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Influence of social antecedents and others' behavior on adherence to protective behaviors against COVID-19

Cristian Yesid Urbano Mejia

Universidad Nacional de Colombia
Facultad de Ciencias Humanas
Departamento de Psicología
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Abstract

Influence of social antecedents and others' behavior on adherence to protective behaviors against COVID-19

During the COVID-19 pandemic, others influenced through their behavior how an individual followed the COVID-19 protective behaviors. The behavior analysis framework proposes that there are antecedent and consequent conditions that could explain why individuals followed the guidelines. This thesis sought to investigate how some antecedents and social consequences predicted adherence. Study 1 explored the relationship between reported adherence, two contexts, and four perceived social consequences. Study 2 explored how the social distance modulated reported adherence and other's behavior and three perceived social consequences. Colombian residents completed surveys based on indirect functional analysis where they reported their adherence in various situations and the likelihood of receiving certain social consequences. Study 1 found that adherence was higher in the indoor context than outdoor context. In addition, consequences such as social approval had more effect in the indoor context. Study 2 found that social distance from the other, the other's behavior, and loss of social gratification were related to adherence. In addition, the other's behavior was more influential when it came from a close other. The findings suggest that adherence to protective behaviors was a social behavior because it was sensitive to the responses of others. Emotional closeness to others was a risk factor explained because close others followed fewer guidelines and gave less feedback.

Keywords: social reinforcement, social punishment, social distance, adherence to protective behaviors, COVID-19, social consequences

Resumen

Influencia de los antecedentes sociales y del comportamiento de los otros en la adherencia a comportamientos protectores contra el COVID-19

Durante la pandemia por COVID-19, los otros influyeron mediante su comportamiento en como un individuo siguió las conductas de protección contra el COVID-19. El marco de trabajo del análisis de la conducta propone que hay condiciones antecedentes y consecuentes que podrían explicar porque las personas siguieron las recomendaciones. Esta tesis buscó indagar como algunos antecedentes y consecuencias sociales predijeron la adherencia. El estudio 1 exploró la relación entre la adherencia reportada, dos contextos y cuatro consecuencias sociales percibidas. El estudio 2 exploró cómo la distancia social moduló entre la adherencia reportada y la conducta de otros, y tres consecuencias sociales percibidas. Residentes colombianos completaron encuestas basadas en el análisis funcional indirecto donde reportaron su adherencia en varias situaciones y la probabilidad de recibir ciertas consecuencias sociales. El estudio 1 encontró que la adherencia fue mayor en el contexto dentro de casa que fuera de casa. Además, las consecuencias como la aprobación social tuvieron más efecto en el contexto dentro de casa. El estudio 2 encontró que la distancia social con el otro, la conducta del otro y la pérdida de gratificación social estuvo relacionada con la adherencia. Además, que la conducta del otro era más influyente cuando venía de una persona cercana. Los hallazgos sugieren que la adherencia a las conductas de protección fue una conducta social porque fue sensible a las respuestas de los otros. La cercanía emocional con el otro fue un factor de riesgo explicado porque los más cercanos siguieron menos las recomendaciones y dieron menos retroalimentación.

Palabras clave: reforzamiento social, castigo social, distancia social, adherencia a las conductas protectoras, COVID-19, consecuencias sociales

Content

Figure List

Tables list

Introduction

During the COVID-19 pandemic, people had to change their behavior to prevent the spread of SARS-CoV-2. For the measures to be effective, people had to emit protective behaviors in all social contexts because the risk of contagion was always present when another person was involved. However, people changed their behavior depending on the context; following the guidelines in some situations was more likely than in others. Social contingencies can explain why people change their behavior according to the social context. This thesis aimed to assess how social antecedents and consequences influenced adherence to protective behaviors against COVID-19 on a large scale from a behavior analysis approach using an indirect functional assessment. Five chapters compose this thesis.

Chapter 1 introduces the concept of protective behaviors against COVID-19 and illustrates how the behavior analysis framework can explain protective behaviors. The chapter introduces the operant conditioning approach, in which antecedent and consequent conditions predict behavior. Subsequently, the chapter illustrates how their antecedents and consequences can explain adherence to protective behaviors and some examples. Finally, the chapter shows how researchers use indirect functional analysis and statistical analysis as tools to assess the contingencies that control behavior at the large-scale level. Among all the possible contingencies that control adherence, social contingencies are the better ones to explain why people change their behavior according to the social context.

Chapter 2 introduces the topic of social contingencies (reinforcement and punishment). The chapter explores some social antecedents and consequences that may

control adherence. This chapter addresses social consequences such as approval and disapproval, or loss of social gratification. It shows the available evidence on the effects of approval on adherence. Also, the chapter addresses social antecedents, such as social context, social distance, and the degree to which the other follows the norms.

Chapter 3 presents Study 1. This study determined how some social antecedents and consequences influence adherence to protective behavior on a large scale. The study used two general social contexts as antecedents (indoor and outdoor) and four social consequences (potential reinforcers and punishments). Through statistical analysis, the results determined that some antecedents and consequences control behavior in a generalized way in the population. The study suggested that the differences between contexts could be due to the social distance of the people involved in each context.

Chapter 4 presents Study 2. This study explored the social distance of the other as a more specific antecedent. This study evaluated how social distance predicted adherence to protective behaviors and its modulation over some social antecedents and consequences. This study tests whether adherence increases as social distance decreases, as Strickland et al. (2022) found. Also, this study evaluates whether social distance modulates the effect of others' behavior; the antecedents and consequences coming from close people should be more influential than those coming from distant people.

Chapter 5 presents a general conclusion of the thesis. According to this research, adherence to protective behaviors was social behavior because was sensitivity to social contingencies. In addition, it supports that social antecedents and consequences such as approval and disapproval have a universal character. The chapter discusses the contradictory effect of the other close ones, although they have the most influence, they are also the ones with which there is the least adherence.

1. Protective Behaviors against COVID-19 from a Behavior Analysis Framework

Behavior analysis is a valuable framework for understanding contextual variables and how they influence behavior. Behavioral principles explain adherence to protective behaviors against COVID-19 from different approaches: operant conditioning (Couto et al., 2020; Hübner, 2021; Shawler & Blair, 2021; Tibério et al., 2020), behavioral economic (Belisle et al., 2022), metacontingencies and culturo-behavior science (Amorim et al., 2020; Couto, 2019; Fonseca et al., 2021), and relational frame theory and contextual behavioral science (Hayes et al., 2020; Stapleton, 2020).

1.1 Protective Behaviors against COVID-19

To mitigate COVID-19 spread, governments and health institutions recommended some biosecurity guidelines or protective behaviors. Health protective behaviors are those that individuals emit, regardless of the perceived or actual health status, to protect and maintain health and prevent diseases (Harris & Guten, 1979). In the COVID-19 pandemic, protective behaviors protected from acquiring and spreading COVID-19. These include many behavioral topographies, such as preventive (mask-wearing, hygiene, vaccination) or avoidant behaviors (avoiding crowds and compliance with quarantine restrictions; Bish & Michie, 2010). Adherence refers to how closely a person's actions align with the guidelines provided by a healthcare provider in the context of a particular illness or condition (Howren, 2013).

The World Health Organization (WHO; 2022a, 2022b) and the Centers for Disease Control and Prevention (CDC; 2022) were the most important health institutions that provided evidence-informed recommendations for infection prevention and control. Their recommendations include vaccination, a physical distance of at least 1 meter from others,

house restriction (self-quarantining), avoiding crowds and close contact, proper mask-wearing, frequent hand-washing with soap and water or alcohol-based hand rub, and disinfecting surfaces. Although people had already implemented many of these recommendations in their behavioral repertoire, it was necessary to change their frequency to make them effective (Harvey et al., 2021). Individuals must increase the frequency of behaviors like hand-washing or surface-cleaning (what was previously rarely done) or modify previous behaviors like physical distancing and mask-wearing during casual social interactions (which was the opposite of what they used to do before).

Although the recommendations apply to all social contexts, some situations represent a higher risk of contagion. COVID-19 transmission is lower in outdoor than indoor contexts (Escandón et al., 2021; Fouda et al., 2021). The main transmission clusters were the household and small gatherings with family and friends (indoor context; Fouda et al., 2021; Leclerc et al., 2020; Thompson et al., 2021). More extended contacts, such as prolonged family meetings (familiar and prolonged contact), were riskier than shorter contacts, such as casual meetings with strangers or other situations related to healthcare and the workplace (Thompson et al., 2021). The low adherence in these situations is possibly one reason why WHO (2021) emphasized adherence to protective behaviors during social gatherings.

During the pandemic, studies on protective behaviors had limitations as they primarily focused on overall compliance with protective measures without assessing adherence in different situations (Freidin et al., 2022; Guevara Beltran et al., 2021). Some questionnaires (for example, Asenjo-Alarcón & Oblitas Gonzales, 2021 and Dehghani et al., 2022) used general questions like "I wear a mask" without specifying the context, implying uniform adherence to guidelines in all situations (Asenjo-Alarcón & Oblitas Gonzales, 2021; Dehghani et al., 2022). However, people changed adherence across various activities. Understanding variations in adherence to protective behaviors can help develop targeted interventions to prevent the spread of airborne diseases in the future (Guevara Beltran et al., 2021). Research can encompass different indoor settings like homes, friends'

houses, restaurants, and workplaces, as well as outdoor contexts such as streets, events with large crowds, public transportation, and open areas

As far as we know, research has focused mainly on protective behaviors towards oneself and ignored others-oriented protective behaviors (encouraging, helping, correcting, reprimanding, or feedbacking). One exception is Bokemper et al. (2021), who studied self-adherence to masks and the encouragement of mask use in others. Studying protecting others is essential because it allows the evaluation of social mechanisms of behavioral change.

1.2 The subjective value of adherence to protective behaviors against COVID-19

Subjective value is a behavioral economic concept that explains why people choose one alternative over another (Buriticá & Dos Santos, 2016). All behavior is choice behavior (Baum, 2004; Clavijo, 1997; Rachlin, 1989); people always choose between two or more alternatives with different consequences. Individuals choose the alternative they value the most (Baum & Rachlin, 1969; Buriticá & Dos Santos, 2016; Clavijo, 1997). Subjective value or reward value describes an individual's perceived value of a reward or consequence (Da Matta et al., 2012; Rachlin et al., 1991); See Buriticá and Dos Santos (2016) for a discussion of the concept. During the pandemic, people could adhere to the measures or not follow the guidelines. The choice depended on the subjective value of each alternative.

Operant conditioning, or the three-term contingency approach, proposes that antecedent and consequence environmental conditions influence behavior (Clavijo, 2006; Skinner, 1953, 1991). Some antecedents control the behavior by signaling the likelihood of reinforcing and punishing consequences for a response (Sidman, 2008; Skinner, 1953; Terrace, 1966). Also, some consequences control the behavior when they increase or decrease the probability of future occurrences (Ferster & Skinner, 1957). The subjective value of an alternative depends on its consequences. The value decreases as characteristics such as delay, probability, and effort increase. (Białaszek et al., 2019; De Villiers, 1977;

Madden et al., 2021). The operant contingency describes the functional relationship between a behavioral class, antecedents, and consequences (Clavijo, 2006; Cooper et al., 2020; Lattal, 1995; Vollmer & Hackenberg, 2001).

During the COVID-19 pandemic, different operant contingencies controlled adherence to protective behaviors. Some antecedents and consequences were artificial --intentionally arranged by people--, and others were natural --normal in the daily dynamics; see Teixeira et al. (2021) for a discussion between natural and artificial reinforcement--. According to Couto et al. (2020), Shawler and Blair (2021), and Tibério et al. (2020), some antecedents were social, such as the presence of others, the others' behavior, verbal messages, and gestures. Other antecedents were artificial, such as posters, warning signs, and reminders. The authors mentioned some consequences like social (social feedback, approval, disapproval, correction messages), tangibles (losing money, receiving a fine), or health-related (preventing COVID-19 self-infection and others-infection).

There were reinforcing contingencies with different concurrent consequences during the pandemic (Couto et al., 2020; Tibério et al., 2020). As Couto et al. (2020) exemplified, some behaviors, like interacting while maintaining physical distancing, could obey different contingencies. This behavior avoided future and uncertain aversive consequences (negative reinforcement) and eliminated the proximal consequence of physical contact or social gratification (negative punishment). There were reinforcement and punishment contingencies for all protective behaviors depending on the social context. Given that individuals value different consequences, it is likely that for each person, different contingencies change the value of adhering to protective behaviors (Shawler & Blair, 2021).

Not following biosecurity measures is a self-control problem because individuals are under control of immediate reinforcers of lesser magnitude (e.g., social interaction) than the control of larger reinforcers in the future (avoiding contagion; Camargo & Calixto, 2020). Some consequences, such as health-related ones, were temporally distant and of low probability; therefore, their effect was low. In contrast, others (like tangibles or social) were

proximal, very likely, and likely had a higher effect. This suggests that not following measures for some people had a high subjective value because it receives an immediate and highly probable social consequence while following the measures has a low subjective value because it has a more delayed and less probable consequence.

There are two types of behaviors: contingency-shaped behavior and rule-governed behavior. In the former, direct contact with the contingency maintain the behavior; in the latter, the verbal description of a contingency maintains the behavior. Rules arise from direct exposure to the contingencies or may come from someone else (Skinner, 1969). Individuals do not have to experience the contingency directly to adapt their behavior according to the contingency; people can learn through the verbal behavior of others (Clavijo, 2004; Skinner, 1969; Tarbox et al., 2020). The rules present in each alternative also changed the subjective value of the alternatives through the establishment of relational networks. Most protective behaviors were not contingency-shaped because people rarely experienced contingencies directly (Tibério et al., 2020). Through rules, people learned some avoidance contingencies, such as adhering makes one prevent the spread of COVID-19 (Shawler & Blair, 2021). During the pandemic, rules came from different sources of authority (e.g., health organizations, politicians) or relatives or friends.

