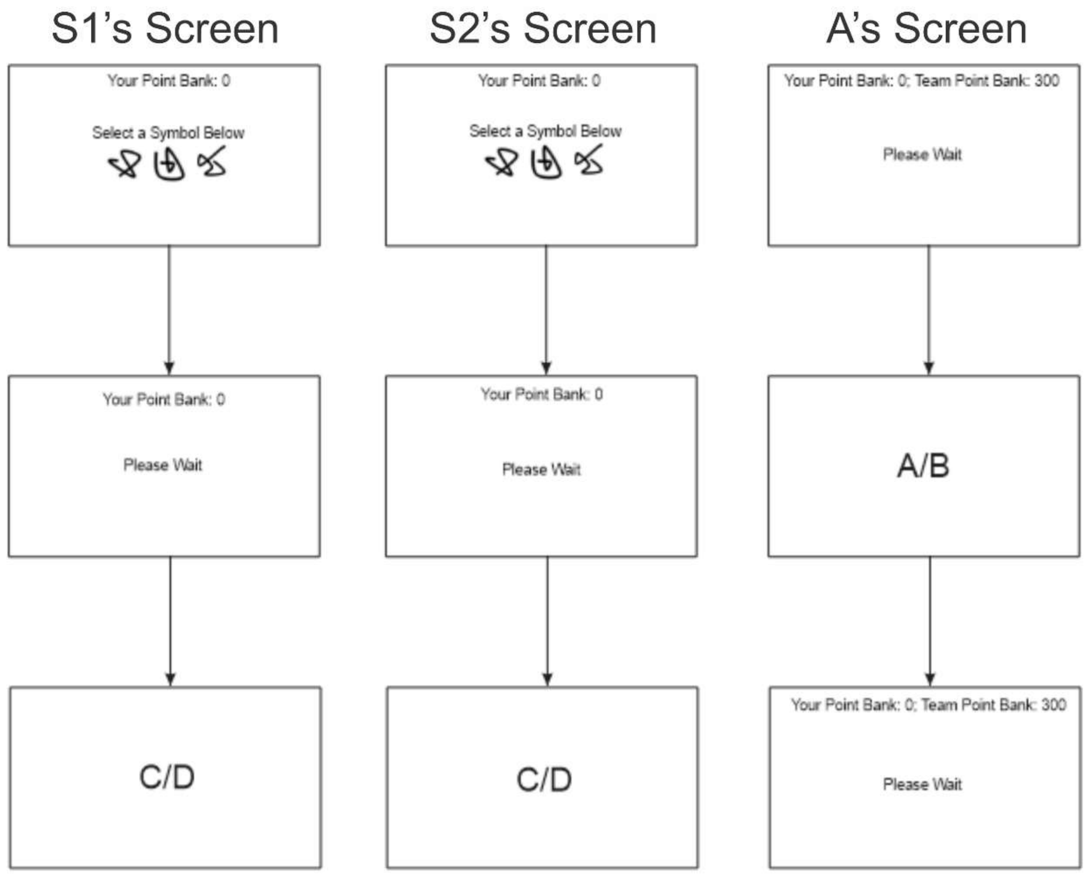

Figure 2.1. Progressions of trials for all participants in a triad. Refer to Figures 2.2 and 2.3 for screen displays A and B, or examples of what allocators saw in Differential and Similar Contact conditions, respectively. Refer to Figures 2.4 and 2.5 for screen displays C and D, or examples of what selectors saw in Differential and Similar Contact conditions, respectively. S1 = Selector 1, S2 = Selector 2, A = Allocator.

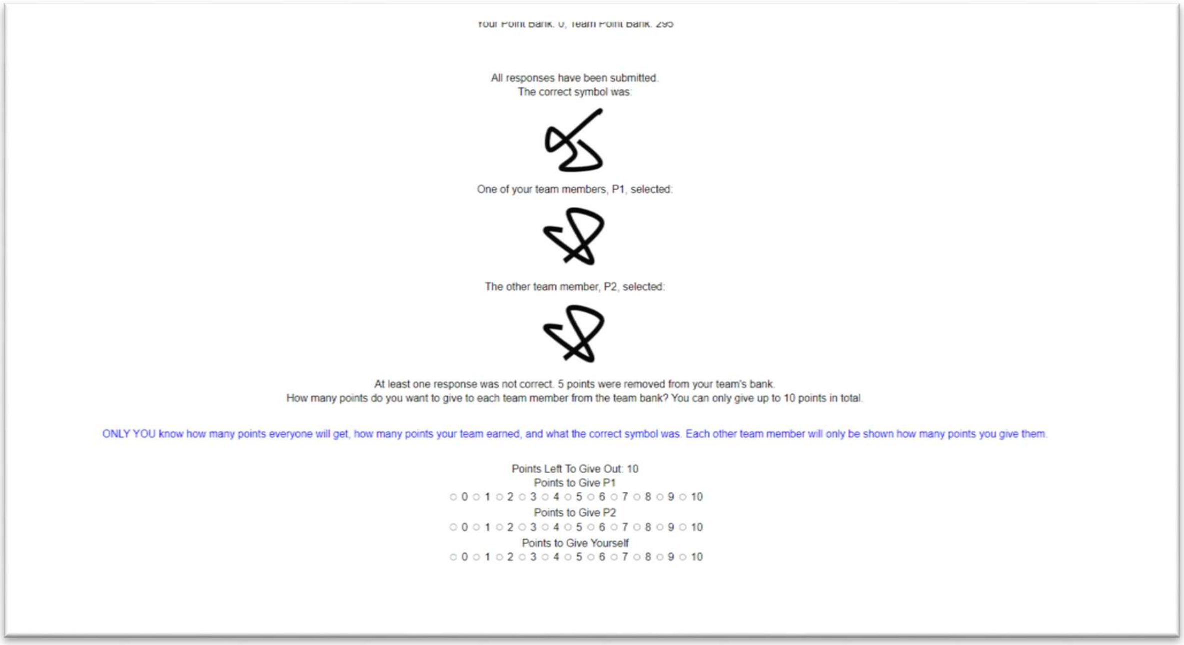

Figure 2.2. Screenshot of the allocator's screen during a Differential Contact trial. Corresponds to A in Figure 2.1.

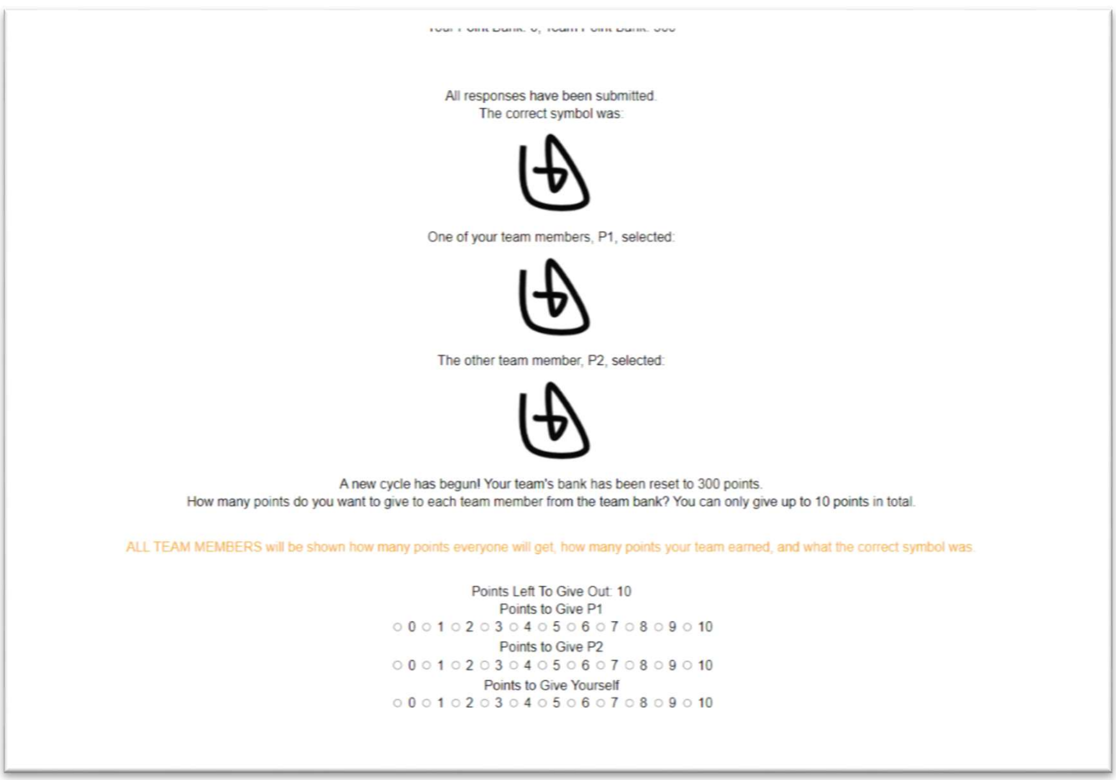

Figure 2.3. Screenshot of the allocator's screen during a Similar Contact trial. Corresponds to B in Figure 2.1.

Figure 2.4. Screenshot of a selector's screen during a Differential Contact trial. Corresponds to C in Figure 2.1.

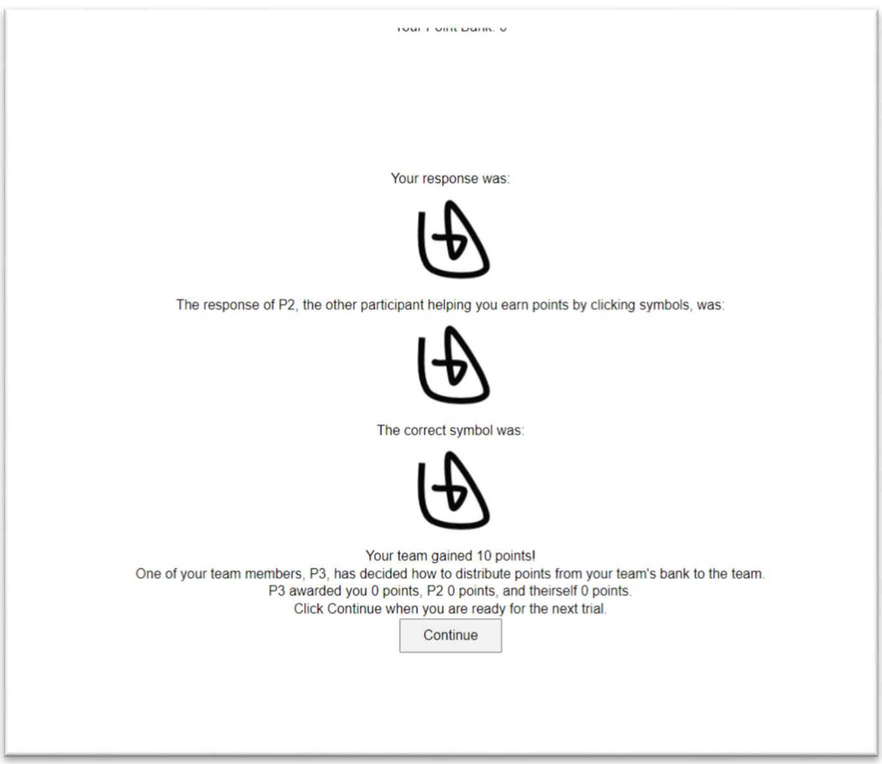

Figure 2.5. Screenshot of a selector's screen during a Similar Contact trial. Corresponds to D in Figure 2.1.

Table 2.2

Post-Questionnaire Questions

Question	Response Format	Response Options
1. What gender(s) do you identify with? Select all genders that you identify with.	Multiple Selection	Male, Female, Other (if Other, participants were required to type a response in a textbox)
2. What language(s) do you speak fluently? Select all the languages that you speak fluently.	Multiple Selection	English, French, Spanish, Portuguese, Italian, German, Russian, Mandarin, Cantonese, Japanese, Arabic, Other (If Other, participants were required to type a response in a textbox)
3. How many semesters of college have you completed?	Single Selection	0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, More than 10
4. What is your current GPA? If this is your first semester, please mark "NA".	Single Selection	NA, 0 to 0.49, 0.5 to 0.99, 1 to 1.49, 1.5 to 1.99, 2 to 2.49, 2.5 to 2.99, 3 to 3.49, 3.5 to 3.99, 4 or Higher
5. Did you have a strategy for earning points? If so, what was it?	Free Response	N/A
6. On a scale of 1 to 10, do you think points were allocated fairly? (1 = Not Fair At All, 10 = Very Fair)	Single Selection	1, 2, 3, 4, 5, 6, 7, 8, 9, 10
7. Consider one of your team members. On a scale of 1 to 10, how well do you know that team member? (1 = Not Well At All, 10 = Very Well)	Single Selection	1, 2, 3, 4, 5, 6, 7, 8, 9, 10
8. Now consider the other team members. On a scale of 1 to 10, how well do you know that team member? (1 = Not Well At All, 10 = Very Well)	Single Selection	1, 2, 3, 4, 5, 6, 7, 8, 9, 10
9. On a scale of 1 to 10, how important was it for you to earn money? (1 = Not Important At All, 10 = Very Important)	Single Selection	1, 2, 3, 4, 5, 6, 7, 8, 9, 10
10. On a scale of 1 to 10, how important was it for you that your other team members earned money? (1 = Not Important At All, 10 = Very Important)	Single Selection	1, 2, 3, 4, 5, 6, 7, 8, 9, 10