Shawler and Blair (2021) mentioned that people follow many rules by pliance, tracking, and augmenting. Pliance is when a person follows a rule because of the speaker's social consequences (Hayes et al., 1989). During the pandemic, people followed the authorities' rules because they learned that obedience leads to social approval (Shawler & Blair, 2021). Tracking is when a person follows a rule that describes contingencies that happen in the world (Hayes et al., 1989). People followed the rules about biosecurity guidelines because following rules in the past had helped them avoid other diseases (Shawler & Blair, 2021). Augmenting is when a person follows a rule because it mentions high-value consequences (Hayes et al., 1989). A person who values his or her family will follow the guidelines if the rule states that taking care of oneself will keep the family from getting sick (Shawler & Blair, 2021).

Rules have different dimensions: explicitness, accuracy, complexity, source, and timing; These dimensions would determine the probability that the listener follows the contingency specified in the rule (Pelaez, 2013; Pelaez & Moreno, 1999). For example, a rule would have less effect if it mentions a delayed or probabilistic consequence (Tarbox et al., 2020). Stapleton (2020) proposed that characteristics such as source authority, plausibility, and motivational augmental control might cause people to follow certain COVID-19 rules more than others. People followed a rule if it mentioned highly valued and probable consequences. A rule such as "wearing a mask will help you avoid contagion" represents little reinforcement because the described consequence is probabilistic and delayed. While a rule such as "I trust my close people, and I will not get infected by socializing with them" represents high reinforcement, indicating that the negative consequences are few and unlikely, and the positive ones are high.

Other two phenomena change the consequences' subjective value: motivational operation and habituation. First, motivational operation refers to environmental variables strengthening or weakening the value of the consequences (Laraway et al., 2003). Shawler and Blair (2021) exemplified that prolonged quarantine or isolation (a motivational operation) increases the value of social interactions and risky behaviors (social gatherings) for some people. Second, repeated exposure to the contexts could cause stimuli habituation; habituation refers to a decrease in response because of repeated exposition (Domjan, 2015). Tibério et al. (2020) suggested that repeated exposure to information on guidelines could cause habituation to warnings and decrease protection response for some individuals.

1.2.1 Risk perception and health-related consequences

Interacting with others during the pandemic was risky given the negative health consequences. Not all individuals directly experienced these negative consequences because consequences were delayed and unlikely. Therefore, most people's protective behavior was controlled by rules indicating that certain behaviors were risky. The perceived probability of obtaining negative consequences is what researchers outside of behavior

analysis call risk perception. Risk perception refers to the perceived possibility of physical, social, or financial harm/detrimental/loss due to a hazard within a particular time frame (Rohrmann & Renn, 2000). In the COVID-19 pandemic, the hazard was getting infected by COVID-19 or not following the biosecurity guidelines. Different studies found that risk perception predicted adherence (Beca-Martínez et al., 2022; Bish & Michie, 2010; Dryhurst et al., 2020; Gerber et al., 2021; Köster et al., 2023; Noone et al., 2021; Parady et al., 2020; Urbano Mejia et al., 2023). People adhered more to protective behaviors to the extent that they consider the negative consequences of contracting COVID-19 more fatal and likely. Nevertheless, there were probably idiosyncrasies in which risks or consequences mattered for each person.

People typically evaluate risks along two dimensions (Rohrmann & Renn, 2000; Slovic, 1987): dreadfulness of risk (the consequences are fatal and uncontrollable) and unknown (the consequences are unknown or unpredictable). During the pandemic, people perceived some dread risks such as getting infected, others being infected, health damage, death, and global disaster. On the other hand, people perceived unknown risks, such as not knowing whether one or the other person is infected (uncertainty) or that the symptoms are delayed (Gerhold, 2020; Shen et al., 2021).

Some situations could be related to higher risks. In particular, people could perceive more risk of infection in certain situations than others. For example, people reported a higher probability of getting infected in closed and crowded spaces or public transport than in education or health centers and on-site work (Beca-Martínez et al., 2022; Jroundi et al., 2023; Rodríguez-Blázquez et al., 2021). Underestimating the risk in specific situations could have posed a challenge in preventing infection.

1.3 Functional Assessment of Protective Behaviors against COVID-19

Functional assessment is a tool for studying the subjective value of adhering to protective behaviors. Functional assessment is a tool to identify the contingencies that

maintain or decrease the behavior (Cooper et al., 2020; Peterson & Neef, 2020), systematically examining the relationship between behavioral classes, antecedents, and consequences (Miltenberger et al., 2019). Functional analysis helps identify contingencies maintaining a high or low frequency of protective behaviors. Couto et al. (2020) and Shawler and Blair (2021) proposed a model for making a functional analysis of protective behaviors based on Daniels and Bailey (2014)'s PIC/NIC analysis designed for organizational contexts. The proposal consists of identifying the concurrent antecedents and consequences of specific behavior and analyzing the characteristics of its consequences (see Couto et al. (2020) and Shawler and Blair (2021) for examples of these analyses). The consequences classification is in three axes: i) positive (P) or negative (N), ii) immediate (I) or delayed (D), and iii) certain (C) or uncertain (U). Also, Couto et al. (2020) proposed replacing positive/negative by reinforcing and punitive and classifying antecedents as salient or faded and discriminative or neutral.

Behavior analysts habitually use functional assessment from an individual approach to identify individual contingencies (idiosyncratic approach). Nevertheless, researchers can use it to identify cultural contingencies (nomothetic approach), i.e., antecedents and consequences that work for most people. Horner and Kittelman (2021) propose expanding the analysis unit to include larger groups. The implementation of ABA on a large scale starts with defining the core features of effective environments; it means contextual events (antecedents and consequences) that sustain positive behavior. Embry (2004) and Embry and Biglan (2008) labeled these features as kernels. Kernels are indivisible procedures with experimental evaluation that produce reliable effects on behavior at a population level (for example, verbal praise and time out). Functional assessment helps identify whether a consequence or antecedent is a kernel if people generally report that it maintains a positive behavior.

Three functional assessment methods exist. Indirect Functional Assessment (IFA) is one of them. This method uses structured interviews, checklists, rating scales, or questionnaires to identify possible events in the natural environment that correlate with the

target behavior. The information about functional relationships is reported by those familiar with the person exhibiting the target behavior (e.g., caregivers) or by the individual himself or herself (Peterson & Neef, 2020).

Researchers can use self-report IFA for individuals to describe the contingencies or rules that controlled their behaviors during the COVID-19 pandemic. Korotitsch and Nelson-Gray (1999) stated that individuals have difficulty identifying and reporting the variables that control their responses. Nevertheless, Callaghan and Darrow (2015) suggested it is plausible that functional assessments via self-report may successfully identify causal and maintaining variables. Also, IFA is helpful for larger-scale implementation of behavior analysis (Bruni & Lancaster, 2019). So, IFA with self-report could help to identify the core features or kernels that promote protective behaviors against COVID-19 on a large scale.

2. Social Antecedents and Consequences

2.1 Social reinforcement and punishment

During the COVID-19 pandemic, social consequences partially influenced protective and risky behaviors. The behavior of others (verbal or nonverbal) can increase or decrease the likelihood of adherence; this process is known as social reinforcement or punishment (Bento et al., 2020). Operant behaviors whose consequences are mediated by other individuals are considered social behaviors (Sampaio & Andery, 2010; Skinner, 1953). Given the characteristics of social consequences, it is likely that social reinforcement partially explained adherence and, therefore, that protective behavior was social behavior. As Couto et al. (2020) and Shawler and Blair (2021) mentioned, social consequences were the most contiguous and likely compared to other consequences. Baum (2000) stated that many self-controlled behaviors (likely adherence to protective behaviors) are strengthened in the short term by social reinforcers delivered by rule-givers because long-term consequences have little effect on behavior. Also, most protective behaviors occur in the presence of others (precisely because others are a risk factor), so they receive constant social feedback in the short term.

Social consequences have some characteristics that facilitate learning, maintenance, and generalization of adherence to protective behaviors among contexts. Guerin (1992, 1994) and Sampaio and Andery (2010) mentioned that social reinforcement is usually generalized, intermittent, variable, adjustable, concurrent with other consequences, complex, and comes from different sources. Social consequences are one of the main behavioral traps or natural contingencies of reinforcement that make behavior challenging to extinguish and easy to reinforce in natural contexts, as Baer and Wolf (1967) and Kohler and Greenwood (1986) mentioned.

Some social consequences are important reinforcers for the human species and likely universal. Skinner (1953) stated that several social consequences are generalized

conditioned reinforcers because they are paired with many primary reinforcers. He argued that these are necessary conditions for accessing other reinforcers. In addition, Baum (2017) and Vollmer and Hackenberg (2001) claimed that some aspects of social stimuli, like eye contact, smile, facial expressions, vocal intonation, body language, and physical contact, are reinforcers or punishers on their own. They are unconditioned (primary or what Baum, 2012, 2018 later called a Phylogenetically Important Event). Baum (2017) stated that genes make certain social events important because of their potential for group selection. Groups can shape the behavior of their members with social reinforcers and punishers and thus facilitate cooperation, competition, and group survival. Baum (2017) also stated that social reinforcers work between family members, affiliated peers, and sometimes strangers. Also, Embry (2004) and Embry and Biglan (2008) mentioned verbal praise, reprimand, pleasant greeting with or without positive physical touch, massage, brushing, or stroking (some social consequences) like kernels.

Despite the apparent universality of social reinforcement, there is a high idiosyncrasy in what stimuli are reinforcers for each person. Social consequences have different topographies like praise, reprimands, verbalizations, compliments, feedback, pleasant comments, etc. Some social consequences are more effective than others (Cooper et al., 2020; Vollmer & Hackenberg, 2001). However, one social consequence could be reinforcing for someone but neutral for another or even punishing; people can have different social reinforcer preferences (Morris & Vollmer, 2019; Vollmer & Hackenberg, 2001). Also, for each person, different elements or configurations of social stimuli may control or reinforce his or her behavior (what McIlvane & Dube, 1992 call stimulus control topography). There are no formal classifications of social reinforcers; however, behavior analysts often mention some types. Flora (2000) and Skinner (1953) appointed some types: attention, approval, affection, and submissiveness. These types are challenging to define, observe, and measure, but behavior analysts use them constantly. It is unclear whether they are entirely different topographies or different levels of complexity (e.g., affection as a more complex form of attention).

2.1.1 Social approval and disapproval

Social approval is a positive evaluation, acknowledgment, and acceptance response of an individual or his behavior. On the other hand, social disapproval implies condemnation, rejection, or negative judgment of an individual or its behavior (American Psychological Association, 2015). Approval and disapproval inform the receiver that his or her behavior is correct and desired or incorrect and undesired. Social approval is likely to be a universal social reinforcer. In contrast, social disapproval is likely to be a universal social punisher. Social approval could be encouragement, gratitude, praise, or feedback. In contrast, social disapproval for not following guidelines could be messages of correction, reprimand, or displeased responses. People could express social disapproval for following guidelines toward mockery, criticism, or invalidation messages.

Psychologists have studied social approval extensively outside of behavior analysis with the concept of social norms, which is typical of social psychology. Others influence a person's behavior in basically two ways: normative and informational influence (Deutsch & Gerard, 1955; Packer et al., 2021). Social norms refer to group-based standards or rules regarding appropriate behaviors. There are two types of norms: descriptive and injunctive. Descriptive norms (normative influence) refer to the perception of what most people do; injunctive norms (informational influence) refer to what most people approve or disapprove of (Cialdini et al., 1991). In behavioral terms, descriptive norms refer to observational learning (do something because others do the same), and injunctive norms refer to social reinforcement (do something because others give social approval).

Approval and disapproval in social interactions may influence adherence to protective behaviors. The more people perceive that following the guidelines brings approval or not following brings disapproval, the more likely they are to follow the guidelines. Some studies found that injunctive norms predict mask-wearing (Dillard et al., 2021), physical distancing (Friemel & Geber, 2021; Rozendaal et al., 2021), intention to stay home (Macy et al., 2021; Owens et al., 2022), and general compliance with COVID-19 guidelines (Barbosa et al., 2023; Blackburn et al., 2023; Cheng et al., 2022; Gaeta González

et al., 2021; Higuchi et al., 2021; Kojan et al., 2022; Latkin et al., 2022; R. A. Smith et al., 2022). Nevertheless, one study found that injunctive norms did not predict future mask-wearing (Heiman et al., 2022) and general compliance with COVID-19 guidelines (Eckel et al., 2021; Zhou et al., 2023). Also, campaigns highlighting injunctive norms (with messages that show the people's approval) increase adherence (Cucchiarini et al., 2021; Dillard et al., 2021; Martínez et al., 2021; R. A. Smith et al., 2021).

There is uncertainty about whether protective behaviors were socially controlled by positive reinforcement contingencies or aversive control. Aversive control refers to control by positive punishment, negative punishment, or negative reinforcement, which usually entails the threat of punishment (Baum, 2017; Catania, 1998). High adherence could be maintained by positive reinforcement (e.g., receiving social approval), negative reinforcement (e.g., avoiding social disapproval), or both (multiple control). Low adherence could be maintained by positive punishment (e.g., social disapproval toward rules-following) or negative punishment (e.g., loss of quality in the interactions). R. A. Smith et al. (2021) suggested that adherence depends on the approval/disapproval rate. They found that people who experienced more disapproval than approval presented more problematic profiles of self-care against COVID-19 than those who experienced more approval than disapproval.