Table 2.3

Answers to Post-Questionnaire across All Triads

			Question									
Experiment	Triad	Participant	Age	1	2	3	4	6	7	8	9	10
	Triad 1	Selector 1	18	F	E+	4	NA	5	6	6	5	5
		Selector 2	19	F	E	2	3.5 to 3.99	5	1	1	1	5
		Allocator	47	F	E	6	2.5 to 2.99	5	1	1	1	10
	Triad 2	Selector 1	19	F	E+	3	2.5 to 2.99	2	1	1	1	1
		Selector 2	18	F	E+	0	NA	7	1	1	1	8
		Allocator	23	F	E	8	4 or >4	8	1	1	1	5
	Triad 3	Selector 1	18	M	E	0	3.5 to 3.99	6	1	1	7	4
		Selector 2	18	M	E	0	NA	8	4	4	8	7
		Allocator	18	F	E+	0	NA	7	1	1	7	7
	Triad 4	Selector 1	18	M	E+	0	NA	4	1	1	6	1
		Selector 2	18	F	E	1	8	10	1	1	1	10
		Allocator	18	F	E	5	2.5 to 2.99	10	1	1	3	3
	Triad 5	Selector 1	18	F	E	0	3 to 3.49	10	1	1	1	5
		Selector 2	22	F	E+	2	1.5 to 1.99	10	1	1	1	4
		Allocator	21	M	E	4	3 to 3.49	8	1	1	3	2
	Triad 6	Selector 1	18	F	E	0	2 to 2.49	10	1	1	1	1
		Selector 2	19	M	E	0	3 to 3.49	5	1	1	1	1
		Allocator	21	M	E+	4	2.5 to 2.99	1	1	1	8	5
	Triad 7	Selector 1	18	F	E	0	3 to 3.49	5	1	1	7	6
		Selector 2	18	F	E+	0	3.5 to 3.99	4	1	1	3	2
		Allocator	19	F	E	0	NA	3	1	1	8	8
	Triad 8	Selector 1	21	F	E	1	3.5 to 3.99	7	1	1	1	2
		Selector 2	20	F	E	2	3 to 3.49	8	1	1	3	5
		Allocator	18	F	E	0	NA	2	1	1	3	1
	Triad 9	Selector 1	18	M	E	0	NA	5	1	1	3	3
		Selector 2	18	F	E	0	3.5 to 3.99	7	1	1	5	4
		Allocator	19	F	E	3	3 to 3.49	10	1	1	5	5
	Triad 10	Selector 1	20	M	E	3	2 to 2.49	9	10	1	2	2
		Selector 2	18	M	E	1	3.5 to 3.99	8	10	1	5	5
		Allocator	19	M	E	1	1 to 1.49	8	1	1	5	10
	Triad 11	Selector 1	22	M	E	6	2.5 to 2.99	8	1	1	2	2
		Selector 2	33	F	E	10	3.5 to 3.99	5	1	1	1	7
		Allocator	20	F	E	3	2.5 to 2.99	5	1	1	2	2
	Triad 12	Selector 1	18	M	E	1	3.0 to 3.49	9	1	1	6	6
		Selector 2	20	M	E+	4	3.0 to 3.49	9	1	1	6	6
		Allocator	19	F	E+	1	2.5 to 2.99	10	1	1	7	9

M = Male, F = Female, NB = Non-Binary, E = English Only, E+ = English and at least one other language.
Refer to Table 2.2 for descriptions of each question. Responses for Question 5 are not included for brevity.

Table 2.4

Instructions Used in Experiment 1

Instructions for Selectors
In this task, you will be working with your team to earn points. You will earn points for your team each trial by clicking on symbols. Like you, one other participant, P2, will be clicking on symbols. The third participant, P3, will be deciding how to split points from your team's bank between the three of you. At the beginning, only P3 will be shown what symbol you are supposed to click. Which symbol you are supposed to click will change periodically throughout the task. When you and P2 both click the correct symbol, your team will earn points. When either of you click the wrong symbol, your team will lose points. The points your team earns will be put into a team bank and given to team members by P3. P3 may give you more points when you respond correctly or less points when you respond incorrectly, but how they allocate points is entirely up to them. Remember, points will be converted into money and given to you at the end of the study. If your team's bank ever runs out, the task is over, and no one will receive any money. If you complete the task, you will receive money based on how many points are in your personal bank. If you earn the most points on your team, you will also receive a $20 bonus. Do not talk over the course of the experiment. When the Continue button appears, click it to progress in the study.
Instructions for Allocators
In this task, you will be working with your team to earn points. Points for your team are earned and lost based on whether the other two participants, P1 and P2, select the correct symbol. If they do select the correct symbol, your team will earn points. If either do not, your team will lose points. Whether your team earns or loses points, you will get to decide how and whether each participant on your team gets any points from your team's bank. At first, only you are shown what the correct symbol is, which will change periodically throughout the task. You can use the points you do or do not give to the other participants to let them know when they have responded correctly or incorrectly, but how you allocate points each trial is entirely up to you. If your team bank ever runs out, the task is over and no one will receive any money. If you complete the task, you will receive money based on how many points are in your personal bank. If you earn the most points on your team, you will also receive a $20 bonus. Do not talk over the course of the experiment. When the Continue button appears, click it to progress in the study.

Text was displayed to participants using 20-point Arial font.

Table 2.5

Outcomes across Triads in Experiment 1

Triad	Conditions Completed	Earned $20 Bonus	DC 1 Trials	DC 2 Trials	SC 1 Trials	DC 3 Trials	SC 2 Trials	S1 Points	S2 Points	A Points
Triad 3	5	A	24	18	18	18	18	76	87	89
Triad 4	5	S1	36	31	28	27	22	110	87	91
Triad 5	1	-	36	26	-	-	-	161	145	108
Triad 6	0	-	25	-	-	-	-	73	73	74

S1 = Selector 2, S2 = Selector 2, A = Allocator, DC # = Differential Contact Iteration, SC = Similar Contact Iteration.

Table 2.6

Pearson Correlations between Trials and Points in the Team's Point Bank for Triad 3

Condition	Trial Range	Point Range	*r*	*n*	*p*
1. Differential Contact	1-24	212-300	-0.900	24	<.0001****
2. Differential Contact	25-42	277-307	-0.521	18	.027*
3. Similar Contact	43-60	258-300	0.082	18	.745
4. Differential Contact	61-78	291-320	0.439	18	.069
5. Similar Contact	79-96	300-334	0.783	18	.0001***

* = $p < .05$, *** = $p < .001$, **** = $p < .0001$

Table 2.7

t-tests of Mean Points Allocated During Stability Trials to the Allocator and Selectors across Conditions for Triad 3

Condition	Mean Points Allocated to Selectors (SD)	Mean Points Self-Allocated (SD)	*t*(*df*)	*p*
1. Differential Contact	1.056 (0.236)	0.917 (0.289)	1.446(28)	.159
2. Differential Contact	1.000 (0.000)	1.000 (0.000)	-[a]	-[a]
3. Similar Contact	1.667 (0.485)	1.400 (0.843)	1.069(26)	.295
4. Differential Contact	1.111 (0.323)	1.091 (0.302)	0.167(27)	.868
5. Similar Contact	1.944 (0.236)	1.800 (0.633)	0.876(26)	.389

[a]*t*-test could not be computed due to a lack of variance in each data set.

Table 2.8

Two-Way ANOVAs of Mean Points Allocated to Selectors 1 and 2 for Correct and Incorrect Selections across Conditions for Triad 3

Condition	Mean (SD)	Variable	SS	*df*	*F*	*p*
1. Differential Contact	S1 Correct: 1.111 (0.333)	Selectors	0.001	1	0.023	.881
	S2 Correct: 1.133 (0.352)	Selections	14.160	1	237.6	<.0001****
	S1 Incorrect: 0.000 (0.000)	Interaction	0.001	1	0.023	.881
	S2 Incorrect: 0.000 (0.000)	Within	2.622	44	-	-
2. Differential Contact[a]	S1 Correct: 1.000 (0.000)	Selectors	-	-	-	-
	S2 Correct: 1.000 (0.000)	Selections	-	-	-	-
	S1 Incorrect: 0.000 (0.000)	Interaction	-	-	-	-
	S2 Incorrect: 0.000 (0.000)	Within	-	-	-	-
3. Similar Contact	S1 Correct: 1.583 (0.515)	Selectors	0.006	1	0.034	.855
	S2 Correct: 1.636 (0.505)	Selections	21.42	1	125.4	<.0001****
	S1 Incorrect: 0.000 (0.000)	Interaction	0.006	1	0.034	.855
	S2 Incorrect: 0.000 (0.000)	Within	5.468	32	-	-
4. Differential Contact	S1 Correct: 1.167 (0.389)	Selectors	>0.000	1	0.003	.953
	S2 Correct: 1.154 (0.376)	Selections	10.22	1	110.6	<.0001****
	S1 Incorrect: 0.000 (0.000)	Interaction	>0.000	1	0.003	.953
	S2 Incorrect: 0.000 (0.000)	Within	2.959	32	-	-
5. Similar Contact	S1 Correct: 2.000 (0.000)	Selectors	0.036	1	0.669	.420
	S2 Correct: 1.857 (0.363)	Selections	26.03	1	486.3	<.0001****
	S1 Incorrect: 0.000 (0.000)	Interaction	0.036	1	0.669	.420
	S2 Incorrect: 0.000 (0.000)	Within	1.713	32	-	-

For Variable, selectors were either Selector 1 or 2. Selections were either correct or incorrect.
[a]Two-way ANOVA could not be computed due to a lack of variance in each data set.
**** = $p < .0001$

Table 2.9

Tukey's Multiple Comparisons for the Two-Way ANOVAs of Mean Points Allocated to Selectors 1 and 2 for Correct and Incorrect Selections across Conditions for Triad 3

Condition	P-Selection 1	P-Selection 2	Predicted (LS) Mean Difference[a]	95% CI of Mean Difference	*p*
1. Differential Contact	P1-Correct	P1-Incorrect	1.111	0.8727 to 1.349	<.0001****
	P2-Correct	P2-Incorrect	1.133	0.8947 to 1.371	<.0001****
3. Similar Contact	P1-Correct	P1-Incorrect	1.583	1.098 to 2.068	<.0001****
	P2-Correct	P2-Incorrect	1.636	1.167 to 2.105	<.0001****
4. Differential Contact	P1-Correct	P1-Incorrect	1.167	0.8103 to 1.524	<.0001****
	P2-Correct	P2-Incorrect	1.154	0.7785 to 1.529	<.0001****
5. Differential Contact	P1-Correct	P1-Incorrect	2.000	1.729 to 2.271	<.0001****
	P2-Correct	P2-Incorrect	1.857	1.549 to 2.165	<.0001****

[a]Predicted values are reported because means, standard deviation, and sample size were used to compute tests. **** = $p < .0001$

Table 2.10

t-tests of Mean Points Self-Allocated on Trials in which Points Were Added to or Removed from the Team's Point Bank for Triad 3

Condition	Mean Points Self-Allocated on Point Gaining Trials (SD)	Mean Points Self-Allocated on Point Losing Trials (SD)	*t*(*df*)	*p*
1. Differential Contact	1.000 (0.000)	0.611 (0.502)	1.871(22)	.075
2. Differential Contact	1.000 (0.000)	0.500 (0.527)	2.667(16)	0.017*
3. Similar Contact	1.778 (0.441)	0.222 (0.441)	7.483(16)	<.0001****
4. Differential Contact	1.200 (0.423)	0.625 (0.518)	2.601(16)	0.019*
5. Similar Contact	2.000 (0.000)	0.000 (0.000)	-[a]	-[a]

[a]*t*-test could not be computed due to a lack of variance in each data set.
* = $p < .05$, **** = $p < .0001$

Table 2.11

t-tests of Mean Points Self-Allocated on Trials in which Points Were Added to or Removed from the Team's Point Bank for Triad 3

Conditions	Trial Type	Mean Points Self-Allocated in the Differential Contact Condition (SD)	Mean Points Self-Allocated in the Similar Contact Condition (SD)	*t*(*df*)	*p*
2. Differential Contact & 3. Similar Contact	Point Gaining	1.000 (0.000)	1.778 (0.441)	4.971(15)	.0002***
	Point Losing	0.500 (0.527)	0.222 (0.441)	1.238(17)	.233
4. Differential Contact & 5. Similar Contact	Point Gaining	1.200 (0.423)	2.000 (0.000)	6.606(20)	<.0001****
	Point Losing	0.625 (0.518)	0.000 (0.000)	2.928(12)	.013*

* = $p < .05$, *** = $p < .001$, **** = $p < .0001$

Table 2.12

Pearson Correlations between Trials and Points in the Team's Point Bank for Triad 4

Condition	Trial Range	Point Range	*r*	*n*	*p*
1. Differential Contact	1-36	98-300	-0.962	36	<.0001****
2. Differential Contact	37-67	133-300	-0.992	31	. <.0001****
3. Similar Contact	68-95	211-300	-0.968	28	<.0001****
4. Differential Contact	96-122	205-300	-0.439	27	<.0001****
5. Similar Contact	123-144	203-309	-0.783	22	<.0001****

**** = $p < .0001$

Table 2.13

t-tests of Mean Points Allocated During Stability Trials to the Allocator and Selectors across Conditions for Triad 4

Condition	Mean Points Allocated to Selectors (SD)	Mean Points Self-Allocated (SD)	*t*(*df*)	*p*
1. Differential Contact	0.111 (0.323)	0.000 (0.000)	1.327(31)	.194
2. Differential Contact	0.278 (0.752)	0.177 (0.728)	0.405(33)	.688
3. Similar Contact	1.000 (0.000)	0.539 (0.519)	3.799(29)	.0007***
4. Differential Contact	1.667 (0.686)	1.000 (1.080)	2.103(29)	.044*
5. Similar Contact	1.333 (0.767)	1.467 (2.560)	0.211(31)	.835

* = $p < .05$, *** = $p < .001$

Table 2.14

Two-Way ANOVAs of Mean Points Allocated to Selectors 1 and 2 for Correct and Incorrect Selections across Conditions for Triad 4

Condition	Mean (SD)	Variable	SS	*df*	*F*	*p*
1. Differential Contact	S1 Correct: 0.917 (1.564)	Selectors	0.001	1	>0.000	.979
	S2 Correct: 0.929 (1.542)	Selections	2.376	1	1.700	.197
	S1 Incorrect: 0.542 (1.141)	Interaction	>0.000	1	>0.000	.989
	S2 Incorrect: 0.546 (1.224)	Within	95.07	68	-	-
2. Differential Contact	S1 Correct: 0.500 (0.905)	Selectors	0.033	1	0.051	.822
	S2 Correct: 0.444 (1.014)	Selections	0.433	1	0.666	.418
	S1 Incorrect: 0.316 (0.749)	Interaction	0.001	1	0.001	.977
	S2 Incorrect: 0.273 (0.703)	Within	37.69	58	-	-
3. Similar Contact	S1 Correct: 1.000 (0.000)	Selectors	0.022	1	1.272	.265
	S2 Correct: 1.000 (0.000)	Selections	11.87	1	673	<.0001****
	S1 Incorrect: 0.083 (0.289)	Interaction	0.022	1	1.272	.265
	S2 Incorrect: 0.000 (0.000)	Within	0.917	52	-	-
4. Differential Contact	S1 Correct: 1.333 (0.594)	Selectors	0.149	1	0.275	.602
	S2 Correct: 1.667 (0.707)	Selections	17.93	1	33.06	<.0001****
	S1 Incorrect: 0.333 (1.000)	Interaction	0.594	1	1.096	.300
	S2 Incorrect: 0.222 (0.732)	Within	27.11	50	-	-
5. Similar Contact	S1 Correct: 1.250 (0.683)	Selectors	0.205	1	0.694	.410
	S2 Correct: 1.556 (0.7727)	Selections	17.23	1	58.35	<.0001****
	S1 Incorrect: 0.000 (0.000)	Interaction	0.205	1	0.694	.410
	S2 Incorrect: 0.000 (0.000)	Within	11.22	38	-	-

For Variable, selectors were either Selector 1 or 2 and selections were either correct or incorrect.
One trial for an incorrect selection by each selector in which they were allocated 10 points was removed in the second Similar Contact condition.
**** = $p < .0001$

Table 2.15

Tukey's Multiple Comparisons for the Two-Way ANOVAs of Mean Points Allocated to Selectors 1 and 2 for Correct and Incorrect Selections across Conditions for Triad 4

Condition	P-Selection 1	P-Selection 2	Predicted (LS) Mean Difference[a]	95% CI of Mean Difference	*p*
3. Similar Contact	P1-Correct	P1-Incorrect	0.917	0.8.00 to 1.033	<.0001****
	P2-Correct	P2-Incorrect	1.000	0.876 to 1.124	<.0001****
4. Differential Contact	P1-Correct	P1-Incorrect	1.000	0.307 to 1.693	.003**
	P2-Correct	P2-Incorrect	1.445	0.752 to 2.138	<.0001****
5. Differential Contact	P1-Correct	P1-Incorrect	1.250	0.602 to 1.898	.0001***
	P2-Correct	P2-Incorrect	1.556	0.998 to 2.114	<.0001****

[a]Predicted values are reported because means, standard deviation, and sample size were used to compute tests.
** = $p < .01$, **** = $p < .001$, **** = $p < .0001$

Table 2.16

t-tests of Mean Points Self-Allocated on Trials in which Points Were Added to or Removed from the Team's Point Bank for Triad 4

Condition	Mean Points Self-Allocated on Point Gaining Trials (SD)	Mean Points Self-Allocated on Point Losing Trials (SD)	*t*(*df*)	*p*
1. Differential Contact	1.000 (2.000)	0.594 (1.214)	0.588(34)	.561
2. Differential Contact	0.000 (0.000)	0.333 (0.802)	0.409(29)	.686
3. Similar Contact	1.000 (0.000)	0.273 (0.456)	3.854(26)	.001**
4. Differential Contact	1.857 (0.690)	0.400 (0.754)	4.489(25)	.0001***
5. Similar Contact	2.000 (0.000)	0.200 (0.414)	10.48(19)	<.0001****

** = $p < .01$, *** = $p < .001$, **** = $p < .0001$

Table 2.17

t-tests of Mean Points Self-Allocated on Trials in which Points Were Added to or Removed from the Team's Point Bank for Triad 4

Conditions	Trial Type	Mean Points Self-Allocated in the Differential Contact Condition (SD)	Mean Points Self-Allocated in the Similar Contact Condition (SD)	*t*(*df*)	*p*
2. Differential Contact & 3. Similar Contact	Point Gaining	0.000 (0.000)	1.000 (0.000)	-[a]	-[a]
	Point Losing	0.333 (0.802)	0.273 (0.456)	0.318(50)	.752
4. Differential Contact & 5. Similar Contact	Point Gaining	1.857 (0.690)	2.000 (0.000)	0.504(11)	.624
	Point Losing	0.400 (0.754)	0.200 (0.414)	0.926(33)	.361

[a] *t*-test could not be computed due to a lack of variance in each data set.

Table 2.18

Instructions Used in Experiment 2

Instructions for Selectors
In this task, you will be working with your team to earn points. You will earn points for your team each trial by clicking on symbols. Like you, one other participant, P2, will be clicking on symbols. The third participant, P3, will be deciding how to split points from your team's bank between the three of you. At the beginning, only P3 will be shown what symbol you are supposed to click. Which symbol you are supposed to click will change periodically throughout the task. When you and P2 both click the correct symbol, your team will earn points. When either of you click the wrong symbol, your team will lose points. The points your team earns will be put into a team bank and given to team members by P3. P3 may give you more points when you respond correctly or less points when you respond incorrectly, but how they allocate points is entirely up to them. Remember, points will be converted into money and given to you at the end of the study. If your team's bank ever runs out, the task is over, and no one will receive any money. If you complete the task, you will receive money based on how many points are in your personal bank. If you earn the most points on your team, you will also receive a $20 bonus. During the task, you can view these instructions again by hovering your mouse over the question mark on your screen. Do not talk over the course of the experiment. When the Continue button appears, click it to progress in the study.
Instructions for Allocators
In this task, you will be working with your team to earn points. Points for your team are earned and lost based on whether the other two participants, P1 and P2, select the correct symbol. If they do select the correct symbol, your team will earn points. If either do not, your team will lose points. Whether your team earns or loses points, you will get to decide how and whether each participant on your team gets any points from your team’s bank. At first, only you are shown what the correct symbol is, which will change periodically throughout the task. You can use the points you do or do not give to the other participants to let them know when they have responded correctly or incorrectly, but how you allocate points each trial is entirely up to you. If your team bank ever runs out, the task is over and no one will receive any money. If you complete the task, you will receive money based on how many points are in your personal bank. If you earn the most points on your team, you will also receive a $20 bonus. During the task, you can view these instructions again by hovering your mouse over the question mark on your screen. Do not talk over the course of the experiment. When the Continue button appears, click it to progress in the study.

Text was displayed to participants using 20-point Arial font.

Table 2.19

Outcomes across Triads in Experiment 2

Triad	Conditions Completed	Earned $20 Bonus	DC 1 Trials	DC 2 Trials	SC 1 Trials	DC 3 Trials	SC 2 Trials	S1 Points	S2 Points	A Points
Triad 7	5	A	36	28	24	18	18	182	164	243
Triad 8	0	-	30	-	-	-	-	54	78	140
Triad 9	0	-	35	-	-	-	-	25	100	75

S1 = Selector 2, S2 = Selector 2, A = Allocator, DC #= Differential Contact Iteration, SC = Similar Contact Iteration.

Table 2.20

Pearson Correlations between Trials and Points in the Team's Point Bank for Triad 7

Condition	Trial Range	Point Range	*r*	*n*	*p*
1. Differential Contact	1-36	22-300	-0.985	36	<.0001****
2. Differential Contact	37-64	164-300	-0.990	28	. <.0001****
3. Similar Contact	65-88	199-300	-0.958	24	<.0001****
4. Differential Contact	89-106	234-300	-0.928	18	<.0001****
5. Similar Contact	107-124	272-303	-0.853	18	<.0001****

**** = $p < .0001$

Table 2.21

t-tests of Mean Points Allocated During Stability Trials to the Allocator and Selectors across Conditions for Triad 7

Condition	Mean Points Allocated to Selectors (SD)	Mean Points Self-Allocated (SD)	*t*(*df*)	*p*
1. Differential Contact	2.167 (1.505)	1.563 (1.365)	1.220(32)	.231
2. Differential Contact	2.556 (1.504)	0.929 (1.072)	3.423(30)	.002**
3. Similar Contact	3.444 (1.097)	1.800 (1.135)	3.756(26)	.0009***
4. Differential Contact	2.778 (0.647)	2.727 (0.647)	0.204(27)	.840
5. Similar Contact	2.778 (0.647)	2.500 (1.080)	0.856(26)	.400

** = $p < .01$, *** = $p < .001$

Table 2.22

Two-Way ANOVAs of Mean Points Allocated to Selectors 1 and 2 for Correct and Incorrect Selections across Conditions for Triad 7

Condition	Mean (SD)	Variable	SS	*df*	*F*	*p*
1. Differential Contact	S1 Correct: 2.750 (1.603)	Selectors	0.271	1	0.238	.628
	S2 Correct: 2.889 (1.537)	Selections	88.41	1	77.56	<.0001****
	S1 Incorrect: 0.208 (0.658)	Interaction	0.417	1	0.365	.547
	S2 Incorrect: 0.240 (0.723)	Within	77.52	68	-	-
2. Differential Contact	S1 Correct: 2.154 (1.573)	Selectors	1.758	1	1.881	.176
	S2 Correct: 2.889 (1.537)	Selections	82.75	1	88.56	<.0001****
	S1 Incorrect: 0.000 (0.000)	Interaction	1.758	1	1.881	.176
	S2 Incorrect: 0.000 (0.000)	Within	48.59	52	-	-
3. Similar Contact	S1 Correct: 2.353 (1.455)	Selectors	1.923	1	1.710	.198
	S2 Correct: 3.200 (1.317)	Selections	82.65	1	73.49	<.0001****
	S1 Incorrect: 0.000 (0.000)	Interaction	1.923	1	1.710	.198
	S2 Incorrect: 0.000 (0.000)	Within	49.48	44	-	-
4. Differential Contact	S1 Correct: 2.538 (0.877)	Selectors	0.425	1	1.474	0.234
	S2 Correct: 3.000 (0.000)	Selections	61.1	1	211.8	<.0001****
	S1 Incorrect: 0.000 (0.000)	Interaction	0.425	1	1.474	0.234
	S2 Incorrect: 0.000 (0.000)	Within	9.232	32	-	-
5. Similar Contact	S1 Correct: 2.867 (0.516)	Selectors	0.000	1	0.000	>.999
	S2 Correct: 2.867 (0.516)	Selections	41.1	1	176.1	<.0001****
	S1 Incorrect: 0.000 (0.000)	Interaction	0.000	1	0.000	>.999
	S2 Incorrect: 0.000 (0.000)	Within	7.467	32	-	-

For Variable, selectors were either Selector 1 or 2 and selections were either correct or incorrect.
**** = $p < .0001$

Table 2.23

Tukey's Multiple Comparisons for the Two-Way ANOVAs of Mean Points Allocated to Selectors 1 and 2 for Correct and Incorrect Selections across Conditions for Triad 7

Condition	P-Selection 1	P-Selection 2	Predicted (LS) Mean Difference[a]	95% CI of Mean Difference	*p*
1. Differential	P1-Correct	P1-Incorrect	2.542	1.678 to 3.405	<.0001****
Contact	P2-Correct	P2-Incorrect	2.215	1.332 to 3.098	<.0001****
1. Differential	P1-Correct	P1-Incorrect	2.154	1.310 to 2.998	<.0001****
Contact	P2-Correct	P2-Incorrect	2.889	1.988 to 3.790	<.0001****
3. Similar	P1-Correct	P1-Incorrect	2.353	1.250 to 3.456	<.0001****
Contact	P2-Correct	P2-Incorrect	3.200	2.183 to 4.217	<.0001****
4. Differential	P1-Correct	P1-Incorrect	2.538	1.875 to 3.201	<.0001****
Contact	P2-Correct	P2-Incorrect	3.000	2.402 to 3.598	<.0001****
5. Similar	P1-Correct	P1-Incorrect	2.867	2.150 to 3.584	<.0001****
Contact	P2-Correct	P2-Incorrect	2.867	2.150 to 3.584	<.0001****

[a]Predicted values are reported because means, standard deviation, and sample size were used to compute tests. **** = $p < .0001$

Table 2.24

t-tests of Mean Points Self-Allocated on Trials in which Points Were Added to or Removed from the Team's Point Bank for Triad 7

Condition	Mean Points Self-Allocated on Point Gaining Trials (SD)	Mean Points Self-Allocated on Point Losing Trials (SD)	*t*(*df*)	*p*
1. Differential Contact	2.000 (0.000)	2.000 (2.500)	0.000(34)	>.999
2. Differential Contact	1.800 (1.095)	0.609 (0.656)	3.258(26)	.003**
3. Similar Contact	2.125 (0.991)	1.250 (1.342)	1.628(22)	.118
4. Differential Contact	3.000 (0.000)	3.500 (1.852)	0.861(16)	.402
5. Similar Contact	3.000 (0.000)	2.750 (2.630)	0.387(16)	.704

** = $p < .01$

Table 2.25

t-tests of Points Self-Allocated on Trials in which Points Were Added to or Removed from the Team's Point Bank for Triad 7

Conditions	Trial Type	Mean Points Self-Allocated in the Differential Contact Condition (SD)	Mean Points Self-Allocated in the Similar Contact Condition (SD)	*t*(*df*)	*p*
2. Differential Contact & 3. Similar Contact	Point Gaining	1.800 (1.095)	2.125 (0.991)	0.553(11)	.591
	Point Losing	0.609 (0.656)	1.250 (1.342)	1.984(37)	.055
4. Differential Contact & 5. Similar Contact	Point Gaining	3.000 (0.000)	3.000 (0.000)	-[a]	-[a]
	Point Losing	3.500 (1.852)	2.750 (2.630)	0.579(10)	.575

[a]*t*-test could not be computed due to a lack of variance in each data set.

Table 2.26

Instructions Used in Experiment 3

Instructions for Selectors
In this task, you will be working with your team to earn points. You will earn points for your team each trial by clicking on symbols. Like you, one other participant, P2, will be clicking on symbols. The third participant, P3, will be deciding how to split points from your team's bank between the three of you. At the beginning, only P3 will be shown what symbol you are supposed to click. Which symbol you are supposed to click will change periodically throughout the task. When you and P2 both click the correct symbol, your team will earn points. When either of you click the wrong symbol, your team will lose points. The points your team earns will be put into a team bank and given to team members by P3. P3 may give you more points when you respond correctly or less points when you respond incorrectly, but how they allocate points is entirely up to them. Remember, points will be converted into money and given to you at the end of the study. If your team's bank ever runs out, the task is over, and no one will receive any money. If you complete the task, you will receive money based on how many points are in your personal bank. If you earn the most points on your team, you will also receive a $20 bonus. Remember, the amount of SONA you earn also depends on how long you participate in the study. If the study ends early because your team's bank runs out of points, you will receive less than the full amount of SONA credit. During the task, you can view these instructions again by hovering your mouse over the question mark on your screen. Do not talk over the course of the experiment. When the Continue button appears, click it to progress in the study.
Instructions for Allocators
In this task, you will be working with your team to earn points. Points for your team are earned and lost based on whether the other two participants, P1 and P2, select the correct symbol. If they do select the correct symbol, your team will earn points. If either do not, your team will lose points. Whether your team earns or loses points, you will get to decide how and whether each participant on your team gets any points from your team’s bank. At first, only you are shown what the correct symbol is, which will change periodically throughout the task. You can use the points you do or do not give to the other participants to let them know when they have responded correctly or incorrectly, but how you allocate points each trial is entirely up to you. If your team bank ever runs out, the task is over and no one will receive any money. If you complete the task, you will receive money based on how many points are in your personal bank. If you earn the most points on your team, you will also receive a $20 bonus. Remember, the amount of SONA you earn also depends on how long you participate in the study. If the study ends early because your team's bank runs out of points, you will receive less than the full amount of SONA credit. During the task, you can view these instructions again by hovering your mouse over the question mark on your screen. Do not talk over the course of the experiment. When the Continue button appears, click it to progress in the study.