Some evidence suggests no negative reinforcement but positive punishment toward adherence. Schumpe et al. (2022) found that the perception of receiving condemnation when people deviate from the rules ("negative reinforcement to compliance") did not predict adherence to any protective behavior. Also, Dillard et al. (2021) found that receiving negative responses toward mask-wearing, like teasing, validation, or anger (positive punishment to compliance), decreased mask-wearing while receiving corrections or anger responses by not wearing a mask did not increase adherence ("negative reinforcement to compliance"). Latkin et al. (2022) found that individuals who thought their friends would see them as rude for following rules (social punishment to compliance) decreased their adherence.

2.1.2 Loss of social gratification

A decrease in the quality and quantity of social interaction could be another consequence that influences protective behaviors. One of the most reported consequences of isolation and other protective behaviors was loneliness and decreases in social interactions or their quality (Buecker & Horstmann, 2022). Some COVID-19 measures decreased the quality of social relationships in aspects like intimacy, connection, communication, support, and norms (Bondoc et al., 2022; Long et al., 2022). For example, mask-wearing can negatively affect emotional recognition (Dantas et al., 2023; Freud et al., 2020; Marini et al., 2021) or speech understanding (Freitag & Tejada, 2022; Yi et al., 2021). Interacting according to the guidelines (wearing a mask, no physical contact, and physical distancing) made people feel that their social interactions were less rewarding (negative punishment). Consequently, people ignored the guidelines to maintain the subjective value of social interactions. Crandall et al. (2022) found that interacting with mask-wearing did not affect social interaction gratification in a pre-pandemic experiment. However, in the experiment context, using masks was the exception rather than the norm.

Psychological states produced by following the guidelines could increase the value of social interaction as reinforcers and facilitate risky behavior. For example, people who stayed at home quarantined for an extended period (i.e., deprivation of social interaction) highly valued seeing friends and having social interactions (Shawler & Blair, 2021). Schultz and Newman (2022) found that individuals who felt lonely (motivation to search for companionship) were less willing to comply with protective behaviors than those who did not. Also, Ayers et al. (2022) found that stress, isolation, and guilt for not being able to interact in person with friends were associated with greater COVID-19 risky behavior, such as making and visiting new friends in person. Therefore, it is essential to identify which situations made individuals feel that their social interactions with adherence were less rewarding.

2.2 Social Antecedents and social distance

People did not adhere to protective behaviors equally in all situations (Guevara Beltran et al., 2021). Few studies have explored the antecedents that controlled adherence to protective behaviors in natural settings. It is unclear which dimensions or configurations (stimulus control topography) of social contexts (antecedents) controlled the behaviors. By investigating environmental antecedents, behavior analysts can identify situations influencing decision-making and discounting behavior during a pandemic (Belisle et al., 2022). Guevara Beltran et al. (2021) suggested that the context of the activity and its type (work, leisure, exercise, or another category) influence the extent to which individuals adhere to protective behaviors. Also, some studies suggested the physical characteristics of the social contexts (indoor vs. outdoor).

Adherence to protective behaviors was sensitive to social contexts (English & Li, 2021; Zheng et al., 2022). In some situations, people adhered more than others (Guevara Beltran et al., 2021). Some studies found that mask-using was lower in indoor public spaces (e.g., grocery stores and retail stores) than in outdoor contexts (e.g., parks, sidewalks, and commercial areas; Gette et al., 2021; Jagadeesan et al., 2021). Although in places like universities (Barrios et al., 2021) or airports (Tolentino et al., 2022), adherence was higher indoors than outdoors. Mask-wearing was lower during social gatherings than during workplace or public spaces (Al Naam et al., 2021). People reported a higher frequency of mask-wearing during routine activities than leisure activities; for example, people reported more adherence at work than at beaches, restaurants, gyms, or parties (Guevara Beltran et al., 2021). In some contexts (like home and workplace), there was more skin-to-skin contact, duration, and frequency of social contact (Zheng et al., 2022).

The presence of another person or certain characteristic or behavior could control adherence to protective behaviors. People were likely to wear/adjust the mask or move away if someone approached them on the street. Some studies found opposite to common belief, that people tended to physically distance themselves more from someone if that person wore a mask than if they did not (Aranguren, 2022; Seres, Balleyer, Cerutti,

Danilov, et al., 2021; Seres, Balleyer, Cerutti, Friedrichsen, et al., 2021). Another study found that people generally avoided potentially risky scenarios, such as coming into proximity with individuals not wearing face masks and showing intention to interact by initiating a handshake (Kühne et al., 2022). For some people, different features of others could facilitate or inhibit adherence, for example, age, sex, race, social closeness, status, or the degree to which it follows the measures.

2.2.1. Others' behavior

Observing others engaging in protective measures may have been a social antecedent that controlled adherence (Shawler & Blair, 2021). Possibly, individuals only adhered to the behaviors in certain situations because the people present also adhered to the behaviors. Observational learning can explain this phenomenon. Observational learning is a correspondence relationship where individuals learn by observing and imitating the actions of a model (Pierce & Cheney, 2017). Two forms of observational learning can explain COVID-19 measures adherence: generalized imitation and complex observational learning. A person has a generalized imitative repertoire when they can imitate new responses and when not every instance of imitation receives reinforcement (Baer & Sherman, 1964). During the COVID-19 pandemic, people imitated the adherence behaviors in each situation and occasionally received reinforcement, probably social. Pierce and Cheney (2017) stated that the temporal distance between the model and the imitation or between the imitation and reinforcer can be wide. In addition, individuals could follow guidelines through complex observational learning. It is when a person responds differently based on a model's observed behavior and consequences (Greer et al., 2006; MacDonald & Ahearn, 2015). Individuals increase their behavior if they observe reinforcement of the model's behavior or decrease behavior if they observe punishment (Bandura, 1965). During the pandemic, individuals might reduce risky behaviors if they perceived that others who violated the guidelines received a social reprimand or negative consequences such as getting seriously ill or dying. Pierce and Cheney (2017) stated that complex rules are in this process, such as

"what happens to others can happen to me" (a form of tracking) or "others will be proud of me if I follow guidelines" (pliance).

Studies outside behavior analysis have widely studied the influence of others' behavior under the name of descriptive norms. As mentioned, descriptive norms refer to the perception of what most people do (Cialdini et al., 1991). Some studies found that descriptive norms predict mask-wearing (Dillard et al., 2021; Heiman et al., 2023), physical distancing (Friemel & Geber, 2021; Rozendaal et al., 2021), intention to stay home (Owens et al., 2022), and general compliance with COVID-19 guidelines (Blackburn et al., 2023; Eckel et al., 2021; Gerber et al., 2021; Gette et al., 2021; Higuchi et al., 2021; Kojan et al., 2022; Zhou et al., 2023). Nevertheless, some studies found that descriptive norms did not predict general compliance with COVID-19 guidelines (Cheng et al., 2022). Influence of descriptive norms over adherence maintained throughout the pandemic (Eckel et al., 2021; Heiman et al., 2023; Zhou et al., 2023).

Descriptive norms can change according to the context, identity, and moment. Gette et al. (2021) found that people reported more adherence and descriptive norms indoors than in outdoor contexts. Descriptive norms had a more intense effect on people with a certain identity than others; for example, in the USA, conservative people tended to follow more descriptive norms than liberal people (Dillard et al., 2021).

2.2.2. Social distance

In social interactions, others' social distance can predict adherence to protective behaviors. Social distance is a psychophysical measure of proximity that indicates how an individual feels toward another person (Jones, 2022). Adherence to protective behaviors is more likely when the other is a distant person (acquaintance or stranger) than a close person (friend or relative; Andrews, 2022; Binter et al., 2023; De Vries & Lee, 2022; Lipsey & Losee, 2023; Ludwig & Strack, 2022; Shamloo et al., 2023; Shukla et al., 2021; Strickland et al., 2022; Zheng et al., 2022). The shorter the social distance from the other (more closeness), the fewer people report using face masks when interacting with the other

(Strickland et al., 2022). People reported that they were less likely to wear a face mask, maintain physical distance, and wash their hands properly when interacting with another person when the other person was close to them. In addition, they were more likely to avoid meeting someone close than distant (Shamloo et al., 2023). People reported a higher risky behavior with friends than with strangers or neighbors (Shukla et al., 2021). People were less likely to wear a mask in a conversation in a public park with a friend than strangers. However, people were more willing to cancel a date with a friend than a stranger when they suspected they were infected (Ludwig & Strack, 2022). People reported being more likely to meet a friend at a coffee shop or restaurant than an acquaintance. In addition, when information about protection came from a friend, people reported spending less on health protection items (De Vries & Lee, 2022). People reported that they were more likely to allow another to visit, to lend an object to another, and to share a car during the pandemic when the other was a friend or parent than a partner (Andrews, 2022). People prefer to keep the mask when interacting with a stranger. Suppose people interact with a relative, and the relative removes the mask. In that case, they tend to remove it and avoid insisting that the relative put it back on (Binter et al., 2023). People perceived that on a visit with close friends and family, they and their friends/family would wear fewer masks. In addition, they would form a less negative impression if friends/family did not wear masks and believed that friends/family would form a less negative impression if they did not (Lipsey & Losee, 2023). These findings suggested that social closeness is a risk factor for adherence to protective behaviors. Nevertheless, Salgado and Berntsen (2021) found that participants report a higher likelihood of complying with masks, sanitizer use, and physical distance for themselves and close other than for an acquaintance (the opposite).

Individuals perceived a lower risk of contagion with close others than distant ones (De Vries & Lee, 2022; Salgado & Berntsen, 2021; Shamloo et al., 2023). De Vries and Lee (2022) found that people perceived less re-infection probability when the source was a friend than a stranger. Shamloo et al. (2023) found that people perceived a higher probability of getting infected by the other and were more likely to infect and affect the

other if the other was close than distant. This lower risk perception leads to a decrease in preventive behavioral intentions. Cruwys et al. (2020) and De Vries and Lee (2022) suggested that when people are with close others, they feel safer and decrease people's risk perceptions, which could result in more COVID-19 risky behaviors of COVID-19. De Vries and Lee (2022) called this phenomenon the friend-shield effect. One explanation is that participants had an optimistic bias. Salgado and Berntsen (2021) found that people believe an acquaintance is more likely to become infected with COVID-19 in the future or be infected without showing symptoms than a close acquaintance or themselves. In addition, people believe an acquaintance would become infected sooner than oneself or a close other. Nevertheless, Ludwig and Strack (2022) did not find significant differences in the perceived risk of contagion between friends and strangers.

Technically, social distance is not an antecedent; it is a measure that describes the emotional closeness to a social antecedent (a person) obtained from a verbal report of the participant. Most studies measure social distance on an ordinal scale (Safin & Rachlin, 2020). Researchers usually ask participants to imagine a list of the 100 people closest to them, where position #1 belongs to the participant's dearest person and position #100 to the most distant acquaintance (Buddiga & Locey, 2021a; Jones & Rachlin, 2006). Some studies then asked participants to write down the names of the people who would occupy positions 1, 2, 5, 10, 20, 50, and 100 (Buddiga & Locey, 2021b; Locey et al., 2011). Studies used names to ensure that participants make choices concerning specific persons rather than abstract persons and avoid post-choice identification (Buddiga & Locey, 2021b). Usually, participants put relatives in the first positions (Hackman et al., 2015; Jones & Rachlin, 2006; Rachlin & Jones, 2008). Nevertheless, consanguinity is not the only variable accounting for social closeness; people tend to assign lesser social distance to those with whom they have shared more interaction time (Gil Mateus, 2023).

2.3. Modulation of social distance in the relationship between contextual events and adherence to protective behaviors

The degree of stimulus control of a social antecedent or consequence depends on the person who emits it. Consequences such as social approval or disapproval are more valuable to people if they come from others close to them than from distant others. Similarly, antecedents such as another's behavior or requests are more valuable if the other is close. Tunçgenç et al. (2021) assessed the influence of the other´s adherence and approval and their interaction with three social scales (close circle, country, and world) on physical distancing. Regarding other´s adherence, authors found that the most influential is the adherence of the close circle; the world had little effect, and the country influenced the adherence only by people closely bonded with their country. Regarding other´s approval, participants' adherence was influenced mainly by the approval of the close circle, and little and in a negative way for the approval of the citizens and people of the world. In general, the other's adherence explained more than approval. In an observational study, Woodcock and Schultz (2021) found that people had the same mask-wearing status as their partners. However, the proportion was higher if the partner was close (83%) than unknown others (33%). Zhou et al. (2023) found that neighbors' adherence behavior influences health behaviors, but citizens´ behavior or others´ approval did not. In COVID-19 vaccination, a close phenomenon, close groups influenced COVID-19 vaccination more than distant groups (Rabb et al., 2022). Also, in problematic behaviors, such as smoking or drinking, close people had more influence than distant people (Borsari & Carey, 2003; Larimer et al., 2011; Phua, 2013; Yanovitzky et al., 2006).

From the social identity approach and social psychology, social identity or group belonging explains why someone influences one´s behavior (Brown, 2020; Reicher et al., 2010; Spears, 2021). The close people are usually friends or family. For an individual, close people are more influential because they are part of one or more groups with which he/she identifies. Specific situations can trigger social identity with the group and increase conformity to group norms (Neville et al., 2021; Stets & Burke, 2000). Individuals belong

to multiple groups, such as family, friends, the neighborhood, same-gender or same-race communities, workplaces, or nations. For example, suppose an individual identifies with his family but little with his neighborhood. In that case, his mother's behaviors will have more influence than his neighbor's. If an individual highly identifies with his nation, other citizens' approval will be a reinforcer.