Text was displayed to participants using 20-point Arial font.

Table 2.27

Outcomes across Triads in Experiment 3

Triad	Conditions Completed	Earned $20 Bonus	DC 1 Trials	DC 2 Trials	SC 1 Trials	DC 3 Trials	SC 2 Trials	S1 Points	S2 Points	A Points
Triad 10	5	S1	36	24	18	18	18	373	271	142
Triad 11	5	S2	18	20	20	18	18	239	247	223
Triad 12	5	S2	36	23	18	19	18	110	112	95

S1 = Selector 2, S2 = Selector 2, A = Allocator, DC #= Differential Contact Iteration, SC = Similar Contact Iteration.

Table 2.28

Pearson Correlations between Trials and Points in the Team's Point Bank for Triad 10

Condition	Trial Range	Point Range	*r*	*n*	*p*
1. Differential Contact	1-36	74-300	-0.960	36	<.0001****
2. Differential Contact	37-60	125-300	-0.993	24	<.0001****
3. Similar Contact	61-78	230-300	-0.936	18	<.0001****
4. Differential Contact	79-96	205-300	-0.956	18	<.0001****
5. Similar Contact	97-114	255-300	-0.946	18	<.0001****

**** = $p < .0001$

Table 2.29

t-tests of Mean Points Allocated During Stability Trials to the Allocator and Selectors across Conditions for Triad 10

Condition	Mean Points Allocated to Selectors (SD)	Mean Points Self-Allocated (SD)	*t*(*df*)	*p*
1. Differential Contact	2.176 (1.741)	0.143 (0.363)	4.6283(29)	<.0002***
2. Differential Contact	4.222 (1.003)	0.000 (0.000)	16.80(32)	<.0001****
3. Similar Contact	5.000 (0.000)	0.000 (0.000)	-[a]	-[a]
4. Differential Contact	5.278 (1.179)	0.000 (0.000)	14.04(26)	<.0001****
5. Similar Contact	5.000 (0.000)	0.000 (0.000)	-[a]	-[a]

[a]*t*-test could not be computed due to a lack of variance in each data set.
*** = $p < .001$, **** = $p < .0001$

Table 2.30

Two-Way ANOVAs of Mean Points Allocated to Selectors 1 and 2 for Correct and Incorrect Selections across Conditions for Triad 10

Condition	Mean (SD)	Variable	SS	*df*	*F*	*p*
1. Differential Contact	S1 Correct: 2.893 (2.283)	Selectors	0.002	1	0.001	.980
	S2 Correct: 3.333 (1.871)	Selections	104.8	1	40.10	<.0001****
	S1 Incorrect: 0.500 (1.069)	Interaction	2.640	1	1.010	.318
	S2 Incorrect: 0.037 (0.193)	Within	177.7	68	-	-
2. Differential Contact	S1 Correct: 3.778 (1.003)	Selectors	3.733	1	9.605	.003**
	S2 Correct: 5.000 (0.000)	Selections	192.6	1	495.6	<.0001****
	S1 Incorrect: 0.000 (0.000)	Interaction	3.733	1	9.605	.003**
	S2 Incorrect: 0.000 (0.000)	Within	17.10	44	-	-
3. Similar Contact[a]	S1 Correct: 5.000 (0.000)	Selectors	-	-	-	-
	S2 Correct: 5.000 (0.000)	Selections	-	-	-	-
	S1 Incorrect: 0.000 (0.000)	Interaction	-	-	-	-
	S2 Incorrect: 0.000 (0.000)	Within	-	-	-	-
4. Differential Contact	S1 Correct: 5.333 (1.291)	Selectors	1.895	1	1.027	.113
	S2 Correct: 5.000 (0.000)	Selections	125.1	1	67.78	<.0001****
	S1 Incorrect: 0.000 (0.000)	Interaction	4.899	1	21654	.319
	S2 Incorrect: 1.429 (2.44)	Within	59.06	32	-	-
5. Similar Contact[a]	S1 Correct: 5.000 (0.000)	Selectors	-	-	-	-
	S2 Correct: 5.000 (0.000)	Selections	-	-	-	-
	S1 Incorrect: 0.000 (0.000)	Interaction	-	-	-	-
	S2 Incorrect: 0.000 (0.000)	Within	-	-	-	-

[a]Two-way ANOVA could not be computed due to a lack of variance in each data set.
For Variable, selectors were either Selector 1 or 2 and selections were either correct or incorrect.
** = $p < .01$, **** = $p < .0001$

Table 2.31

Tukey's Multiple Comparisons for the Two-Way ANOVAs of Mean Points Allocated to Selectors 1 and 2 for Correct and Incorrect Selections across Conditions for Triad 10

Condition	P-Selection 1	P-Selection 2	Predicted (LS) Mean Difference[a]	95% CI of Mean Difference	*p*
1. Differential Contact	P1-Correct	P1-Incorrect	2.393	0.911 to 3.875	.0009***
	P2-Correct	P2-Incorrect	3.296	1.873 to 4.719	<.0001****
2. Differential Contact	P1-Correct	P1-Incorrect	3.778	2.968 to 4.588	<.0001****
	P1-Correct	P2-Correct	-1.222	-1.923 to -0.521	.0001***
	P1-Correct	P2-Incorrect	3.778	3.178 to 4.378	<.0001****
	P1-Incorrect	P2-Correct	-5.000	-5.905 to -4.095	<.0001****
	P1-Incorrect	P2-Incorrect	0.000	-0.830 to 0.830	>.999
	P2-Correct	P2-Incorrect	5.000	4.276 to 5.724	<.0001****
4. Differential Contact	P1-Correct	P1-Incorrect	5.333	3.317 to 7.349	<.0001****
	P2-Correct	P2-Incorrect	3.571	2.030 to 5.112	<.0001****

[a]Predicted values are reported because means, standard deviation, and sample size were used to compute tests. *** = $p < .001$, **** = $p < .0001$

Table 2.32

t-tests of Mean Points Self-Allocated on Trials in which Points Were Added to or Removed from the Team's Point Bank for Triad 10

Condition	Mean Points Self-Allocated on Point Gaining Trials (SD)	Mean Points Self-Allocated on Point Losing Trials (SD)	*t*(*df*)	*p*
1. Differential Contact	0.286 (.0488)	1.207 (2.455)	0.978(34)	.335
2. Differential Contact	0.000 (0.000)	1.389 (3.346)	1.002(22)	.327
3. Similar Contact	0.000 (0.000)	3.125 (3.720)	2.677(16)	.017*
4. Differential Contact	0.000 (0.000)	3.571 (4.756)	2.536(16)	.022*
5. Similar Contact	0.000 (0.000)	10.000 (0.000)	-[a]	-[a]

[a]*t*-test could not be computed due to a lack of variance in each data set.

* = $p < .05$

Table 2.33

t-tests of Mean Points Self-Allocated on Trials in which Points Were Added to or Removed from the Team's Point Bank for Triad 10

Conditions	Trial Type	Mean Points Self-Allocated in the Differential Contact Condition (SD)	Mean Points Self-Allocated in the Similar Contact Condition (SD)	*t*(*df*)	*p*
2. Differential Contact & 3. Similar Contact	Point Gaining	0.000 (0.000)	0.000 (0.000)	-[a]	-[a]
	Point Losing	1.389 (3.346)	3.125 (3.720)	1.181(24)	.249
4. Differential Contact & 5. Similar Contact	Point Gaining	0.000 (0.000)	0.000 (0.000)	-[a]	-[a]
	Point Losing	3.571 (4.756)	10.000 (0.000)	2.262(8)	.054

[a]*t*-test could not be computed due to a lack of variance in each data set.

Table 2.34

Pearson Correlations between Trials and Points in the Team's Point Bank for Triad 11

Condition	Trial Range	Point Range	*r*	*n*	*p*
1. Differential Contact	1-18	227-301	-0.913	18	<.0001****
2. Differential Contact	19-38	205-300	-0.956	20	<.0001****
3. Similar Contact	39-58	282-307	-0.810	20	<.0001****
4. Differential Contact	59-76	235-307	-0.928	18	<.0001****
5. Similar Contact	77-94	269-300	-0.654	18	.003**

** = $p < .01$, **** = $p < .0001$

Table 2.35

t-tests of Mean Points Allocated During Stability Trials to the Allocator and Selectors across Conditions for Triad 11

Condition	Mean Points Allocated to Selectors (SD)	Mean Points Self-Allocated (SD)	*t*(*df*)	*p*
1. Differential Contact	4.500 (0.985)	0.364 (0.505)	12.87(27)	<.0001****
2. Differential Contact	3.500 (1.425)	1.643 (1.277)	3.824(30)	.0006***
3. Similar Contact	3.167 (0.384)	3.000 (0.500)	0.962(25)	.345
4. Differential Contact	3.000 (0.000)	3.889 (0.333)	11.55(25)	<.0001****
5. Similar Contact	3.000 (0.000)	3.000 (0.000)	-[a]	-[a]

[a]*t*-test could not be computed due to a lack of variance in each data set.
*** = $p < .001$, **** = $p < .0001$

Table 2.36

Two-Way ANOVAs of Mean Points Allocated to Selectors 1 and 2 for Correct and Incorrect Selections across Conditions for Triad 11

Condition	Mean (SD)	Variable	SS	*df*	*F*	*p*
1. Differential Contact	S1 Correct: 4.636 (0.809)	Selectors	0.048	1	0.055	.817
	S2 Correct: 4.308 (1.109)	Selections	122.7	1	139.1	<.0001****
	S1 Incorrect: 0.429 (0.797)	Interaction	0.488	1	0.554	.462
	S2 Incorrect: 0.600 (0.894)	Within	28.22	32	-	-
2. Differential Contact	S1 Correct: 4.100 (1.197)	Selectors	0.506	1	0.397	.533
	S2 Correct: 3.429 (1.505)	Selections	103.4	1	80.99	<.0001****
	S1 Incorrect: 0.300 (0.483)	Interaction	1.732	1	1.357	.252
	S2 Incorrect: 0.500 (0.548)	Within	45.94	36	-	-
3. Similar Contact	S1 Correct: 3.188 (0.544)	Selectors	0.006	1	0.016	.900
	S2 Correct: 3.125 (0.500)	Selections	17.56	1	44.56	<.0001****
	S1 Incorrect: 1.500 (1.291)	Interaction	0.006	1	0.016	.900
	S2 Incorrect: 1.500 (0.577)	Within	14.19	36	-	-
4. Differential Contact	S1 Correct: 2.846 (0.376)	Selectors	0.011	1	0.044	.834
	S2 Correct: 2.714 (0.611)	Selections	43.64	1	172.4	<.0001****
	S1 Incorrect: 0.200 (0.447)	Interaction	0.055	1	0.219	0.643
	S2 Incorrect: 0.250 (0.500)	Within	8.098	32	-	-
5. Similar Contact	S1 Correct: 3.000 (0.000)	Selectors	0.154	1	7.390	.011*
	S2 Correct: 3.000 (0.000)	Selections	44.51	1	2136	<.0001****
	S1 Incorrect: 0.333 (0.577)	Interaction	0.154	1	7.390	.011*
	S2 Incorrect: 0.000 (0.00)	Within	0.667	32	-	-

For Variable, selectors were either Selector 1 or 2 and selections were either correct or incorrect.
$^{*} = p < .05$, $^{****} = p < .0001$

Table 2.37

Tukey's Multiple Comparisons for the Two-Way ANOVAs of Mean Points Allocated to Selectors 1 and 2 for Correct and Incorrect Selections across Conditions for Triad 11

Condition	P-Selection 1	P-Selection 2	Predicted (LS) Mean Difference[a]	95% CI of Mean Difference	*p*
1. Differential	P1-Correct	P1-Incorrect	4.207	3.142 to 5.273	<.0001****
Contact	P2-Correct	P2-Incorrect	3.708	2.549 to 4.867	<.0001****
2. Differential	P1-Correct	P1-Incorrect	3.800	2.621 to 4.979	<.0001****
Contact	P2-Correct	P2-Incorrect	2.929	1.643 to 4.215	<.0001****
3. Similar	P1-Correct	P1-Incorrect	1.688	0.8691 to 2.507	<.0001****
Contact	P2-Correct	P2-Incorrect	1.625	0.8061 to 2.444	<.0001****
4. Differential	P1-Correct	P1-Incorrect	2.646	2.025 to 3.267	<.0001****
Contact	P2-Correct	P2-Incorrect	2.464	1.795 to 3.133	<.0001****
5. Similar	P1-Correct	P1-Incorrect			
Contact			2.667	2.452 to 2.881	<.0001****
Contact	P2-Correct	P2-Incorrect	3.000	2.808 to 3.192	<.0001****

[a]Predicted values are reported because means, standard deviation, and sample size were used to compute tests. **** = $p < .0001$

Table 2.38

t-tests of Mean Points Self-Allocated on Trials in which Points Were Added to or Removed from the Team's Point Bank for Triad 11

Condition	Mean Points Self-Allocated on Point Gaining Trials (SD)	Mean Points Self-Allocated on Point Losing Trials (SD)	*t*(*df*)	*p*
1. Differential Contact	0.000 (0.000)	0.889 (0.333)	8.000(16)	<.0001****
2. Differential Contact	0.750 (1.035)	2.000 (1.044)	2.631(18)	.017*
3. Similar Contact	2.813 (0.544)	3.250 (1.708)	0.914(18)	.373
4. Differential Contact	4.083 (0.669)	4.000 (2.191)	0.903(16)	.903
5. Similar Contact	3.000 (0.000)	3.000 (0.000)	-[s]	-[s]

[a]*t*-test could not be computed due to a lack of variance in each data set.
* = $p < .05$, **** = $p < .0001$

Table 2.39

t-tests of Mean Points Self-Allocated on Trials in which Points Were Added to or Removed from the Team's Point Bank for Triad 11

Conditions	Trial Type	Mean Points Self-Allocated in the Differential Contact Condition (SD)	Mean Points Self-Allocated in the Similar Contact Condition (SD)	*t*(*df*)	*p*
2. Differential Contact & 3. Similar Contact	Point Gaining	0.750 (1.035)	2.813 (0.544)	6.466(22)	<.0001****
	Point Losing	2.000 (1.044)	3.250 (1.708)	1.1178(14)	.097
4. Differential Contact & 5. Similar Contact	Point Gaining	4.083 (0.669)	3.000 (0.000)	6.084(24)	<.0001****
	Point Losing	4.000 (2.191)	3.000 (0.000)	0.894	.397

[a]*t*-test could not be computed due to a lack of variance in each data set.
**** = $p < .0001$

Table 2.40

Pearson Correlations between Trials and Points in the Team's Point Bank for Triad 12

Condition	Trial Range	Point Range	*r*	*n*	*p*
1. Differential Contact	1-36	150-300	-0.977	36	<.0001****
2. Differential Contact	37-59	250-300	-0.703	23	.0002***
3. Similar Contact	60-77	281-331	0.895	18	<.0001****
4. Differential Contact	78-96	272-331	-0.558	19	.013*
5. Similar Contact	97-114	292-327	0.753	18	.0003***

$^{*} = p < .05$, $^{***} = p < .001$, $^{****} = p < .0001$

Table 2.41

t-tests of Mean Points Allocated During Stability Trials to the Allocator and Selectors across Conditions for Triad 12

Condition	Mean Points Allocated to Selectors (SD)	Mean Points Self-Allocated (SD)	*t*(*df*)	*p*
1. Differential Contact	0.889 (1.451)	0.462 (0.967)	0.922(29)	.364
2. Differential Contact	1.000 (0.840)	0.750 (0.866)	0.789(28)	.437
3. Similar Contact	2.000 (0.686)	2.000 (0.707)	0.000(25)	>.999
4. Differential Contact	0.833 (0.515)	0.571 (0.852)	1.079(30)	.289
5. Similar Contact	2.444 (0.511)	2.444 (0.527)	0.000(25)	>.999

Table 2.42

Two-Way ANOVAs of Mean Points Allocated to Selectors 1 and 2 for Correct and Incorrect Selections across Conditions for Triad 12

Condition	Mean (SD)	Variable	SS	*df*	*F*	*p*
1. Differential Contact	S1 Correct: 2.071 (2.129)	Selectors	0.334	1	0.176	.676
	S2 Correct: 2.214 (2.119)	Selections	67.31	1	35.49	<.0001****
	S1 Incorrect: 0.091 (0.294)	Interaction	<.000	1	<.000	.992
	S2 Incorrect: 0227 (0.685)	Within	129.0	68	-	-
2. Differential Contact	S1 Correct: 0.818 (0.874)	Selectors	0.081	1	0.220	.642
	S2 Correct: 1.000 (0.866)	Selections	7.756	1	21.04	<.0001****
	S1 Incorrect: 0.083 (0.289)	Interaction	0.105	1	0.295	.596
	S2 Incorrect: 0.071 (0.267)	Within	15.48	42	-	-
3. Similar Contact	S1 Correct: 1.833 (0.718)	Selectors	0.170	1	0.394	.535
	S2 Correct: 1.667 (0.724)	Selections	17.09	1	39.55	<.0001****
	S1 Incorrect: 0.167 (0.408)	Interaction	<.000	1	<.000	.999
	S2 Incorrect: 0.000 (0.000)	Within	13.83	32	-	-
4. Differential Contact	S1 Correct: 0.923 (0.641)	Selectors	0.003	1	0.011	.916
	S2 Correct: 0.889 (0.601)	Selections	7.221	1	31.43	<.0001****
	S1 Incorrect: 0.000 (0.000)	Interaction	0.003	1	0.011	.916
	S2 Incorrect: 0.000 (0.000)	Within	7.812	34	-	-
5. Similar Contact	S1 Correct: 2.143 (0.663)	Selectors	0.021	1	0.062	.805
	S2 Correct: 2.231 (0.599)	Selections	11.07	1	32.74	<.0001****
	S1 Incorrect: 1.000 (0.000)	Interaction	0.139	1	0.410	.527
	S2 Incorrect: 0.800 (0.447)	Within	10.82	32	-	-

For Variable, selectors were either Selector 1 or 2 and selections were either correct or incorrect
**** = $p < .0001$.

Table 2.43

Tukey's Multiple Comparisons for the Two-Way ANOVAs of Mean Points Allocated to Selectors 1 and 2 for Correct and Incorrect Selections across Conditions for Triad 12

Condition	P-Condition 1	P-Condition 2	Predicted (LS) Mean Difference[a]	95% CI of Mean Difference	*p*
1. Differential Contact	P1-Correct	P1-Incorrect	1.980	0.9033 to 3.057	.0002***
	P2-Correct	P2-Incorrect	1.987	0.9099 to 3.063	.0001***
2. Differential Contact	P1-Correct	P1-Incorrect	0.7349	0.1471 to 1.323	.012*
	P2-Correct	P2-Incorrect	0.9286	0.3270 to 1.530	.002**
3. Similar Contact	P1-Correct	P1-Incorrect	1.666	0.8950 to 2.438	<.0001****
	P2-Correct	P2-Incorrect	1.667	0.6914 to 2.643	.0007***
4. Differential Contact	P1-Correct	P1-Incorrect	0.9231	0.3696 to 1.477	.0009***
	P2-Correct	P2-Incorrect	0.8889	0.3737 to 1.404	.0006***
5. Similar Contact	P1-Correct	P1-Incorrect	1.143	0.3695 to 1.917	.003**
	P2-Correct	P2-Incorrect	1.431	0.7130 to 2.149	.0001***

[a]Predicted values are reported because means, standard deviation, and sample size were used to compute tests. * = $p < .05$, ** = $p < .01$, *** = $p < .001$, **** = $p < .0001$

Table 2.44

t-tests of Mean Points Self-Allocated on Trials in which Points Were Added to or Removed from the Team's Point Bank for Triad 12

Condition	Mean Points Self-Allocated on Point Gaining Trials (SD)	Mean Points Self-Allocated on Point Losing Trials (SD)	*t*(*df*)	*p*
1. Differential Contact	1.000 (0.926)	0.536 (1.427)	0.865(24)	.393
2. Differential Contact	1.500 (0.548)	0.000 (0.000)	11.82(21)	.0001***
3. Similar Contact	1.750 (0.754)	0.167 (0.408)	4.759(16)	.0002***
4. Differential Contact	1.143 (0.890)	0.000 (0.000)	4.496(17)	.0003***
5. Similar Contact	2.231 (0.599)	0.800 (0.447)	4.812(16)	.0002***

*** = $p < .001$

Table 2.45

t-tests of Mean Points Self-Allocated on Trials in which Points Were Added to or Removed from the Team's Point Bank for Triad 12

Conditions	Trial Type	Mean Points Self-Allocated in the Differential Contact Condition (SD)	Mean Points Self-Allocated in the Similar Contact Condition (SD)	*t*(*df*)	*p*
2. Differential Contact & 3. Similar Contact	Point Gaining	1.500 (0.548)	1.750 (0.754)	0.718(16)	.483
	Point Losing	0.000 (0.000)	0.167 (0.408)	1.762(21)	.093
4. Differential Contact & 5. Similar Contact	Point Gaining	1.143 (0.890)	2.231 (0.599)	3.252(18)	.004**
	Point Losing	0.000 (0.000)	0.800 (0.447)	6.508(15)	<.0001****

[a]*t*-test could not be computed due to a lack of variance in each data set.

** = $p < .01$, **** = $p < .0001$

Appendix C

Table 3.1

Instructions Used in Experiment 4

P1 Instructions	P2 Instructions
RS Condition	
In this task, you will earn points by selecting one of three symbols across a series of trials. Each trial, you will have 10 seconds to select a symbol below the "Select a symbol below" text to earn points. Select symbols by clicking on them. When you have selected a symbol, a border will appear around it. You may change your selection as many times as you want each trial before 10 seconds has elapsed. To change your selection, simply click on another symbol. After the 10 seconds has elapsed, you will be shown how many points you have earned based on the symbol you select. Points are not based on where the symbol is on your screen, just which symbol you select. Earning the most points in the fewest number of responses will result in you earning the most amount of money you can. Like you, the other participants are also trying to earn money by earning points. The amount of money you make is only based on how many points you earn; the amount of points other participants earn will not affect how much money you make, and how many points you earn will not affect how much money they make. Do not talk over the course of the experiment. When the Continue button appears, click it to progress in the study.	In this task, you will earn points by selecting one of three symbols across a series of trials. Each trial, you will have 10 seconds to select a symbol below the "Select a symbol below" text to earn points. Select symbols by clicking on them. When you have selected a symbol, a border will appear around it. You may change your selection as many times as you want each trial before 10 seconds has elapsed. To change your selection, simply click on another symbol. After the 10 seconds has elapsed, you will be shown how many points you have earned based on the symbol you select. Points are not based on where the symbol is on your screen, just which symbol you select. Earning the most points in the fewest number of responses will result in you earning the most amount of money you can. Like you, the other participants are also trying to earn money by earning points. The amount of money you make is only based on how many points you earn; the amount of points other participants earn will not affect how much money you make, and how many points you earn will not affect how much money they make. Do not talk over the course of the experiment. When the Continue button appears, click it to progress in the study.
HP1 Condition	
HP1 Condition	HP1 Condition
You have completed the first condition. In the next condition, you will see symbols appear above the "Select a symbol below" text. For each different symbol that appears, you should click on a specific symbol below the "Select a symbol below" text to earn the most points possible each trial. For example, if you see symbol "B" appear above the "Select a symbol below" text, you can earn the most points possible on that trial by selecting symbol "A" below the "Select a symbol below" text. When the Continue button appears, click it to progress in the study.	You have completed the first condition. When the Continue button appears, click it to progress in the study.
MCP1 Condition	
MCP1 Condition	MCP1 Condition
You have completed the second condition. When the Continue button appears, click it to progress in the study.	You have completed the second condition. When the Continue button appears, click it to progress in the study.
MIFP1 Condition	
You have completed the third condition. You may have noticed that you could click on new symbols located on the left side of your screen in the previous condition. Clicking on these symbols makes them appear on another participant’s screen. The symbol will remain on the other participant's screen for the duration of time you are able to select symbols, unless you select another one of the new symbols, which will replace the symbol you clicked before. This happens to the same participant throughout the whole condition. In the next condition, you will be able to click on these symbols to make them appear on the same participant’s screen again. You will also be able to see what symbol that participant selects and how many points they earn each trial. Like you, the other participant is trying to earn money by earning points. The amount of money you make is only based on how many points you earn; the amount of points the other participant earns will not affect how much money you make, and how many points you earn will not affect how much money they make. Unlike you, they will only see the symbols they can select to earn points below the “Select a symbol below” text and the symbols that you click on located on the left side of your screen. They will not see the symbols that you see above the "Select a symbol below" text, what symbols you are selecting to earn points, or how many points you are earning each trial. Because of this, the only way they will know what symbol to select to earn the most points possible each trial is if you tell them what to select by consistently sending them a particular symbol for each different symbol that appears above the “Select a symbol below” text. For example, if selecting symbol “A” below the “Select a symbol below" text earns you the most points when you see symbol “B” above the “Select a symbol below" text, you can tell the other participant you saw symbol “B” by always clicking on symbol “C” on the left side of your screen when you see symbol “B”, allowing them to earn the most points possible by selecting symbol “A” when they see symbol "C". Remember, you can send symbols by clicking on the symbols located on the left side of your screen. When the Continue button appears, click it to progress in the study.	You have completed the third condition. You may have noticed new symbols appearing on your screen in a new way in the previous condition. These symbols appear on your screen because another participant in the room is clicking on identical symbols on their screen. That participant can tell you what symbol to click to earn the most points possible each trial by sending you these new symbols. For example, if you see symbol “C” appear above the “Select a symbol below” text, the other participant may be trying to tell you to select symbol “A” below the “Select a symbol below” text so that you can earn the most points possible on that trial. If you did not see any symbols appear above the "Select a symbol below" text in the previous condition, these symbols were not clicked by another participant. Nothing happens to anyone else when you click on these new symbols. When the Continue button appears, click it to progress in the study.

RR Condition	
You have completed the fourth condition. In the next condition, the same participant you were interacting with in the previous condition will be able to send you symbols so that they appear on your screen. That participant can tell you what symbol to click to earn the most points possible each trial by sending you the same symbols you could send them in the last condition. For example, if you see symbol "C" appear above the "Select a symbol below" text, the other participant may be trying to tell you to select symbol "A" below the "Select a symbol below" text so that you can earn the most points possible on that trial. Nothing happens to anyone else when you click on these symbols. When the Continue button appears, click it to progress in the study.	You have completed the fourth condition. In the next condition, you can click on new symbols located on the left side of your screen. Clicking on these symbols makes them appear on another participant's screen, the same participant that has been able to interact with you throughout this task. The symbol will remain on the other participant's screen for the duration of time you are able to select symbols, unless you select another one of the new symbols, which will replace the symbol you clicked before. This happens to the same participant throughout the whole condition. If you have seen these new symbols before, it was because the participant who has been able to interact with you was sending them to you by clicking on them. You will also be able to see what symbol that participant selects and how many points they earn each trial. Additionally, you will see symbols appear above the "Select a symbol below" text. For each different symbol that appears, you should click on a specific symbol below the "Select a symbol below" text to earn the most points possible each trial. For example, if you see symbol "B" appear above the "Select a symbol below" text, you can earn the most points possible on that trial by selecting symbol "A" below the "Select a symbol below" text. Like you, the other participant is trying to earn money by earning points. The amount of money you make is only based on how many points you earn; the amount of points the other participant earns will not affect how much money you make, and how many points you earn will not affect how much money they make. Unlike you, they will only see the symbols they can select to earn points below the "Select a symbol below" text and the symbols that you click on located on the left side of your screen. They will not see the symbols that you see above the "Select a symbol below" text, what symbols you are selecting to earn points, or how many points you are earning each trial. Because of this, the only way they will know what symbol to select to earn the most points possible each trial is if you tell them what to select by consistently sending them a particular symbol for each different symbol that appears above the "Select a symbol below" text. For example, if selecting symbol "A" below the "Select a symbol below" text earns you the most points when you see symbol "B" above the "Select a symbol below" text, you can tell the other participant you saw symbol "B" by always clicking on symbol "C" on the left side of your screen when you see symbol "B", allowing them to earn the most points possible by selecting symbol "A" when they see symbol "C". Remember, you can send symbols by clicking on the symbols located on the left side of your screen. When the Continue button appears, click it to progress in the study.

Text was displayed to participants using 20-point Arial font.