An individual conforms to his group's norms when the individual feels affinity or belonging to the group (Graziani et al., 2022; Lapinski & Rimal, 2005; Neville et al., 2021; Packer et al., 2021). Reactions to deviations from social norms are one mechanism that explains conformity. Packer et al. (2021) pointed out that in the context of the pandemic, reactions to the violations may have varied depending on how important compliance with the guidelines was to the group. When adherence to guidelines was not a central goal of the group, individuals were more punitive of outgroup violations than ingroup violations (intergroup hypocrisy) for maintaining a positive group image. That explains why adherence was lower with close others than with distant others. When guidelines adherence violation is a central goal of the group that differentiates it from other groups, individuals were more punitive of ingroup goal violations. If individuals perceived that norm violation caused harm to ingroup members by increasing the risk of infection or death, individuals showed strong negative reactions toward deviants. Graziani et al. (2022) and Marinthe et al. (2022) found that belongingness with family or friends (close groups) is more predictive of adherence to guidelines than belongingness with the nation or humanity (distant groups) because the person perceives COVID-19 as a threat to his or her close groups. Also, Shahnawaz et al. (2022) found that identification with the nation and the family in India predicted adherence.

Social distance may mediate the loss of social gratification in social interactions as a negative punishment for adherence to protective behaviors. As Gil Mateus (2023) stated, people allocate more interaction time to those they consider close to them. Thus, individuals may experience a greater loss of social gratification with those close than with

distant ones. In addition, the loss of social gratification is likely to be experienced more intensely when the other is closer than distant.

2.4. Research question and objectives

Given that behavior analysis is a useful approach to understanding the contextual variables that affect adherence, and studies can use IFA to study social phenomena on a large scale, this thesis aimed to assess how social antecedents and consequences influenced adherence to protective behaviors against COVID-19 on a large scale from a behavior analysis approach using an indirect functional assessment. Study 1 explored two general social contexts as antecedents (indoor and outdoor) and four social consequences (potential reinforcers and punishments of social approval, disapproval, and loss of gratification). Study 2 explored the social distance of the other as a more specific antecedent and its modulation over another antecedent (behavior of other) and some social consequences (social approval, disapproval, and loss of gratification).

3. Study 1

Study 1 evaluated the relationship between some social antecedents, some perceived social consequences, and reported adherence to COVID-19 protective behaviors. The four selected protective behaviors were mask-wearing, hand washing, physical distancing (self-oriented), and correcting others (others-oriented) in two social contexts (outdoor and indoor with visitors). The four selected social consequences (one for each contingency type) were Receiving Social Approval (RSA; likely positive reinforcer), Avoiding Being Judged (ABJ; likely negative reinforcer), Receiving Social Rejection (RSR; likely positive punisher), and Losing Gratification in Social Relationships (LGSR; likely negative punisher). The four contingencies helped assess whether adherence was controlled by positive reinforcement or aversive control and whether reinforcers were more likely than punishers.

The hypothesizes were:

- H1: Adherence to protective behaviors would be higher outdoors than indoors with visitors.
- H2: The more perceived RSA and ABJ for adherence to protective behaviors, the greater adherence to protective behaviors
- H3: The lower perceived RSR and LGSR for adherence to protective behaviors, the greater adherence to protective behaviors

3.1. Method Study 1

3.1.1. Participants

Five hundred eighty-seven Colombian residents (25.2% men, 73.6% women, and 0.5% non-binary) with ages between 18 and 79 years (M = 35.80; SD = 13.69) participated in the study. Fifty participants were excluded from the study because they scored the same on all social consequences (see instrument section), demonstrating a lack of attention to the items.

3.1.2. Instruments

A virtual survey made in *Google Forms* presents the instrument. The instrument had seven sections: a) informed consent, b) sociodemographic information, c) protective behaviors, d) exposure to the contexts and e) social consequences.

One instrument in Spanish assessed frequencies of protective behaviors, exposition to the contexts, and social consequences when adopting protective behaviors. Three experts reviewed the initial items to ensure their content validity and made suggestions about the content and writing. They used a content validity form based on the one proposed by Escobar-Pérez and Cuervo-Martínez (2008). The experts were a behavior analyst, a psychometric psychologist, and a health psychologist. Four people participated in a pilot test. They gave feedback on understanding the items and the words used. After that, the corrections were made.

Protective behaviors

Eight items assessed how much participants adhered to protective behaviors against COVID-19 in two specific social contexts. The four behaviors assessed were: mask-wearing, physical distancing, hand washing, and correcting others. Operationalization of protective behaviors was based on the descriptions made by the CDC (2022) and the WHO (2022b). The two contexts were being outside and being at home with visitors, two situations where social agents carry a contagion risk. The items had the following structure:

"When I am in the *social context*, I perform the *protective behavior*." This structure is similar to the other indirect behavioral assessment scales used (Iwata et al., 2013; Lewis et al., 1994; Matson & Vollmer, 1995), with the difference that this is a self-report type and no other report. The social context was in bold to facilitate the participants' differentiations of the items. These items were scored on a 5-point Likert frequency scale (1 = never, 2 = almost never, 3 = sometimes, 4 = almost always, 5 = always). Protective behavior definitions were before the items in the survey to ensure that the participants estimated the frequency of the behaviors with the appropriate topographies. Table 1 shows the operational definitions of contexts and protective.

Table 1.
Variable definitions

Variable	Levels	Definition
Protective behavior	Mask-wearing	The proper use of a mask consists of completely covering the nose, mouth, and chin and adjusting it so that there are no gaps on the sides.
	Physical distancing	Proper physical distancing is to stay at least one meter away from people who do not live with you.
	Hand-washing	Proper hand-washing consists of washing hands with soap and water and rubbing the soap for more than 40 seconds. Proper hand disinfection consists of rubbing alcohol or hand sanitizer completely over the hands and allowing them to dry. Washing and disinfection should be done after touching any surface or object that likely has been handled by others.

Variable	Levels	Definition
	Correcting others	A reprimand refers to verbally correcting or disapproving a person for not following biosafety guidelines.
Social context	Being outdoors.	It means being away from home in crowded places, where one is likely to interact with strangers or acquaintances, for example, on the street, on public transport, or in stores.
	Being indoors.	It means being at home with visitors (people who are not household members) in interaction situations such as gatherings.

Note. Definitions are based on the CDC (2022) and the WHO (2022b) descriptions.

Exposure to the contexts

Two items assessed the frequency of exposure to the two social contexts (outdoor and indoor with visitors). The items were "I go outside and pass crowded places" and "I receive visits from people who do not live with me." These items were scored on a 7-point Likert frequency scale (0 = never, 1 = 1 to 5 times a month, 2 = 6 to 10 times a month, 3 = 11 to 15 times a month, 4 = 16 to 20 times a month, 5 = 21 to 25 times a month, 6 = 25 to 30 times a month).

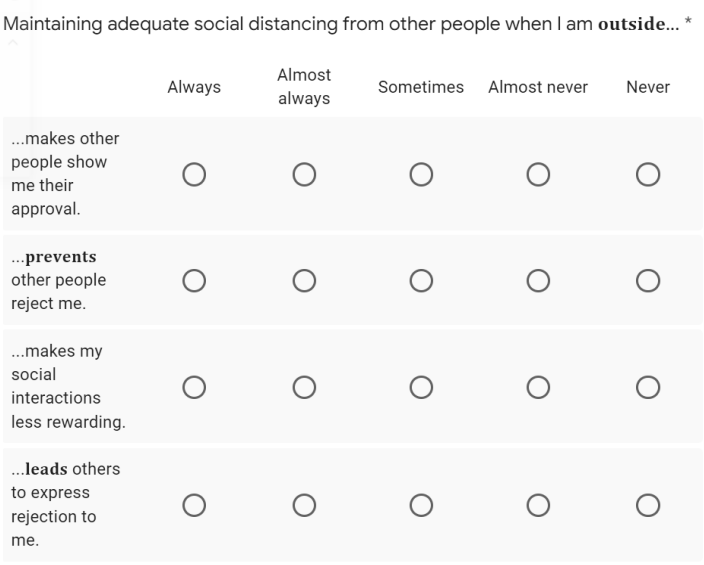
Social consequences

Eight multiple-choice grid items assessed the perceived frequency of receiving certain social consequences when adhering to a protective behavior. The multiple-choice grid item consisted of the statement´s main part and the grid. Each grid row was the statement´s complement part, and each column was a response option. The statement´s main part according to the following structure: "Doing *the protective behavior* in *the social context*...", and the statement´s complement parts with the structure "...causes me to *receive*

the social consequence" (see Figure 1). The items presented some social consequences in bold to facilitate the participants to differentiate the items. The instrument assessed four social consequences for the four protective behaviors in the two social contexts mentioned above. These items were rated on a 5-point frequency scale (1 = never, 2 = almost never, 3 = sometimes, 4 = almost always, 5 = always).

Figure 1.

Example of multiple-choice grid item



3.1.3. Procedure

The study consisted of the virtual and massive application of the instrument. The survey dissemination was through social media networks (Facebook and Instagram). Also, the survey was shared with acquaintances and academic colleagues and asked them to share it. In addition, there were paid ads on Facebook and Instagram so that the survey reached as many Colombian residents as possible. The collection lasted 102 days. It started on July 30 and ended on October 10, 2021 (10 days after the planned finalization date). The incentive for participating was an opportunity to participate in a raffle with three financial rewards: one of $150.000 COP (approximately $38 USD) and two of $50.000 COP (approximately $13 USD).

3.1.4. Open science

There was a pre-register in *Open Science Framework* made on August 31, 2021 (https://osf.io/7kc93/?view_only=cd4067869c5641928951dac04286db47). All the data and the instrument are available in the repository (https://osf.io/7rhn6/?view_only=cd4067869c5641928951dac04286db47).

3.1.5. Ethical guidelines

The Faculty of Human Sciences of the Universidad Nacional de Colombia Ethics Committee gave the ethical approval *B.VIE-FCH-097-2021* to the research on July 29, 2021. This study followed the ethical guidelines of *Law 1090 of 2006* (deontological and bioethical code for the practice of psychology in Colombia), the *Ethics Code for Behavior Analysts* (Behavior Analyst Certification Board, 2020), and the *Ethical Principles of Psychologists and the Code of Conduct* (American Psychological Association, 2017). All participants digitally signed an ethical consent form explaining the research, its benefits, and its risks. The consent explained the rights of the participants, such as confidentiality and the use of information.

3.1.6. Data analysis.

Data analysis was in the statistical software *RStudio* version 1.3.1093 (RStudio Team, 2020) with R version 4.0.3 (R Core Team, 2020). First, the descriptive statistics for the variables were run. Also, an exploratory factor analysis with varimax rotation was run on the items to know the instrument structure. Kaiser criterion was used to determine the number of factors. This criterion consists of retaining factors with variance (eigenvalues) greater than 1.

Second, generalized linear mixed models were run. The model assessed whether social context, exposure to the context, the four social consequences, the interaction between exposure and context, and the interactions between social contexts and the social consequences predict the adherence to protective behaviors (fixed effect). The participant was the random effect. There was a model for each of the protective behaviors. This model was different from the planned model 1 in the preregister. It was pertinent to add the exposure and the interactions to the planned model to better understand the phenomenon. This analysis aimed to assess how much the perception of receiving specific social consequences predicts the adherence level to protective behaviors. This does not necessarily indicate functional relationships between behavior and consequence.

Third, the difference in adherence to protective behaviors and the difference in perceived social consequences between contexts was calculated. The difference was calculated by subtracting the score of the outdoor context from the indoor context. A linear regression model was run to assess whether changes in perception of receiving the four social consequences predicted changes in adherence to protective behaviors (exploratory analysis). An increase in consequence accompanied by an increase in adherence suggests social reinforcement. Conversely, an increase in consequence accompanied by a decrease in adherence suggests social punishment.

Fourth, the changes were classified in adherence and the perception of social consequences into three categories: increase, no change, and decrease. Each behavior-consequence relationship was classified into five groups: group 1 (no behavior change and no change in consequences), group 2 (insensitivity to consequences: no behavior change and change in consequences), group 3 (reinforcement: behavior change and change in consequence in the same direction), group 4 (behavior change with no change in consequences), and group 5 (punishment: behavior change and change in consequence in the opposite direction). The proportion of people in each group was calculated, differentiating people with behavioral change and those without (exploratory analysis).

The second planned model in the preregister was discarded from this study to maintain the focus on social contextual factors.

3.2. Results Study 1

3.2.1. Descriptive statistics and instrument structure

Colombian residents generally reported high adherence to protective behaviors, as shown in Table 2. Mask-wearing was the behavior with the highest adherence while correcting others was the lowest. Adherence was higher in the outdoor context than in the indoor context, except for correcting others. Mask-wearing was the protective behavior with the highest difference between contexts (M = 0.87) and correcting others (M = -0.25), and hand-washing (M = 0.25) were the lowest. In general, the variation was greater in the outdoor context than indoors. The factor analysis retained only one factor that explained 50.1% of the variance. All protective behaviors correlated positively and highly with the factor. The exposure to the outdoor context (M = 1.62) was higher than the indoor context ($M = 0.94$).

Table 2.
Protective behaviors descriptive statistics

Protective Behavior	Social Context	Score *M* (*SD*)	Score Difference *M* (*SD*)	Factor loading
Mask-wearing	Outdoors	4.74 (0.53)	0.87 (1.14)	.59
	Indoors	3.87 (1.24)		.75
Physical distancing	Outdoors	4.44 (0.76)	0.60 (1.03)	.67
	Indoors	3.84 (1.17)		.82
Hand-washing	Outdoors	4.64 (0.63)	0.25 (0.76)	.60
	Indoors	4.40 (0.88)		.69
Correcting others	Outdoors	3.29 (1.29)	-0.25 (0.99)	.69
	Indoors	3.54 (1.30)		.81
Exposure to the contexts	Outdoors	1.62 (1.55)	0.68 (1.50)	
	Indoors	0.94 (0.93)		

Note. Scores for protective behaviors are on a frequency scale of 1 to 5. The higher the score, the more people adhere to protective behaviors. Context exposure scores are on a frequency scale from 0 to 6. The higher the score, the more people are exposed to specific contexts.