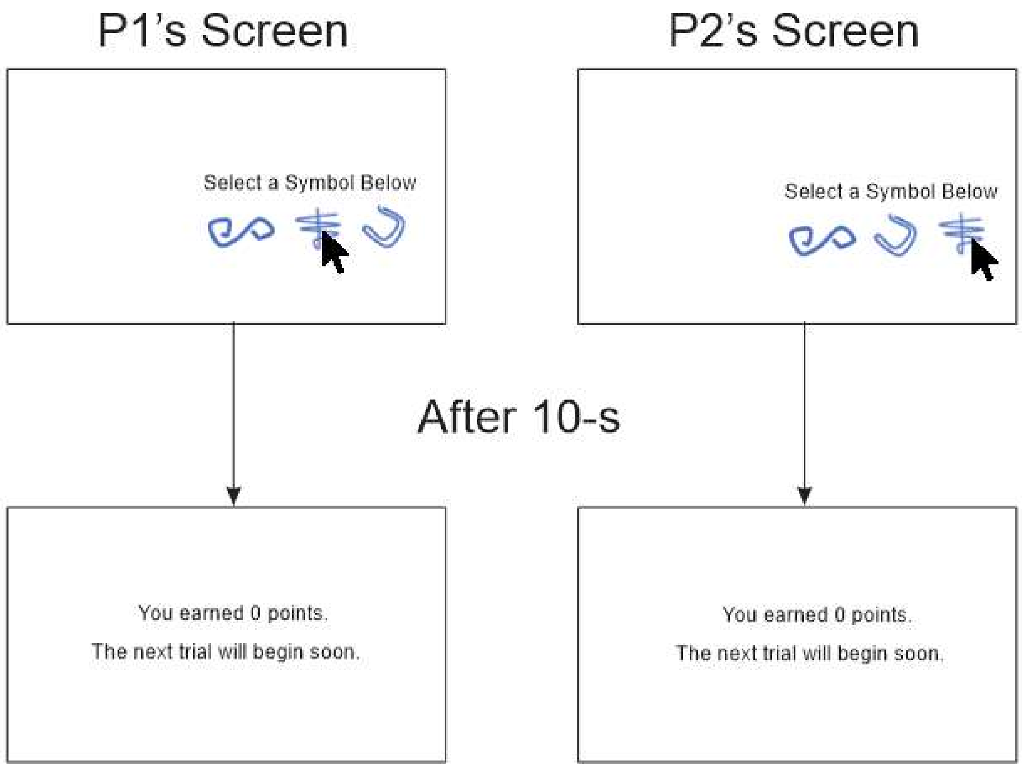

Figure 3.1 A trial in the RS condition for two participants in the same dyad. Depictions are not drawn to scale.

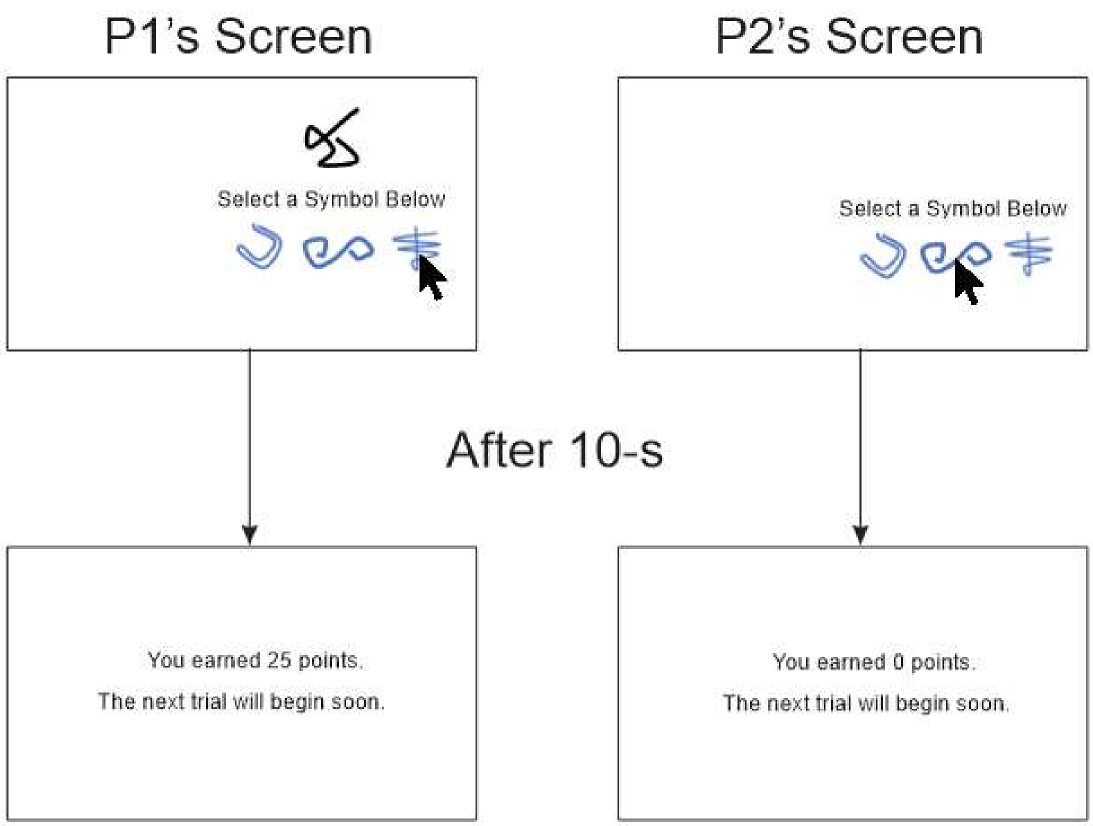

Figure 3.2 A trial in the HP1 condition for two participants in the same dyad. Depictions are not drawn to scale.

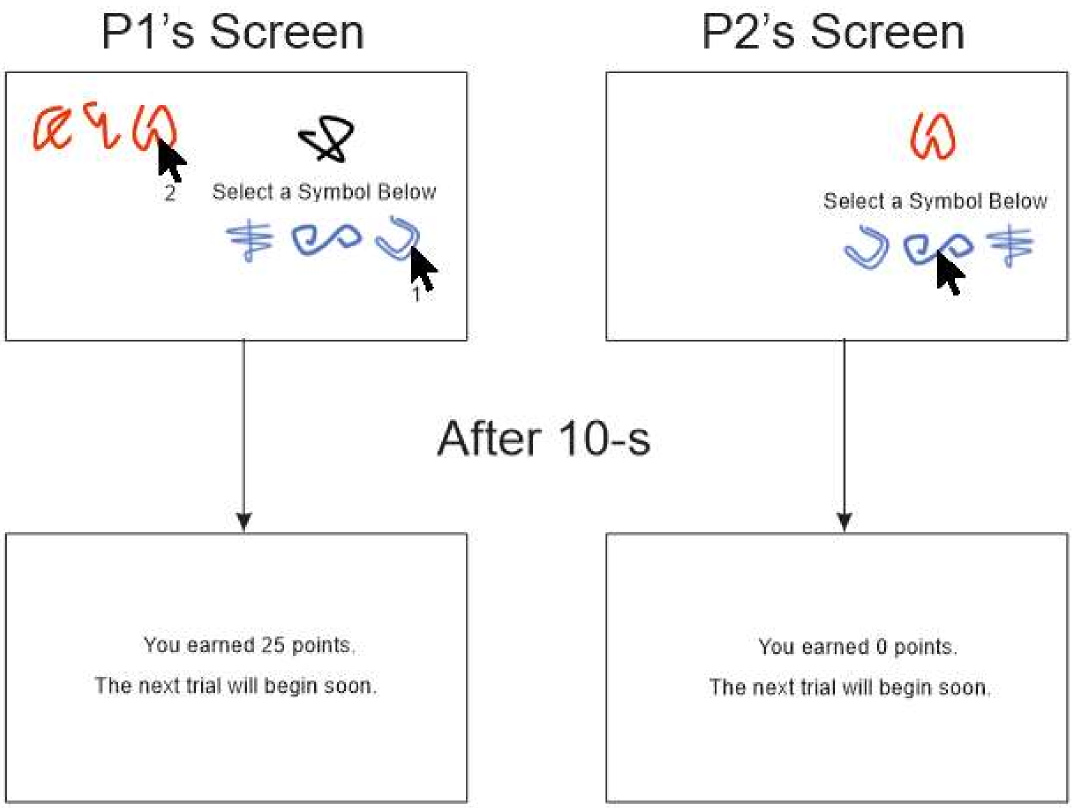

Figure 3.3. A trial in the MCP1 condition for two participants in the same dyad. Cursor 1 for P1 illustrates P1 selecting a stimulus object upon which points are contingent. Cursor 2 for P1 illustrates P1 selecting a message stimulus object, after which an identical stimulus object appears on P2's screen. Depictions are not drawn to scale.

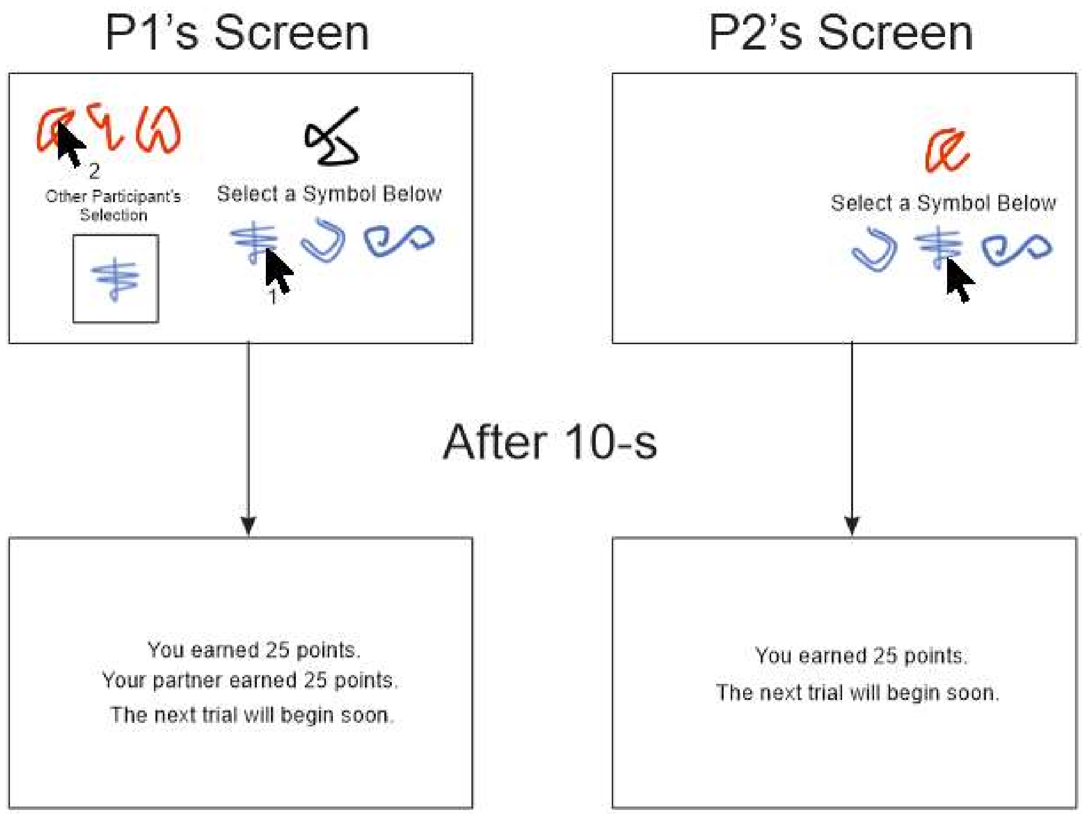

Figure 3.4. A trial in the MIFP1 condition for two participants in the same dyad. Cursor 1 for P1 illustrates P1 selecting a stimulus object upon which points are contingent. Cursor 2 for P1 illustrates P1 selecting a message stimulus object, after which an identical stimulus object appears on P2's screen. The stimulus object in the box on P1's screen appeared after P2 selected an identical stimulus object. Depictions are not drawn to scale.

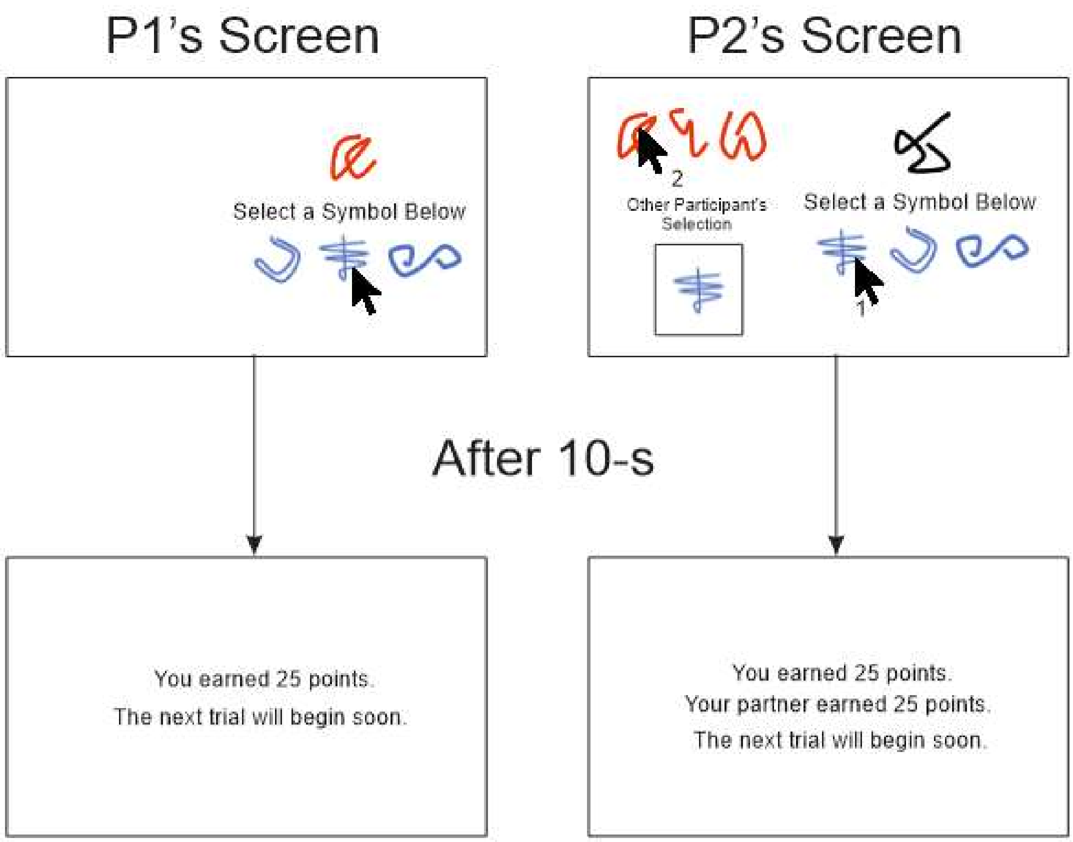

Figure 3.5. A trial in the RR condition for two participants in the same dyad. Cursor 1 for P2 illustrates P2 selecting a stimulus object upon which points are contingent. Cursor 2 for P2 illustrates P2 selecting a message stimulus object, after which an identical stimulus object appears on P1's screen. The stimulus object in the box on P2's screen appeared after P1 selected an identical stimulus object. Depictions are not drawn to scale.

Table 3.2

Descriptive Statistics of Functional Contacts Observed During Stability Trials in Experiment 4

			Number of Stability Trials (*n* = 12)				
			Condition				
Dyad	P	Functional Contact	RS M (SD)	HP1 M (SD)	MCP1 M (SD)	MIFP1 M (SD)	RR M (SD)
1	P1	Correct Selection	0.250 (0.423)	1.000 (0.000)	1.000 (0.000)	1.000 (0.000)	1.000 (0.000)
		Messaging	-	-	1.000 (0.000)	1.000 (0.000)	-
	P2	Correct Selection	0.167 (0.389)	0.333 (0.492)	0.167 (0.389)	1.000 (0.000)	1.000 (0.000)
		Messaging	-	-	-	-	1.000 (0.000)
		Total Trials	14	60	12	60	17
2	P1	Correct Selection	0.167 (0.389)	0.833 (0.389)[a]	1.000 (0.000)	1.000 (0.000)	0.833 (0.389)
		Messaging	-	-	0.000 (0.000)	0.000 (0.000)	-
	P2	Correct Selection	0.167 (0.389)	0.583 (0.515)[a]	0.167 (0.389)	0.333 (0.492)	1.000 (0.000)
		Messaging	-	-	-	-	0.667 (0.492)
		Total Trials	14	60	24	24	41
3	P1	Correct Selection	0.333 (0.492)	1.000 (0.000)	1.000 (0.000)	1.000 (0.000)	0.250 (0.452)
		Messaging	-	-	0.083 (0.289)	0.083 (0.289)	-
	P2	Correct Selection	0.250 (0.452)	0.167 (0.389)	0.167 (0.389)	0.417 (0.515)	0.167 (0.389)
		Messaging	-	-	-	-	1.000 (0.000)
		Total Trials	14	60	36	24	29

[a]HP1 was completed in 60 trials due to participants failing to meet stability criteria. This should be appreciated when comparing their results from HP1 to results from other conditions and dyads. P = Participant

Table 3.3

Two-Way ANOVAs of Mean Number of Stability Trials in which Dyad Members Participated in Correct Selections during RS and HP1 Conditions

Dyad	Variable	SS	*df*	*F*	*p*
Dyad 1	Dyad Member	1.688	1	11.28	.002**
	Condition	2.521	1	16.85	.0002***
	Interaction	1.021	1	6.823	.012*
	Residual	6.583	44	-	-
Dyad 2	Dyad Member	0.188	1	1.042	.3129
	Condition	3.521	1	19.57	<.0001****
	Interaction	0.188	1	1.042	.3129
	Residual	7.917	44	-	-
Dyad 3	Dyad Member	2.521	1	16.85	.0002***
	Condition	1.021	1	6.823	.012*
	Interaction	1.688	1	11.28	.002**
	Residual	6.583	44	-	-

For Variable, dyad members were either P1 or P2 and conditions were either RS or HP1.
$^{*} = p < .05$, $^{**} = p < .01$, $^{***} = p < .001$, $^{****} = p < .0001$

Table 3.4

Tukey's Multiple Comparisons for the Two-Way ANOVAs of Mean Number of Stability Trials in which Dyad Members Participated in Correct Selections during RS and HP1 Conditions

Dyad	P-Condition 1	P-Condition 2	Mean Difference	95% CI of Mean Difference	*p*
Dyad 1	P1-RS	P1-HP1	-0.7500	-1.172 to -0.3284	.0001***
	P1-RS	P2-RS	0.08333	-0.3383 to 0.5050	.952
	P1-RS	P2-HP1	-0.08333	-0.5050 to 0.3383	.952
	P1-HP1	P2-RS	0.8333	0.4117 to 1.255	<.0001****
	P1-HP1	P2-HP1	0.6667	0.2450 to 1.088	.0007***
	P2-RS	P2-HP1	-0.1667	-0.5883 to 0.2550	.718
Dyad 2	P1-RS	P1-HP1	-0.6667	-1.068 to -0.2657	.0008***
	P2-RS	P2-HP1	-0.4167	-0.8176 to -0.01573	.040*
Dyad 3	P1-RS	P1-HP1	-0.6667	-1.088 to -0.2450	.0007***
	P1-RS	P2-RS	0.08333	-0.3383 to 0.5050	.952
	P1-RS	P2-HP1	0.1667	-0.2550 to 0.5883	.718
	P1-HP1	P2-RS	0.7500	0.3284 to 1.172	.0001***
	P1-HP1	P2-HP1	0.8333	0.4117 to 1.255	<.0001****
	P2-RS	P2-HP1	0.08333	-0.3383 to 0.5050	.952

$^{*} = p < .05$, $^{***} = p < .001$, $^{****} = p < .0001$

Table 3.5

Two-Way ANOVAs of Mean Number of Stability Trials in which P1s Participated in Messaging during MCP1 and MIFP1 Conditions

Variable	SS	*df*	*F*	*p*
P1	7.194	2	49.98	>.0001****
Condition	0.681	1	9.456	.003**
Interaction	1.361	2	9.456	.0002***
Residual	4.750	66	-	-

For Variable, P1s were either from Dyad 1, 2, or 3 and conditions were either MCP1 or MIFP1.
$^{**} = p < .01$, $^{***} = p < .001$, $^{****} = p < .0001$

Table 3.6

Tukey's Multiple Comparisons for the Two-Way ANOVAs of Mean Number of Stability Trials in which P1s Participated in Messaging during MCP1 and MIFP1 Conditions

P1-Condition 1	P1-Condition 2	Mean Difference	95% CI of Mean Difference	*p*
Dyad 1-MCP1	Dyad 1-MIFP1	-0.583	-0.905 to -0.262	<.0001****
Dyad 1-MCP1	Dyad 2-MCP1	0.417	0.095 to 0.738	.004**
Dyad 1-MCP1	Dyad 2-MIFP1	0.417	0.095 to 0.738	.004**
Dyad 1-MCP1	Dyad 3-MCP1	0.333	0.012 to 0.655	.038*
Dyad 1-MCP1	Dyad 3-MIFP1	0.333	0.012 to 0.655	.038*
Dyad 1-MIFP1	Dyad 2-MCP1	1.000	0.679 to 1.321	<.0001****
Dyad 1-MIFP1	Dyad 2-MIFP1	1.000	0.679 to 1.321	<.0001****
Dyad 1-MIFP1	Dyad 3-MCP1	0.917	0.595 to 1.238	<.0001****
Dyad 1-MIFP1	Dyad 3-MIFP1	0.917	0.595 to 1.238	<.0001****
Dyad 2-MCP1	Dyad 2-MIFP1	0.000	-0.322 to 0.322	>.999
Dyad 2-MCP1	Dyad 3-MCP1	-0.083	-0.405 to 0.238	.973
Dyad 2-MCP1	Dyad 3-MIFP1	-0.083	-0.405 to 0.238	.973
Dyad 2-MIFP1	Dyad 3-MCP1	-0.083	-0.405 to 0.238	.973
Dyad 2-MIFP1	Dyad 3-MIFP1	-0.083	-0.405 to 0.238	.973
Dyad 3-MCP1	Dyad 3-MIFP1	0.000	-0.322 to 0.322	>.999

$^{*} = p < .05$, $^{**} = p < .01$, $^{****} = p < .0001$

Table 3.7

Two-Way ANOVA of Mean Number of Stability Trials in which P2s Participated in Correct Selections during MCP1 and MIFP1 Conditions

Variable	SS	*df*	*F*	*p*
P2	1.028	2	2.866	.064
Condition	1.389	1	7.746	.007**
Interaction	3.528	2	9.838	.0002***
Residual	11.83	66	-	-

For Variable, P2s were either from Dyad 1, 2, or 3 and conditions were either MCP1 or MIFP1.
** = $p < .01$, *** = $p < .001$

Table 3.8

Tukey's Multiple Comparisons for the Two-Way ANOVA of Mean Number of Stability Trials in which P2s Participated in Correct Selections during MCP1 and MIFP1 Conditions

P2-Condition 1	P2-Condition 2	Mean Difference	95% CI of Mean Difference	*p*
Dyad 1-MCP1	Dyad 1-MIFP1	-0.833	-1.341 to -0.326	.0001***
Dyad 1-MCP1	Dyad 2-MCP1	-0.417	-0.924 to 0.0907	.168
Dyad 1-MCP1	Dyad 2-MIFP1	-0.167	-0.674 to 0.341	.928
Dyad 1-MCP1	Dyad 3-MCP1	0.000	-0.507 to 0.507	>.999
Dyad 1-MCP1	Dyad 3-MIFP1	-0.250	-0.757 to 0.257	.699
Dyad 1-MIFP1	Dyad 2-MCP1	0.417	-0.091 to 0.924	.168
Dyad 1-MIFP1	Dyad 2-MIFP1	0.667	0.159 to 1.174	.004**
Dyad 1-MIFP1	Dyad 3-MCP1	0.833	0.326 to 1.341	.0001***
Dyad 1-MIFP1	Dyad 3-MIFP1	0.583	0.076 to 1.091	.015*
Dyad 2-MCP1	Dyad 2-MIFP1	0.250	-0.257 to 0.757	.699
Dyad 2-MCP1	Dyad 3-MCP1	0.417	-0.091 to 0.924	.168
Dyad 2-MCP1	Dyad 3-MIFP1	0.167	-0.341 to 0.674	.928
Dyad 2-MIFP1	Dyad 3-MCP1	0.167	-0.341 to 0.674	.928
Dyad 2-MIFP1	Dyad 3-MIFP1	-0.083	-0.591 to 0.424	.997
Dyad 3-MCP1	Dyad 3-MIFP1	-0.250	-0.757 to 0.257	.699

* = $p < .05$, ** = $p < .01$, *** = $p < .001$

Table 3.9

Two-Way ANOVA of Mean Number of Stability Trials in which P1s and P2s Participated in Messaging during MIFP1 and RR Conditions Respectively

Variable	SS	*df*	*F*	*p*
Dyad	5.583	2	51.42	<.0001****
Condition	5.014	1	92.35	<.0001****
Interaction	2.694	2	24.81	. <.0001****
Residual	3.583	66	-	-

For Variable, dyads were either 1, 2, or 3 and conditions were either MIFP1 or RR.
**** = $p < .0001$

Table 3.10

Tukey's Multiple Comparisons for the Two-Way ANOVA of Mean Number of Stability Trials in which P1s and P2s Participated in Messaging during MIFP1 and RR Conditions Respectively

Dyad-Condition 1	Dyad-Condition 2	Mean Difference	95% CI of Mean Difference	*p*
Dyad 1-MIFP1	Dyad 1-RR	0.000	-0.279 to 0.279	>.999
Dyad 1-MIFP1	Dyad 2-MIFP1	1.000	0.721 to 1.279	<.0001****
Dyad 1-MIFP1	Dyad 2-RR	0.333	0.054 to 0.613	.010*
Dyad 1-MIFP1	Dyad 3-MIFP1	0.917	0.638 to 1.196	<.0001****
Dyad 1-MIFP1	Dyad 3-RR	0.000	-0.279 to 0.279	>.999
Dyad 1-RR	Dyad 2-MIFP1	1.000	0.721 to 1.279	<.0001****
Dyad 1-RR	Dyad 2-RR	0.333	0.054 to 0.613	.010*
Dyad 1-RR	Dyad 3-MIFP1	0.917	0.638 to 1.196	<.0001****
Dyad 1-RR	Dyad 3-RR	0.000	-0.279 to 0.279	>.999
Dyad 2-MIFP1	Dyad 2-RR	-0.667	-0.946 to -0.388	<.0001****
Dyad 2-MIFP1	Dyad 3-MIFP1	-0.083	-0.363 to 0.196	.951
Dyad 2-MIFP1	Dyad 3-RR	-1.000	-1.279 to -0.721	<.0001****
Dyad 2-RR	Dyad 3-MIFP1	0.583	0.304 to 0.863	<.0001****
Dyad 2-RR	Dyad 3-RR	-0.333	-0.613 to -0.054	.010*
Dyad 3-MIFP1	Dyad 3-RR	-0.9167	-0.757 to 0.257	<.0001****

* = $p < .05$, **** = $p < .0001$

Table 3.11

Two-Way ANOVA of Mean Number of Stability Trials in which P2s Participated in Correct Selections during MIFP1 and RR Conditions Respectively

Variable	SS	*df*	*F*	*p*
P2	6.028	2	27.44	$<.0001^{****}$
Condition	0.347	1	3.161	.080
Interaction	2.694	2	12.26	. $<.0001^{****}$
Residual	7.250	66	-	-

For Variable, P2s were either from Dyad 1, 2, or 3 and conditions were either MIFP1 or RR.
$^{****} = p < .0001$

Table 3.12

Tukey's Multiple Comparisons for the Two-Way ANOVA of Mean Number of Stability Trials in which P2s Participated in Messaging during MIFP1 and RR Conditions Respectively

P2-Condition 1	P2-Condition 2	Mean Difference	95% CI of Mean Difference	*p*
Dyad 1-MIFP1	Dyad 1-RR	0.000	-0.397 to 0.397	>.999
Dyad 1-MIFP1	Dyad 2-MIFP1	0.667	0.270 to 1.064	$<.0001^{****}$
Dyad 1-MIFP1	Dyad 2-RR	0.000	-0.397 to 0.397	>.999
Dyad 1-MIFP1	Dyad 3-MIFP1	0.583	0.186 to 0.981	$.0008^{***}$
Dyad 1-MIFP1	Dyad 3-RR	0.833	0.436 to 1.230	$<.0001^{****}$
Dyad 1-RR	Dyad 2-MIFP1	0.667	0.270 to 1.064	$<.0001^{****}$
Dyad 1-RR	Dyad 2-RR	0.000	-0.397 to 0.397	>.999
Dyad 1-RR	Dyad 3-MIFP1	0.583	0.186 to 0.981	$.0008^{***}$
Dyad 1-RR	Dyad 3-RR	0.833	0.436 to 1.230	$<.0001^{****}$
Dyad 2-MIFP1	Dyad 2-RR	-0.667	-1.064 to -0.270	$<.0001^{****}$
Dyad 2-MIFP1	Dyad 3-MIFP1	-0.083	-0.481 to 0.314	.990
Dyad 2-MIFP1	Dyad 3-RR	0.167	-0.231 to 0.564	.820
Dyad 2-RR	Dyad 3-MIFP1	0.583	0.186 to 0.981	$.0008^{***}$
Dyad 2-RR	Dyad 3-RR	0.833	0.436 to 1.230	$<.0001^{****}$
Dyad 3-MIFP1	Dyad 3-RR	0.250	-0.147 to 0.647	.443

$^{***} = p < .001$, $^{****} = p < .0001$

Appendix D

Table 4.1

Instructions Used for Discounting Assessments

Instructions for Delay Discounting Assessment
Please read the following questions as they appear. You will be asked whether you would prefer a smaller amount of money today or a larger amount of money after a particular delay. Although these rewards are hypothetical, please answer as if you were actually receiving the rewards you choose. Choose your preference by clicking on the button with your preference when it appears. When you are ready to begin, click Continue when it appears.
Instructions for Social Discounting Assessment
Please read the following questions as they appear. For these questions, imagine the people closest to you in order from 1 to 100. Person 1 may be a close friend or relative and Person 100 may be an acquaintance or someone you recognize. You will be asked whether you would prefer a smaller amount of money for yourself or a larger amount of money for a particular person on your list. Although these rewards are hypothetical, please answer as if you and the people on your list were actually receiving the rewards you choose. Choose your preference by clicking on the button with your preference when it appears. When you are ready to begin, click Continue when it appears.