The social consequences most frequently reported by participants were positive (RSA and ABJ consecutively). In contrast, the least were the negative consequences (LGSR

and RSR consecutively). Participants reported a higher frequency of positive consequences in the outdoor context than in the indoor context. Also, participants reported a lower frequency of negative consequences in the outdoor context than in the indoor context. The factor analysis retained three factors that explained 66.9% of the variance. The first factor explained 32.3% of the variance, including all the RSR and LGSR items. The second factor explained 20.3% and was composed of RSA items and RSR items about rejecting others. Finally, the last factor explained 14.4%, and it was composed of the rest of the RSR items (See Table 8 Appendix A).

3.2.2. Models for the adherence level to protective behaviors

Table 3 presents the generalized linear mixed model coefficients for each protective behavior. Social context predicted adherence to all protective behaviors. The higher effect was for wearing masks. Also, exposure to the context predicted adherence. This effect interacted with the context, changing the tendency. The more exposure to the indoor context, the lesser adherence to protective behaviors. Nevertheless. The more exposure to the outdoor context, the more adherence to protective behaviors (as shown in Figure 2).

The results suggest that the perceived probability of receiving certain social consequences predicts the general level of adherence. RSA was the strongest predictor for all behaviors, especially for mask-wearing. Also, it interacted with the context in all behaviors except correcting others. For these behaviors, the effect was stronger in the indoor context. Avoiding being judged did not predict adherence, except hand-washing with a slight and unexpected effect. In contexts where hand washing avoids being judged, people tend to wash their hands less (as shown in Figure 2).

The social rejection had the opposite effect as expected. For mask-wearing and physical distancing, people tend to adhere more in contexts where social rejection for adhering to the rule is highly likely. Social rejection interacted with the context for these behaviors. The effect was stronger in the indoor context. Finally, losing gratification in social relationships had an expected effect on mask-wearing and physical distancing. In

social interactions with little sense of loss of gratification, people will adhere more to the rules. Nevertheless, with hand-washing, the effect was the opposite and slight. The less gratification people feel in the interaction, the more they will wash their hands (as shown in Figure 2).

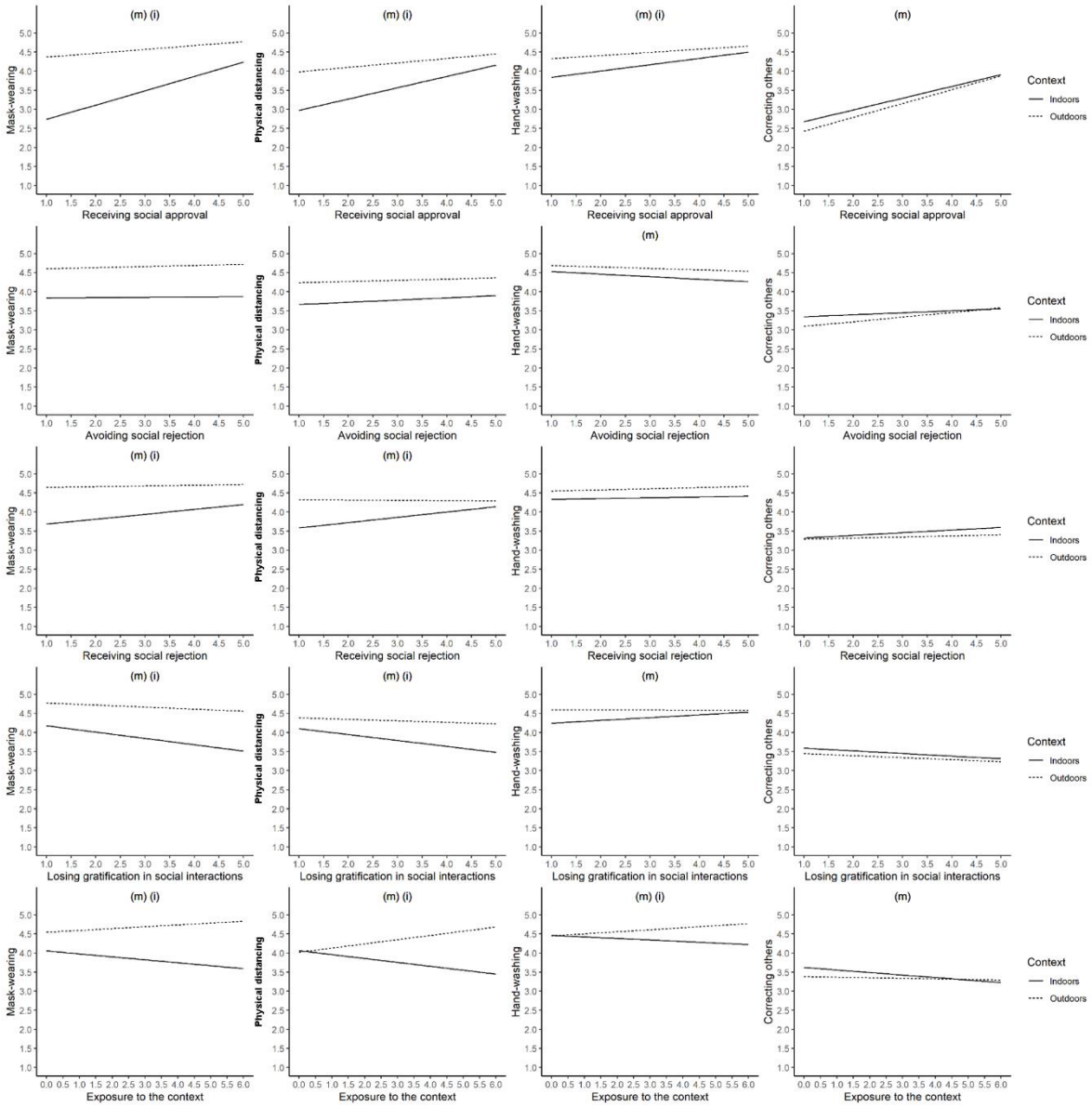
Table 3.
Generalized linear mixed models for the level of adherence

Predictor	Mask-wearing	Physical distancing	Hand-washing	Correcting-others
Intercept	2.71***	2.86***	3.78***	2.38***
Context: Outdoors	1.45***	0.75***	0.39**	-0.58***
Exposure to the context	-0.08***	-0.10***	-0.04*	-0.07**
RSA	0.38***	0.30***	0.17***	0.31***
ABJ	0.01	0.06	-0.07**	0.05
RSR	0.13***	0.14***	0.02	0.07
LGSR	-0.17***	-0.16***	0.07*	-0.07
Exposure * Outdoors	0.13***	0.21***	0.09**	0.05
RSA * Outdoors	-0.28***	-0.18***	-0.08*	0.05
ABJ * Outdoors	0.02	-0.03	0.03	0.07
RSR * Outdoors	-0.11*	-0.15**	0.01	-0.04
LGSR * Outdoors	0.11*	0.12*	-0.07	0.02

Note. * p<.05<; ** p<.01; *** p<.001; RSA = Receive Social Approval; ABJ = Avoid Being Judged; RSR = Receive Social Rejection; LGSR = Lose Gratification in Social Relationships.

Figure 2.

Representation of predictions



Note. Each column represents a protective behavior against COVID-19. Each row represents a social consequence. The last row represents the exposure to the context. The dotted line represents the behavior in the outdoor context. The solid line represents the behavior in the indoor context. Scores for protective behaviors are on a frequency scale of 1 to 5. The higher the score, the more people adhere to protective behaviors. Context exposure scores are on a frequency scale from 0 to 6. The higher the score, the more people are exposed to specific contexts. Scores for social consequences are on a frequency scale of 1 to 5. The

higher the score, the more people perceive receiving the specific social consequence for adhering to the protective behavior. High levels of avoiding social rejection imply low levels of social rejection. High levels of loss of gratification in social relationships imply low social gratification. Each graph represents the relationship between a perceived consequence and adherence. The value of the variables not represented was kept constant with their respective mean to make the graphs.

3.2.3. Models for behavior change between contexts

Table 4 presents the coefficients of the linear models for each protective behavior. None of the social consequences worked as reinforcers or punishers for hand-washing behavior. Social approval worked as a reinforcer for adhering to the remaining protective behaviors. Also, avoiding being judged was a reinforcer for mask-wearing and physical distancing. On the other hand, social rejection for following the measures worked as a punisher for physical distancing and losing gratification in social relationships worked as a punisher for mask-wearing.

Table 4.
Linear models for change in adherence

Predictor	Mask-wearing	Physical distancing	Hand-washing	Correcting-others
Coefficient	0.69***	0.47***	0.24***	-0.19***
RSA	0.27***	0.23***	0.05	0.23***
ABJ	0.16***	0.16***	-0.02	0.06
RSR	-0.05	-0.12*	-0.05	-0.05
LGSR	-0.13**	-0.02	-0.04	-0.05

Note. * p<.05<; ** p<.01; *** p<.001; RSA = Receive Social Approval; ABJ = Avoid Being Judged; RSR = Receive Social Rejection; LGSR = Lose Gratification in Social Relationships.

3.2.4. Changes in behavior and consequences

Frequencies of behavioral changes are in Table 5. Approximately half of the people behave the same in both contexts for all protective behaviors, except for hand-washing, where two-thirds of the sample did not change their behavior. Most people increase their adherence from the outdoor to the indoor context. Table 9 Appendix A presents the distribution of participants. A group of people presented changes in consequences and did not present behavioral changes (between 22.7% and 39.8% of people without behavior change). Of the group of people who presented behavioral changes, approximately half had no change in the perception of consequences (between 40.9% and 66.2%), except hand-washing, which had a higher proportion (between 62.1% and 81.1%). In general, positive consequences worked as reinforcers for a much larger group (32.8% - 48.2%, 22.6% for hand-washing) than they did as punishers (10.9% - 16.6%). Hand-washing was the behavior in that positive consequences worked less as reinforcers. On the other hand, negative consequences worked as punishers for a small group of people (10.0% - 27.2%) and reinforcers for a smaller group (8.9% - 21.4%).

Table 5.
Frequencies of behavioral changes

Protective behavior	Behavior change		
	Increase	No change	Decrease
Mask-wearing	296 (50.4%)	274 (46.7%)	17 (2.9%)
Physical distancing	240 (40.9%)	312 (53.2%)	35 (6.0%)
Hand-washing	143 (24.4%)	397 (67.6%)	47 (8.0%)
Correcting others	84 (14.3%)	334 (56.9%)	169 (28.8%)

Note. Increase means that people adhere more outdoors than indoors; No change means that adherence is the same in both contexts; Decrease means that people adhere more indoors than outdoors.

3.3. Discussion and Conclusions Study 1

This study evaluated the relationship between some social antecedents, some perceived social consequences, and reported adherence to COVID-19 protective behaviors. Results suggested that social antecedents and consequences did affect the adherence level to protective behaviors against COVID-19. People reported changing their behavior according to the social situation and perceived probability of receiving certain social consequences. Social consequences had different effects depending on context. The effect was small but considerable in the indoor context, while the effect was almost null in the outdoor context. Mask-wearing and hand-washing were the main protective behaviors under the control of several social consequences (the more socially sensible). While correcting others and hand-washing was the least. Several contingencies or rules simultaneously influenced adherence (multiple control).

As expected (H1), adherence to protective behaviors was higher outdoors (public or crowded places) than indoors with visitors (home with visitors, a private place). Paradoxically, people follow the guidelines more in contexts with less risk of contagion (Escandón et al., 2021; Fouda et al., 2021). Correcting others was higher indoors than outdoors. The largest differences between contexts were for mask-wearing and physical distancing, precisely the behaviors that occur in the presence of others. Hand washing, a behavior that does not necessarily occur in the presence of others, showed the smallest difference between contexts. Also, results were consistent with Al Naam et al. (2021) about lower mask-wearing in social gatherings (likely indoor context) and Zheng et al. (2022) about more risky behavior were more likely to occur at home or among family members (likely indoor context).

The social distance of the members involved in each social context may explain the difference in adherence between contexts. In the indoor context (likely social gatherings), visitors are usually friends or relatives (people with low social distance). People interact mainly with strangers or acquaintances (people with high social distance) outdoors. Results

of Strickland et al. (2022) are consistent with this idea because the adherence to mask-wearing was lower with close ones.

The selected contexts for this study were not specific enough to determine stimulus control topographies. Future studies can explore more specific contexts like social gatherings (indoor vs. outdoor, small vs. large, with close people vs. distant people, with little isolation vs. much isolation), public transportation, or the workplace.

Results confirmed the hypothesis that the more perceived RSA and ABJ for adherence to protective behaviors, the greater adherence to protective behaviors (H2). At the population level, the more the context presented social approval for following the norms, the more adherence the participants reported. ABJ did not predict the general level of adherence. Nevertheless, the model of behavior changes between contexts showed that ABJ did work as a negative reinforcer. People adhere more to the context in which they perceive more ABJ and RSA. Results suggest that protective behaviors had multiple control, although they were controlled mainly by positive reinforcement contingencies or rules.

Adhering to protective behaviors was also for avoiding or escaping from social disapproval (aversive control). People were sensitive to expressions of dislike or rejection. The findings suggest that correcting and reprimanding the norm-breaking was a social control method in society. In the indoor context, the homeowner possibly was the enforcer. In the outdoor context, the enforcers were possibly authority figures such as policemen, security guards, store owners, etcetera. Possibly other passers-by also corrected, although less likely. Future studies can assess who is the source of disapproval in each context and whether people are sensitive to disapproval from peers or only from authority figures. People reported higher RSA than ABJ, which suggests people are more likely to promote guidelines-following than correct not following in others. It is consistent with the fact that participants reported correcting others infrequently. Although there were no measures to encourage behaviors, these may be greater than correcting behaviors. Results at the population level are consistent with Dillard et al. (2021) and Schumpe et al. (2022), who

found that perceived levels of correcting behavior did not predict the general level of adherence.

Results confirmed the hypothesis that the lesser perceived RSR and LGSR for adherence to protective behaviors, the greater adherence to protective behaviors (H3). There was social punishment for adherence. People decreased their adherence in certain situations because they received a social rejection or felt that interacting was not as rewarding as before. The probability of social rejection at the population level predicted general adherence to protective behaviors. Nevertheless, social rejection worked as a social punisher; people decreased adherence in the context where they perceived more social rejection. Punisher consequences were less likely than reinforcer consequences, and adherence was high. It suggested that in the Colombian sample, the punishment was minimal.

Contrary to expectations, the more people perceive social rejection for following the rules, the more adherence they will show. This contradictory effect is similar to the one found by Bir and Widmar (2021). There are three possible explanations for these results. First, social rejection only functions depending on the relationship to social approval. As R. A. Smith et al. (2021) demonstrated, more approval than disapproval was related to more adherence than the inverse. In this study, participants reported lower rejection levels than approval, which may have produced more adherence. Second, people could have counter-controlled behavior. Countercontrol is a side effect of attempts of aversive control (Fontes & Shahan, 2021; Sidman, 2000). Countercontrol is a response to aversive social control attempts that result in the extinction or punishment of the punishing behavior of the punisher agent (Skinner, 1953). People resist or ignore the expressions of social rejection and adhere more. This would be consistent with Dillard et al. (2021), who demonstrated a similar phenomenon with oppositional behavior. They found that in the USA, the conservatives who received more disapproval for adhering presented more reactance (motivational state produced by the feeling of loss of freedom) to the campaigns for adherence and, therefore, less adherence. Third, there could be problems in understanding

the item of social punishment. Although the pilot participants demonstrated a good understanding of the item, there were no attention checks in the study to ensure that participants interpreted the item correctly. The proportion of participants whose RSR worked as reinforcers was similar to the proportion who worked as punishers, which suggests that many participants may have interpreted the item in reverse (not following the norm causes me to receive social rejection). The findings at the population level were opposed to the finding in the behavioral change between contexts. However, these are complementary findings suggesting that there is also high social rejection in high approval contexts, which does not necessarily function as a reinforcer.

Losing gratification in social relationships was a social punisher for most self-oriented protective behaviors. People who perceived that adhering to the rules (physical distancing and mask-wearing) made their interactions less rewarding adhered less. Therefore, they possibly prefer to interact, not following the guidelines. Adherence was higher for people whose interaction value did not change by adhering. Interacting with physical distancing and mask-wearing could produce psychological states of discomfort, lack of connection, or loneliness that difficult adherence, as Schultz and Newman (2022) found. This phenomenon probably occurred in the late months of quarantine when isolation increased the value of interacting while breaking the norms, as Shawler and Blair (2021) suggested. Future studies can explore which elements of the interactions people experienced as less rewarding, to propose policies to counteract them.

The social context interacts with almost all social consequences for almost all protective behaviors. This interaction demonstrates that approval had a different effect in each context. The approval and disapproval in the indoor context were more reinforcing and punishing than in the outdoor context. The effect on the outdoor context was almost null. The social distance of the people involved in each context can explain this interaction.

People tended to adhere similarly to all protective behaviors. However, there were differences in the social reinforcement for each behavior. Mask-wearing and physical distancing were the protective behaviors that were most socially controlled. While hand-

washing and correcting others were the least. This is consistent with Cheng et al. (2022), who found that injunctive norms (approval) predicted mask-wearing and physical distancing, but not hand washing. Hand-washing is hardly socially controlled because the social reinforcers are distant and not contingent on behavior. Possibly this behavior was controlled by artificial antecedents in the environment, such as signs, posters, washing or disinfecting fountains near the door or in places of transit, or natural consequences of being clean. The findings suggest that protective behaviors that occur in the presence of others are most socially controlled.

The influence of exposure to the contexts on adherence differences in each context was an unexpected result (exploratory analysis). In the indoor context, the greater the exposure, the lower the adherence. In the outdoor context, the greater the exposure, the greater the adherence. Apparently, there is habituation to danger signals, as Tibério et al. (2020) suggested, but only in the indoor context with close people. Whereas on the street, there were likely so many natural or artificial antecedents, the danger response is maintained, and adherence increases with greater exposure.

Some limitations may affect the generalizability of these findings. First, the collection tries to reach a large enough sample to represent all regions of the country. Nevertheless, most participants were from Bogotá D.C. (the capital city of Colombia). As Ruiz-Pérez and Aparicio Barrera (2020) showed, the rate of infractions of the measures during the pandemic differed in the regions of Colombia. Similarly, there could be geographical differences in social feedback. Second, there was a bias in the study. Possibly the people who completed the survey were who agreed with the measures. Likely, there was an underrepresentation of people with low adherence. Third, data collection during the late phase of the pandemic could weaken the data information.

4. Study 2

Study 2 assessed how social distance modulated the relationship between others' adherence behavior, some perceived social consequences, and adherence to protective behaviors against COVID-19. In study 1, people adhered more to the outdoor and indoor contexts. Also, social consequences were more intense in the indoor context than outdoor. One explanation for these two findings is that the social distance of people in each context differs. In an indoor context, there were close others who were more influential. In the outdoor context, there were distant others who were less influential. Therefore, Study 2 explored social distance modulation over adherence behavior. This study also tested whether the indoor context was more likely for people with shorter social distance.

The social consequences were the same as in Study 1 (approval, disapproval, and losing gratification in social relationships). While in Study 1, the social contexts were general antecedents, study 2 used a specific antecedent, a social interaction between only two people (varying the social distance). In Study 1, there could be as much approval as disapproval in one context. However, study 2 used a continuous scale between approval and disapproval because the other could only approve or disapprove of the participant for following the guidelines. Study 2 also explored whether others attend more to following guidelines than not following guidelines. This study only used physical distancing and mask-wearing, the two socially controlled protective behaviors that Study 1 suggested. Finally, this study explored whether social distance influenced the perceived risk of contagion and whether perceived risk was related to adherence behavior.

The hypotheses were:

- H1: People would increase their adherence to protective behaviors with distant people than with close people.
- H2: The perceived risk of contagion would increase as social distance increases.
- H3: Gratification and loss of gratification for adherence to protective behaviors in social interactions would decrease as social distance increases.

- H4: Social distance, others' behavior, compliance approval, non-compliance approval, perceived risk of contagion, loss of social gratification, and the interaction of these variables with social distance predict adherence to protective behaviors.
- H5: Social distance and the interaction between social distance and sociodemographic variables (same sex, age difference) of the other and consanguinity predict adherence.
- H6: The discounting of indoor interaction with social distance is more pronounced than the discounting of outdoor interaction with social distance.

4.1. Method Study 2

4.1.1. Participants

One hundred fifty-two individuals (66.4% women and 33.6% men between 18 and 87 years; M = 30.91; SD = 12.50) participated in the study. Most participants were Colombian residents (90.1%), while 9.9% were from other Latin American countries. The used devices were 65.8% of times a cellphone, 33.6% a computer, and 0.7% a tablet. Vaccination status was 71.7% of times with full doses, 23.7% with incomplete doses, and 4.6% were not vaccinated. A group of 56.6% reported having been infected with COVID-19 at least once, while 43.4% did not. Inclusion criteria were to be over 18 years of age (legal age), a Spanish speaker, and report knowing at least six people.

4.1.2. Program

A program in *JSPsych* (De Leeuw, 2015) presented the experimental task and collected the data. Participants could complete the experiment on a computer, tablet, or cellphone.

4.1.3. Procedure

The study was a within-subject design in which the participant estimated each measurement for six social distances (2, 5, 10, 20, 50, 100), with a non-probabilistic convenience and snowball sampling. A university professor recruited participants from one course at the *Universidad Nacional de Colombia* [National University of Colombia]. The students received a bonus in the grades of an academic course for completing the experiment and recruiting at least two participants. Participants from past studies through email were invited. Also, a poster recruited participants through social networks with a paid

Facebook ad. As an incentive for participating in the study, people participated in a raffle for one of three monetary rewards of COP 200,000. Interested persons could start the experiment by clicking on a shared link. The collection was between October 26 and November 29, 2022. The participants completed the experiment between 8 and 30 minutes.

Before running the experiment, there was a pilot test with six students. The student made the experiment stopping after each section, and the experimenter made questions about the understanding of questions, instructions, statements, and scales. The experimenter asked whether the participants felt the variable influenced adherence and how they were expressed in real situations. The participants had misunderstood the meaning of the perceived risk of contagion item, so the researcher had to modify it.

The program started by welcoming the participants and asking them to look for a quiet space with few distractions and to start only when they had the time and space. The instructions were in Spanish. Next, the software requested sociodemographic information (age, sex, country), COVID-19 vaccination status (not vaccinated, incomplete dose, total dose), and whether the participant had been infected with COVID-19. The software checked if the participant met the inclusion criteria; if not, it did not allow the participant to participate.

Subsequently, the software presented the next instruction extracted from Buddiga and Locey (2021):

> "Imagine that you have made a list of the 100 people closest to you in the world, from position 1 to 100. Person 1 is your closest friend or relative, while person 100 is an acquaintance or someone you recognize. You do not need to write the list down, just imagine that you have done so".

In the next screen, the software requested the names of the people who occupy positions 2, 5, 10, 20, 50, and 100. These positions were the same used by Strickland et al. (2022) plus position 2. Participants had to write a different name for each position. The software asked that reported people to be of legal age, alive, not live in the same house as the participant, and not be non-human animals or fictitious characters. The software

checked if the participant's responses met the conditions; if not, it asked for the names again.

The software gave the following framing statement:

"Imagine the following situation. A few days ago, the World Health Organization (WHO) announced that a new strain of the COVID-19 virus has been discovered and is spreading rapidly. Authorities announce with concern that existing vaccines do not generate immunity or protect against this variant. For this reason, the Ministry of Health established biosecurity guidelines: mask-wearing and maintaining a physical distance of at least one meter."

The framing statement had two attentional checks. At the end of the statement, there was an instruction to respond "five" in the next question independent of the question. Also, the software presented three comprehension questions. If the participant did not pass the attentional checks, the software presented the statement again and asked the participant to read the instruction carefully. Subsequently, the software asked to answer the subsequent questions considering the person's statement and previous experience during the pandemic.

Then, the software presented 13 blocks of questions. Each block consisted of six questions (one per social position). The software presented each social position in a random order. All the questions in the block had the same structure but varied in the name of the person occupying that social position. Before each question of the first seven blocks, the statement, "Imagine you met with [name] to talk." A 100-step Visual Analog Scale (VAS) will accompany each question except for the questions that ask for categorical information.

Adherence to protective behaviors

Two blocks of questions assessed adherence to protective behaviors against COVID-19. The questions were: "How likely are you to wear a mask when interacting with [name]?" and "How likely are you to maintain the physical distance of one meter when interacting with [name]?" The VAS was from 0 to 100, where: 0 = "Not at all likely," 50 = "Somewhat likely," and 100 = "Very likely."

Other's behavior

Two blocks of questions assessed the perceived adherence of others to protective behaviors against COVID-19 protective behaviors. The questions were "How likely is [name] to wear a mask when interacting with you?" and "How likely is [name] to maintain the physical distance of one meter when interacting with you?" The VAS was the same as the questions of adherence.

Social approval and disapproval

Two blocks of questions assessed the perceived approval of others for following or not following the guidelines. The questions were: "How much would [name] approve or disapprove of you for following the biosafety guidelines?" and "How much would [name] approve or disapprove of you NOT following the biosafety recommendations?" This measure was similar to that used in Study 1. The VAS was from -50 to 50, where: -50 = "He/she would strongly disapprove of me," -25 = "He/she would moderately disapprove of me," 0 = "He/she would neither approve nor disapprove of me," 25 = "He/she would moderately approve of me" and 50 = "He/she would strongly approve of me."

Perceived risk of contagion

A block of questions assessed the perceived risk of contagion by not following biosafety guidelines against COVID-19. The question was: "How likely are you to get COVID-19 from interacting with [name] if you do NOT follow biosafety rules? The VAS was the same as the questions of adherence.

Loss of social gratification

Two blocks of questions assessed the perceived loss of social gratification from following biosecurity guidelines against COVID-19. The questions were: "How pleasant or unpleasant was it for you to interact with [name] before the pandemic?" and "How pleasant

or unpleasant is it for you to interact with [name] following biosafety recommendations?" The VAS was from -50 to 50, where: -50 = "very unpleasant", -25 = "somewhat unpleasant", 0 = "neutral", 25 = "somewhat pleasant," and 50 = "very pleasant". The subtraction of the two measures was the loss of social gratification.

Social information

A block with three questions inquired about the information of each reported person in the social distance. The questions were: "What is [name] of you?" with three answer options (blood relative, non-blood relative, non-relative), "[name] is?" with three answer choices (female, male, non-binary), "and how old is [name]?" with a textbox to respond.

Interaction in the social contexts

Two blocks of questions assessed exposure to two social contexts with a risk of contagion. The questions were: "How likely are you to interact with [name] indoors?" and "How likely are you to interact with [name] outdoors?" The VAS was the same as the questions of adherence.