Text was displayed to participants using 20-point Arial font.

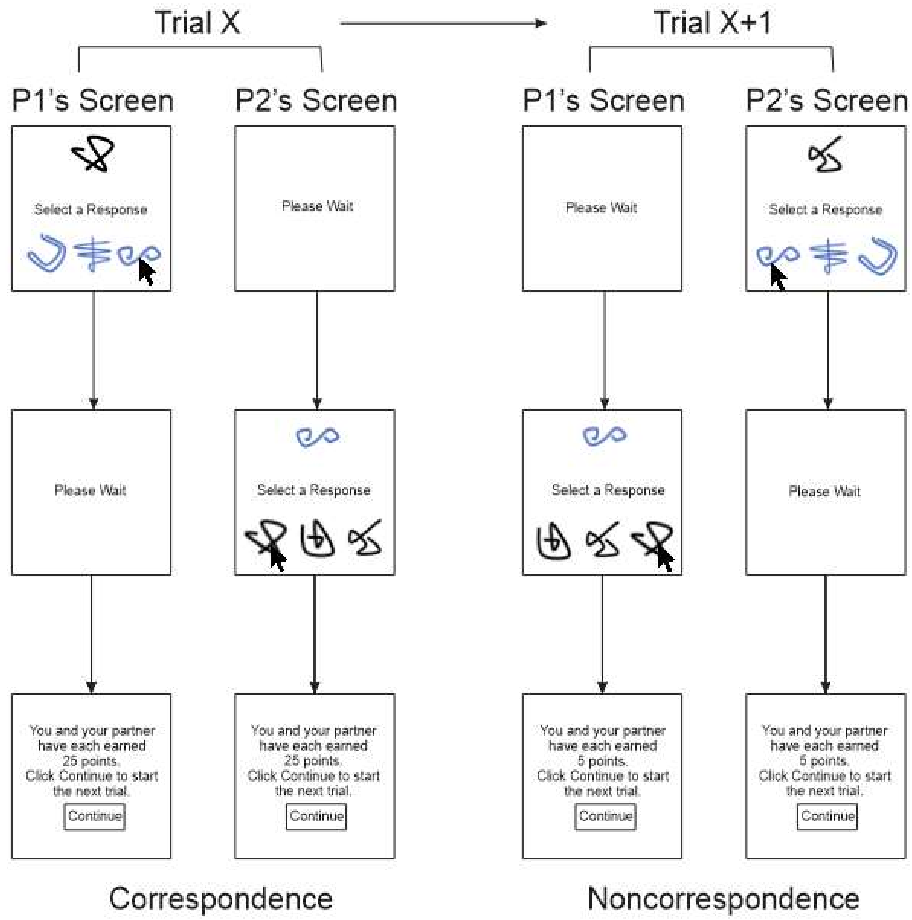

Figure 4.1. Example of consecutive TBMTS trials occurring in a CM condition. Depictions are not drawn to scale.

Table 4.2

Instructions Used for TBMTS

In this task, you and your partner will complete trials to earn points. On each trial, one of you will first select a symbol from Set B in the presence of a symbol from Set A, and then the other will select a symbol from Set A in the presence of the symbol from Set B selected by the first participant to respond. The amount of points you will earn on each trial depends on (1) which symbol from Set A is presented to the first participant to respond and (2) which symbol from Set A is selected by the second participant to respond. You and your partner will take turns responding first and second during trials so that, if you respond first and your partner responds second on Trials 1, 3, 5, etc, you respond second and your partner responds first on Trials 2, 4, 6, etc. The more points you earn, the better the chance that you win the $100 Amazon giftcard. When you have finished reading and understanding these instructions, click Continue when it appears to begin.

Text was displayed to participants using 20-point Arial font.

Table 4.3

Post-Questionnaire Questions

Question	Response Format	Response Options
1. What gender(s) do you identify with? Select all genders that you identify with.	Multiple Selection	Male, Female, Other (if Other, participants were required to type a response in a textbox)
2. What language(s) do you speak fluently? Select all the languages that you speak fluently.	Multiple Selection	English, French, Spanish, Portuguese, Italian, German, Russian, Mandarin, Cantonese, Japanese, Arabic, Other (If Other, participants were required to type a response in a textbox)
3. How many semesters of college have you completed?	Single Selection	0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, More than 10
4. What is your current GPA? If this is your first semester, please mark “NA”.	Single Selection	NA, 0 to 0.49, 0.5 to 0.99, 1 to 1.49, 1.5 to 1.99, 2 to 2.49, 2.5 to 2.99, 3 to 3.49, 3.5 to 3.99, 4 or Higher
5. When did you realize that you could make symbols appear on another participant’s screen?	Free Response	N/A
6. When did you realize that another participant could make symbols appear on your screen?	Free Response	N/A
7. On a scale of 1 to 10, how important was it for you to earn the $100 Amazon giftcard? (1 = Not Important At All, 10 = Very Important)	Single Selection	1, 2, 3, 4, 5, 6, 7, 8, 9, 10
8. On a scale of 1 to 10, how important was it for you that another participant earned the $100 Amazon giftcard? (1 = Not Important At All, 10 = Very Important)	Single Selection	1, 2, 3, 4, 5, 6, 7, 8, 9, 10

Table 4.4

Answers to Post-Questionnaire across All Triads

Participant	Age	1	2	3	4	7	8	Indicated Not Knowing They Could Interact with Others
P1	18	F	E	0	NA	7	5	No
P2	18	F	E	0	NA	10	8	No
P3	18	F	E	0	NA	5	5	No
P4	18	F	E	0	NA	8	8	No
P5	18	F	E+	0	NA	10	1	No
P6	18	F	E	0	NA	7	2	No
P7	18	M	E	0	NA	5	5	No
P8	18	F	E+	0	3.5-3.99	10	10	No
P9	20	M	E	4	2.5-.299	5	5	No
P10	18	F	E	0	3.5-3.99	6	3	Yes
P11	22	F	E	>10	3.5-3.99	1	1	Yes
P12	18	F	E+	0	NA	3	9	No
P13	18	M	E	0	2-2.49	2	1	Yes
P14	18	M	E+	0	3.5-3.99	7	10	No
P15	18	M	E	0	NA	4	4	No
P16	18	M	E	0	3-3.49	3	4	Yes
P17	19	M	E	0	NA	3	2	No
P18	19	M	E+	2	2.5-2.99	1	1	No
P19	18	F	E+	1	3-3.49	8	1	No
P20	18	M	E	0	3.5-3.99	3	3	No
P21	18	F	E+	0	3.5-3.99	2	1	No
P22	20	M	E	0	NA	8	8	No
P23	21	M	E	1	3-3.49	1	8	No
P24	18	F	E+	0	NA	5	9	No
P25	21	F	E	5	3.5-3.99	6	6	No
P26	23	M	E	3	3-3.49	5	1	No
P27	22	F	E	7	3-3.49	8	3	No
P28	20	F	E	6	3.5-3.99	5	8	No
P29	18	M	O+	1	2.5-2.99	9	9	No
P30	18	F	E	1	3.5-3.99	8	1	No

M = Male, F = Female, E = English Only, E+ = English and at least one other language. O+ = Other languages than English. Refer to Table 4.3 for descriptions of each question. The last column indicates if participants indicated that they did not know they were interacting with others during TBMTS in responses to Questions 5 and/or 6.

Table 4.5

TBMTS and Discounting Results

P	R1 Points	R2 Points	P3 Points	Total Points	R1 CM Trials	R1 C	R2 CM Trials	R2 C	R3 CM Trials	R3 C	CMs C	Total Flexible	DD *k*	SD *k*
P1	890	1035	990	2915	41	1	63	0	43	1	2	2	1.111	1.658
P2	890	540	550	1980	41	1	52	0	46	0	1	0	0.037	0.040
P3	445	1035	660	2140	49	0	63	0	60	0	0	0	0.004	0.039
P4	1760	665	990	3415	30	1	53	0	43	1	2	0	0.019	>.001
P5	445	665	550	1660	49	0	53	0	46	0	0	0	0.175	0.186
P6	1760	540	660	2960	30	1	52	0	60	0	1	1	0.375	0.028
P7	775	1740	2100	4615	59	0	20	1	27	1	2	0	1.008	0.024
P8	925	1740	590	3255	57	1	20	1	62	0	2	1	>.001	0.015
P9	1020	670	825	2515	58	1	58	0	53	0	1	0	1.044	0.019
P10	925	910	825	2660	57	1	52	1	53	0	2	0	0.174	0.0197
P11	1020	910	2100	4030	58	1	52	1	27	1	3	3	>.001	>.001
P12	775	670	590	2035	59	0	58	0	52	0	0	0	.001	0.012
P13	660	570	1090	2320	56	0	50	0	62	0	0	0	0.554	0.190
P14	630	720	1090	2440	54	0	56	0	62	0	0	0	0.671	0.074
P15	995	570	900	2465	59	0	50	0	56	0	0	0	1.892	0.341
P16	660	1045	970	2675	56	0	61	0	66	0	0	0	0.284	0.095
P17	995	720	970	2685	59	0	56	0	66	0	0	0	0.072	0.071
P18	630	1045	900	2575	54	0	61	0	56	0	0	0	0.109	0.006
P19	835	1480	2180	4495	59	0	28	1	17	1	2	2	0.777	0.599
P20	545	1480	1630	3655	41	0	28	1	18	1	2	1	0.985	0.128
P21	555	1220	520	2295	55	0	56	1	48	0	1	0	0.002	0.004
P22	555	695	2180	3430	55	0	47	0	17	1	1	0	1.438	0.0951
P23	835	1220	1630	3685	59	0	56	1	18	1	2	0	0.193	0.693
P24	545	695	520	1760	41	0	47	0	48	0	0	0	0.193	0.693
P25	745	735	750	2230	61	0	55	0	58	0	0	0	0.168	0.058
P26	745	2660	975	4380	61	0	13	1	38	1	2	0	>.001	>.001
P27	560	1070	975	2605	52	0	46	1	38	1	2	0	0.200	0.011
P28	560	735	730	2025	52	0	55	0	62	0	0	0	0.013	0.114
P29	1655	2660	730	5045	36	1	13	1	62	0	2	2	0.111	0.002
P30	1655	1070	750	3475	36	1	46	1	58	0	2	0	0.559	0.122
Mean (SD)	866.3 (376.8)	1050 (552.1)	1031 (517.3)	2947 (900.2)	51.13 (9.460)	0.333 (0.479)	47.33 (14.71)	0.400 (0.498)	47.40 (15.71)	0.333 (0.478)	1.067 (0.980)	0.400 (0.814)	0.406 (0.496)	0.178 (0.342)
Median R^2	-	-	-	-	-	-	-	-	-	-	-	-	.802	.676

Table 4.6

One-Way ANOVA of Various Mean Comparisons in TBMTS Rounds

Test	Variable	SS	*df*	*F*	*p*
Points	Round	20731780	2	1.285	.282
	Residual	21344262	87	-	-
CM Condition Trials	Round	283.8	2	0.770	.466
	Residual	16035	87	-	-
Conditions Completed	Round	0.089	2	0.188	.829
	Residual	20.53	87	-	-

For Variable, rounds were either 1, 2, or 3.

Table 4.7
Correlations between Potential Predictors and TBMTS Outcomes

Variable	R1 Points	R2 Points	R3 Points	Total Points	R1 CM	R1 C	R2 CM	R2 C	R3 CM	R3 C	Total CM C	Total Flexible
DD ln(*k*)	0.024	-0.290	0.182	-0.064	-0.172	-0.176	0.162	-0.278	-0.091	0.010	-0.222	-0.219
SD ln(*k*)	-0.334	-0.312	0.017	-0.322	0.049	-0.325	0.222	-0.267	-0.015	-0.154	-0.370*	-0.151
DD ln(*k*) JB	0.019	0.050	0.527*	0.338	0.082	0.017	-0.272	0.016	-0.265	0.302	0.181	0.251
SD ln(*k*) JB	-0.223	-0.307	0.477	0.027	0.100	-0.286	0.012	0.013	-0.402	0.333	0.031	0.082
Age	-0.166	0.196	0.260	0.200	0.409*	-0.144	-0.080	0.241	-0.317	0.433	0.264	0.034
Gender	0.102	-0.265	-0.342	-0.317	-0.306	0.333	0.215	0.027	0.066	-0.095	0.130	0.185
LS	-0.372*	-0.065	-0.229	-0.328	0.155	-0.309	0.040	-0.089	0.124	-0.309	-0.347	-0.055
Q7	0.286	0.097	-0.200	0.064	-0.431*	0.413	-0.314	0.000	0.057	-0.026	0.189	0.076
Q8	0.028	-0.033	-0.142	-0.090	-0.129	0.104	-0.035	-0.232	0.093	-0.097	-0.114	-0.116
Understood	0.112	-0.212	-0.241	-0.222	-0.209	0.289	0.165	-0.389*	0.225	-0.144	-0.127	-0.068

DD = delay discounting, SD = social discounting, R# = round, C = completion, JB = Johnson and Bickel's (2008) exclusion criteria were applied, Q# = answers to questions from the post-questionnaire, LS = languages spoken (i.e., either English or multiple languages other than English)
$^{*} = p < .05$