4.1.4. Ethical considerations

The Faculty of Human Sciences of the Universidad Nacional de Colombia Ethics Committee gave the ethical approval *B.FCH.1.002-195-22* to the research. This study followed the ethical guidelines of *Law 1090 of 2006* (deontological and bioethical code for the practice of psychology in Colombia) and the *Ethical Principles of Psychologists and the Code of Conduct* (American Psychological Association, 2017). All participants digitally signed an ethical consent form explaining the research, its benefits, and its risks. The consent explained the rights of the participants, such as confidentiality and the use of information.

4.1.5. Open science

The researcher made the pre-register in *Open Science Framework* on October 21, 2022 (https://osf.io/jg6y2/?view_only=4ef2ebcce89a4da38166ba14f5a9e0b8). All the data and the instrument are available in the repository (https://osf.io/ue8ft/?view_only=82129e96e08f46d0bf5af57eac666184).

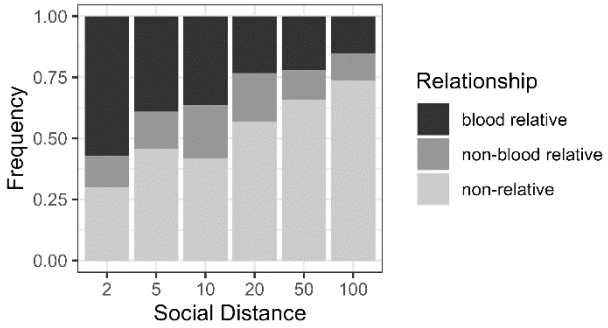
4.1.6. Data Analysis

Data analysis was in the statistical software *RStudio* version 1.3.1093 (RStudio Team, 2020) with *R* version 4.0.3 (R Core Team, 2020). The analysis started with Generalized Linear Mixed Models (GLMM) to test the hypotheses. The random effect was the participant. To test hypotheses 1, 2, 3, and 6, social distance was the unique predictor for the variables. To test hypotheses 4 and 5, the analysis was two models (one for mask-wearing and one for physical distancing) by each hypothesis.

4.2. Results Study 2

In the study, 30.3% of the participants responded incompletely. The participants reported information from 870 individuals. These individuals were 58.4% women, 40.9% men, and 0.7% non-binary with ages between 18 and 92 (M = 37.3, SD = 16.5). The individuals reported were 58.5% of the same sex of the participant and 41.5% of the different sex. In addition, people stated that the others were between 55 years younger and 65 years older than themselves. (M = 6.6, SD = 15.3). The greater the social distance, the less likely the other was to be a blood relative and the more likely it was to be a non-relative (see Figure 3). The smallest group was always non-blood relatives. A Pearson's chi-squared test revealed a significant association between the two variables (χ^2 (10) = 98.6, p < .001).

Figure 1.
Social distance vs. social relationship

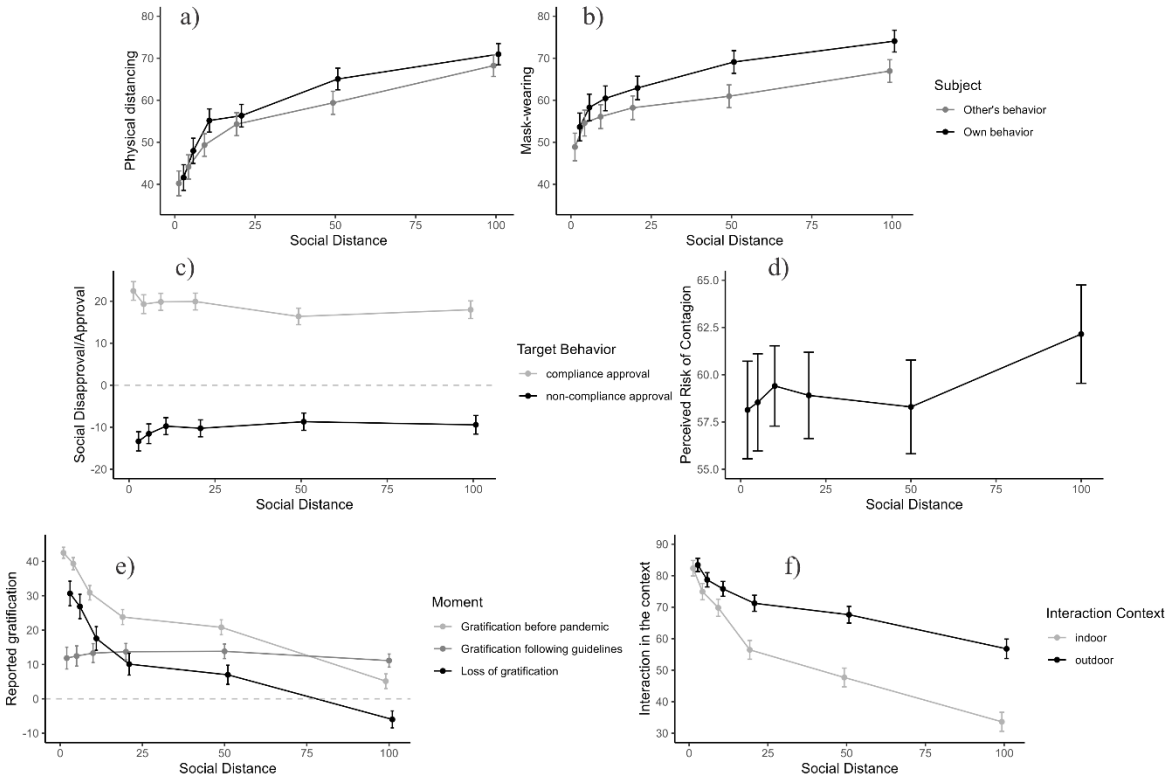


4.2.1. Social distance as a predictor

Social distance predicted different variables. Figure 4 shows the relationship between variables and social distance. Table 6 shows the models of GLMM for predicting the variables with social distance. Social distance significantly predicted the own and the other's mask-wearing and physical distancing. Adherence increased in an apparently hyperbolic way (see Figure 4). A paired t-test indicated that own mask-wearing was significant higher than own physical distancing, t(899) = 7.5, p < .001. Individuals reported greater own adherence than the other for mask-wearing, t(899) = 5.7, p < .001 and physical

distancing, $t(905) = 4.4$, $p < .001$. Social distance did not significantly predict either compliance approval or non-compliance approval. People tended to report approval for compliance and disapproval for non-compliance. There was a slight decrease in the probability of receiving approval or disapproval as social distance increased. In terms of absolute value, compliance approval was significantly higher than non-compliance disapproval, $t(893) = 8.3$, $p < .001$. Also, compliance approval correlated significantly and negatively with non-compliance approval, $r = -0.54$, $p < .001$. Social distance did not predict the perceived risk of contagion. Although apparently, the greater the social distance, the greater the risk. The perceived risk of contagion is higher with the person in position 100 is apparently higher than with the other positions. Gratification before the pandemic was significantly higher than gratification following guidelines, $t(659) = 10.4$, $p < .001$. Gratification before the pandemic and loss of gratification decreased significantly as social distance increased. This decrease was also in an apparently hyperbolic form (see Figure 4). Nevertheless, gratification following guidelines did not change across social distances. Interaction in the contexts decreased significantly as social distance increased. At position 100, the average loss of reward is negative, which means that it is more rewarding to interact by following the guidelines. The interaction in the indoor context was low with people with high social distances.

Figure 4.
Relationship between social distance and variables



Note. a) Mask-wearing, b) Physical distancing, c) social approval/disapproval, d) perceived risk of contagion, e) social gratification, f) interaction in the context. The x-axis goes from 1 to 100, the greater the social distance, the lesser the closeness. In figures *a* and *b*, the y-axis goes from 0 to 100, the higher the score, the greater the adherence. In figure *c*, the y-axis goes from -50 to 50, values less than 0 imply disapproval, and greater than 0 imply approval. In figure *d*, the y-axis goes from 0 to 100, the higher the score, the greater the risk perception. In figure *e*, the y-axis goes from -50 to 50, values less than 0 mean unpleasant interaction, and greater than 0 mean pleasant interaction. In figure *f*, the y-axis goes from 0 to 100, the higher the score, the greater the interaction.

Table 6.
Predictions of variables with social distance as predictor

Predicted Variable	Predictor	Estimate	SE	t.value	*p*
Own mask-wearing	Intercept	57.32	2.44	23.95	<.001 ***
	Position	0.18	0.02	7.85	<.001 ***
Own physical distancing	Intercept	48.19	2.28	21.27	<.001 ***
	Position	0.26	0.02	11.01	<.001 ***
Other's mask-wearing	Intercept	52.99	2.21	24.18	<.001 ***
	Position	0.15	0.03	5.62	<.001 ***
Other's physical distancing	Intercept	44.64	2.22	20.26	<.001 ***
	Position	0.26	0.02	10.67	<.001 ***
Compliance approval	Intercept	20.41	1.57	13.26	<.001 ***
	Position	-0.04	0.02	-2	0.07
Non-compliance approval	Intercept	-11.38	1.72	-4.22	<.001 ***
	Position	0.03	0.02	0.33	.13
Perceived risk of contagion	Intercept	58.23	1.87	31.21	<.001 ***
	Position	0.03	0.02	1.46	.15
Gratification before pandemic	Intercept	37.64	1.24	28.65	<.001 ***
	Position	-0.34	0.02	-13.87	<.001 ***
Gratification following guidelines	Intercept	13.06	2.07	8.62	<.001 ***
	Position	-0.01	0.02	-0.66	.61
Loss of gratification	Intercept	24.58	2.33	10.27	<.001 ***
	Position	-0.33	0.03	-10.04	<.001 ***
Indoor interaction	Intercept	74.92	2.07	36.43	<.001 ***
	Position	-0.45	0.03	-16.63	<.001 ***
Outdoor interaction	Intercept	79.65	1.85	43.07	<.001 ***
	Position	-0.24	0.02	-9.74	<.001 ***

Note. SE = Standard Error. Italic fonts represent the variables that were predicted by social distance. * p < .05, ** p < .01, *** p < .001

4.2.2. Social distance as a moderator in the prediction of adherence

Table 7 presents the GLMM for predicting adherence to protective behaviors. In model 1 (mask-wearing) and model 2 (physical distancing), social distance predicted adherence for both protective behaviors. Other's behavior predicted both behaviors significantly and interacted with social distance. This interaction was negative, the greater the distance, the lesser the influence of the others' behavior on adherence. Neither of the two types of social approval predicted adherence nor their interactions. Similarly, neither the risk of contagion nor its interaction predicted adherence. Loss of social gratification predicted adherence significantly. The greater the loss of gratification, the lesser the adherence. However, the interaction of social distance and loss of gratification did not.

In model 3 (mask-wearing) and model 4 (physical distancing), the analysis explored if the characteristics of the other predicted adherence. Again, social distance was a significant predictor. For mask-wearing, the age difference and social category significantly predicted adherence. The older the other was with one, the more adherence one reported with the other. The participant reported more adherence if the other was a nonrelative compared to blood or non-blood relatives. With physical distance, only the interaction between age difference and social distance was a significant predictor. The effect of social distance was greater if the other was older than the participant.

Table 7.
GLMM predicting adherence to protective behaviors

Model	Predictor	Estimate	SE	t-value	p-value
Model 1 (Mask-wearing)	Intercept	26.65	3.98	6.69	<.001 ***
	SD	0.20	0.08	2.67	<.01 **
	OB	0.58	0.04	14.36	<.001 ***
	C-A	0.03	0.07	0.43	.67
	NC-A	-0.01	0.07	-0.13	.89
	Risk	0.02	0.05	0.37	.71

	LOG	-0.14	0.04	-3.76	<.001 ***
	*SD*OB*	0.00	0.00	-2.49	.01 *
	SD*C-A	0.00	0.00	-0.47	.64
	SD*NC-A	0.00	0.00	-0.74	.46
	SD*Risk	0.00	0.00	0.13	.90
	SD*LOG	0.00	0.00	0.22	.83
Model 2 (Physical distancing)	*Intercept*	14.17	3.46	4.10	<.001 ***
	SD	0.24	0.07	3.34	<.001 ***
	OB	0.75	0.04	19.55	<.001 ***
	C-A	0.02	0.06	0.26	.79
	NC-A	0.05	0.06	0.90	.37
	Risk	0.01	0.04	0.14	.89
	LOG	-0.09	0.03	-2.56	.01 *
	*SD*OB*	0.00	0.00	-4.70	<.001 ***
	SD*C-A	0.00	0.00	-0.63	.53
	SD*NC-A	0.00	0.00	-1.84	.07
	SD*Risk	0.00	0.00	1.06	.29
	SD*LOG	0.00	0.00	-1.38	.17
Model 3 (Mask-wearing)	*Intercept*	51.66	3.40	15.19	<.001 ***
	SD	0.15	0.07	2.20	.03 *
	Non-blood relative	-2.33	3.61	-0.65	.52
	Non-relative	6.72	2.92	2.31	.02 *
	Difference age	0.18	0.08	2.15	.03 *
	Same-Sex	3.19	2.41	1.32	.19
	SD*Non-blood relative	0.07	0.09	0.73	.47
	SD*Non-relative	0.03	0.07	0.38	.70
	SD*Difference age	0.00	0.00	0.89	.37

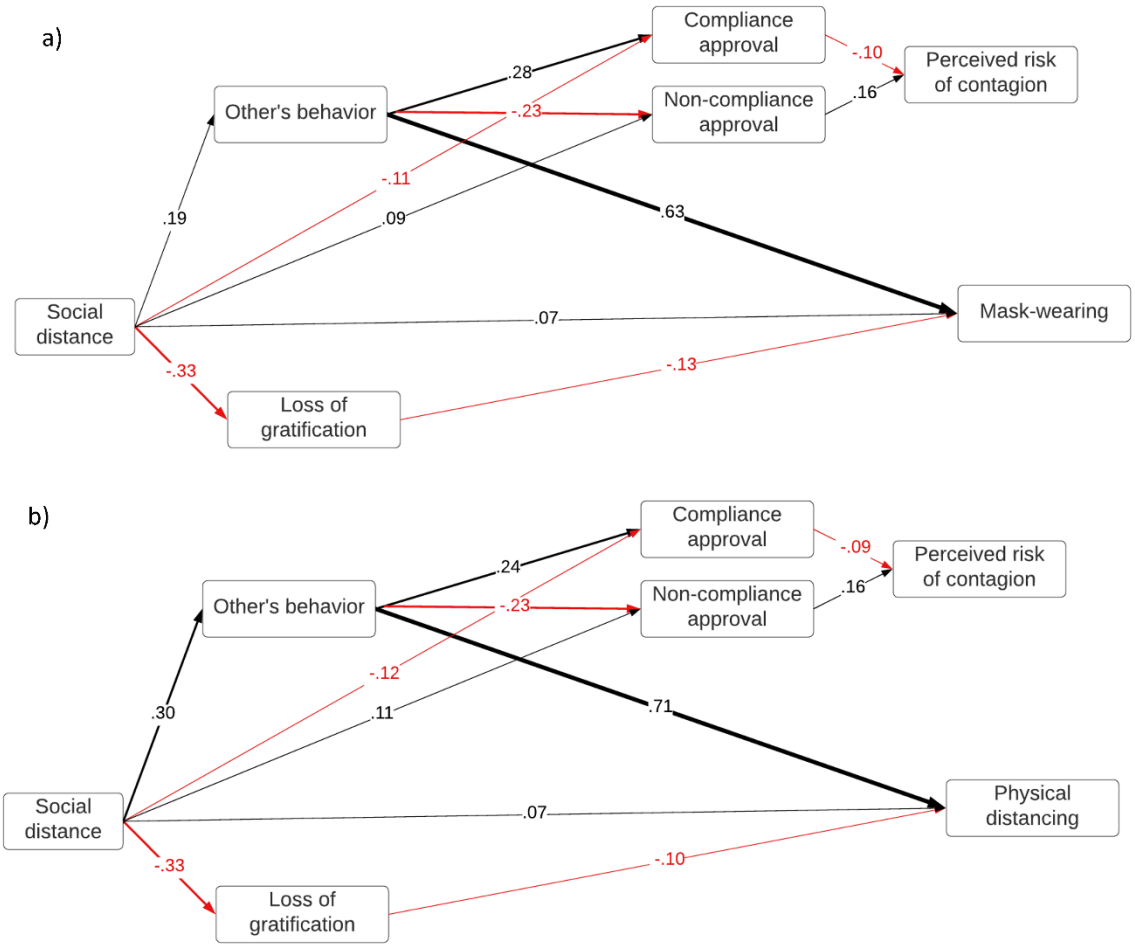
	SD*Same Sex	-0.04	0.05	-0.75	.45
Model 4 (Physical distancing)	Intercept	45.75	3.30	13.85	<.001 ***
	SD	0.17	0.07	2.56	.01 *
	c	0.96	3.62	0.26	.79
	Non-relative	3.25	2.92	1.11	.27
	Difference age	0.12	0.08	1.42	.16
	Same Sex	0.57	2.41	0.24	.81
	SD*Non-blood relative	-0.03	0.09	-0.28	.78
	SD*Non-relative	0.04	0.07	0.59	.55
	SD*Difference age	0.00	0.00	2.29	.02 *
	SD*Same Sex	0.03	0.05	0.53	.60

Note. SE = Standard Error. Italic letters represent the variables that were predictors. SD = Social Distance, OB = Others' behavior, C-A = Compliance Approval, NC-A = Non-compliance Approval, Risk = Perceived Risk of Contagion, LOG = Loss Of Gratification. * p < .05, ** p < .01, *** p < .001

An exploratory analysis with a path analysis examined the relationships between social distance, the other's behavior, and loss of gratification as predictors of adherence behavior and perceived risk of contagion. This analysis explored whether approval was related to the other's behavior. In addition, the analysis addressed the perceived risk as a response rather than a predictor (contextual event). The model fit the data well, $\chi^2(4) = 219.166$, $p < .001$. These results indicate that the proposed path model adequately represents the observed data and provides valuable insights into the relationships among the variables in the study. Figure 5 shows the results of this analysis. The other's behavior was the strongest predictor of both protective behavior's adherence. Again, the greater the loss of social gratification, the lower the adherence, and the loss experienced decreases as social distance increases. The results are somewhat contradictory. The greater the social distance, the less likely compliance approval and non-compliance disapproval. However, the greater the social distance, the greater the adherence of others, and the greater the adherence of

others, the greater the likelihood that others will approve of compliance or disapprove of non-compliance. The novel finding is that compliance approval negatively predicted the perceived risk, and non-compliance approval positively predicted it. Again, neither risk nor any approval type predicted adherence.

Figure 5.
Path analysis of the relationship between variables



Note. The black lines represent the positive correlations. The red lines represent negative correlations. The thicker the line, the stronger the correlation.

4.3. Discussion and Conclusions Study 2

Study 2 assessed how social distance modulated the relationship between others' adherence behavior, some perceived social consequences, and adherence to protective behaviors against COVID-19. Social antecedents and consequences have greater control if their source is someone close than someone distant. Social distance was a characteristic of the other that influenced adherence to protective behaviors during social interactions. The strongest predictor was the others' behavior. The effect of other's behavior interacted with social distance; the more closeness, the more influential the other's behavior. The unique perceived consequence that predicted adherence was losing gratification in social interactions. Apparently, antecedent situations explain adherence more than consequences.

As expected (H1), participants reported greater adherence to protective behaviors when interacting with others as the social distance from the other increased. Results are consistent with what Strickland et al. (2022) found about mask-wearing. Also, the results confirmed the findings that with close people, there are more risky behaviors than with distant people (Andrews, 2022; Binter et al., 2023; De Vries & Lee, 2022; Lipsey & Losee, 2023; Ludwig & Strack, 2022; Shamloo et al., 2023; Shukla et al., 2021; Zheng et al., 2022). This phenomenon suggests that proximity is a risk factor. Possibly, factors such as loss of social gratification and the behavior of others may explain this phenomenon. Nevertheless, there may be different behavioral patterns. There may also be people who decreased their adherence as the social distance increased or people who did not change their adherence. Future studies can make a latent class or clustering analysis to classify behavior patterns.

As social distance increased, adherence increased with an apparently exponential shape (curve). This curve was like the one found by Strickland et al. (2022). This form suggests that health risk behaviors are also discounted hyperbolically, in the same way, that rewards are discounted socially, temporally, or probabilistically (Białaszek et al., 2019). Other studies have also found that adherence behavior is hyperbolically discounted (Andrews, 2022; Belisle et al., 2022; Harman, 2021). Belisle et al. (2022) found that people

discount the willingness to self-isolate as the probability of a pandemic increases. Harman (2021) found that people discounted compliance with social distancing as the time requirement for isolation increased. Also, Andrews (2022) found that people hyperbolically decreased the probability of not choosing a risk as the probability of receiving a monetary penalty increases. Future studies can test if equations such as the one proposed by Rachlin (2016) fit the adherence discounting found in this study. That equation can mathematically account for discounting or incremental patterns (or adcounting patterns, as Molano Gallardo, 2023, called them). Note that the phenomenon presents hyperbolic discounting because the target behavior is not following the guidelines (decrease) rather than adherence (increase).

Consanguinity was related to social distance. The shorter the distance, the more likely people were to report someone who was a blood relative and the less likely they were to report someone who was a non-relative, consistent with other studies (Buddiga & Locey, 2021b; Hackman et al., 2015; Jones & Rachlin, 2006; Rachlin & Jones, 2008). Also, consanguinity was a risk factor; people reported lower mask-wearing with blood and non-blood relatives than non-relatives, regardless of social distance.

That people take more risks with relatives seems contrary to kin selection. The kin selection or inclusive fitness suggests individuals show more cooperation and altruism towards their close relatives because relatives share a significant portion of their genes. When an individual helps a close relative reproduce, they indirectly promote the transmission of their genes (enhancement of fitness) to the next generation (Hamilton, 1964; West et al., 2002). Some studies found that people gave relatives more money (more altruism) regardless of their social distance (Buddiga & Locey, 2021b; Rachlin & Jones, 2008). Nevertheless, this is the opposite of Study 2´s results, adherence behaviors; people show less protection (less altruism) with their relatives than non-relatives regardless of social distance. Arnot et al. (2020) suggested that response can change according to life history. Some situations, such as high mortality and unpredictable and harsh environments, promote a faster life history strategy. This life history leads to more risky behaviors, less

future-oriented behaviors, and more pace of reproduction. The covid-19 pandemic may have been experienced as an uncertain and high-mortality situation, leading to risky behaviors being adaptive to maintain reproductive success.

One limitation of the traditional measure of social distance is that positions are predetermined almost exponentially (1, 2, 5, 10, 20, 50, 100). Participants had to find a person for each of the positions. However, the discount would probably not be hyperbolic if participants were free to choose positions. Pilot participants in this study and Krejci Muñoz (2023)'s participants reported difficulty in understanding or assigning people to positions 50 and 100. Future studies could allow a free assignment of positions. Also, future studies can use ratio scale measures as physical distancing estimation (Safin & Rachlin, 2020) or line drawing (Krejci Muñoz, 2023). Pictorial measures such as the Inclusion of Other in the Self Scale (Aron et al., 1992) used by Shamloo et al. (2023) can be useful too.

Contrary to expected (H2), the risk did not change as the social distance increased. Results are inconsistent with studies like De Vries and Lee (2022) and Shamloo et al. (2023). The study could not confirm the friend-shield effect that Cruwys et al. (2020) and De Vries and Lee (2022) described. Social desirability bias and methodological issues can explain this difference. In the current study, the software asked directly to participants how likely they would be to become infected when interacting with a specific person not following the norms. By logical reasoning or social desirability, participants could think that the risk is the same regardless of the person. Indirect measures of perceived risk, like those used by De Vries and Lee (2022) and Salgado and Berntsen (2021), can be better to avoid these biases. For example, De Vries and Lee (2022) asked about the probability of reinfection if the other was the source of infection or the probability of getting infected in the favorite restaurant if the participant encounters the other. Also, De Vries and Lee (2022) and Shamloo et al. (2023) used group comparisons. Salgado and Berntsen (2021) made an intra-subject comparison between oneself, a close other, and an acquaintance. However, the authors measured the likelihood that the other would become infected, not the likelihood that one would become infected by interacting with them.

Partially as expected (H3), gratification and loss of gratification for adherence to protective behaviors in social interactions decreased as social distance increased. Pre-pandemic gratification decreased as social distance increased, but gratification during the pandemic did not. Apparently, interacting by following norms makes all interactions equally rewarding regardless of social distance. Interaction with close people is clearly more valuable for individuals. Individuals assign more time, wait for less to interact with close people (Gil Mateus, 2023), and share more money with close people (Jones, 2022). During the pandemic, individuals experimented a decrease in intimacy, quality time, social support, social contact, and norms of interaction (Bondoc et al., 2022; Fatahi et al., 2021; Lee et al., 2021; Long et al., 2022; McKenna-Plumley et al., 2021). Due to individuals receiving these affective resources from people close to distant people, the perceived loss of gratification decreases as social distance increases.

Contrary to the hypothesis, social distance, others' behavior, social approval for norm-following and norm-breaking, perceived risk of contagion, loss of social gratification, and the interaction of these variables with social distance did not predict adherence to protective behaviors (H4). The primary predictor was others' behavior and loss of gratification. Social distance did modulate the effect of others' behavior on adherence behavior. However, it did not modulate the effect of loss of gratification. People tended to imitate the behavior of close others more than distant ones, consistent with other studies (Tunçgenç et al., 2021; Woodcock & Schultz, 2021; Zhou et al., 2023). Social distance mediates the relationship between loss of gratification and adherence behavior rather than modulating it. The greater the social distance, the lower the loss of gratification, which leads to lower adherence. Contrary to Study 1, the social consequences of approval or disapproval did not predict adherence.

The perceived risk of contagion had no relation with adherence to protective behaviors. This negative result contradicts Shamloo et al. (2023), who found a positive relationship with a similar measure. Also, it is inconsistent with Salgado and Berntsen (2021), who found inconsistent relationships between perceived risk of contagion and

adherence to protective behaviors (some positive and some negative). The findings of this study indicate that people may engage in riskier behavior with those close to them but do not necessarily identify the situation as riskier. People know that interactions with close associates are risky, but they are still more willing to take that risk.

The findings suggest that antecedents mainly controlled adherence to protective behavior rather than its consequences, consistent with Tunçgenç et al. (2021), who found that the descriptive norm (other´s behavior) predicted more than the injunctive norm (approval). In social norms studies, there were different results about whether descriptive norms (others' behavior), injunctive norms (social approval), or both predicted adherence to protective behavior. Some studies found that both norms predicted adherence to protective behaviors (Blackburn et al., 2023; Dillard et al., 2021; Friemel & Geber, 2021; Higuchi et al., 2021; Owens et al., 2022; Rozendaal et al., 2021). Other studies found that descriptive norms predicted adherence, but injunctive norms did not (Eckel et al., 2021; Gerber et al., 2021; Heiman et al., 2023; Kojan et al., 2022). Nevertheless, other studies found that injunctive norms predicted, but descriptive norms did not (Cheng et al., 2022; Macy et al., 2021). These contradictory results are likely because studies used different protective behaviors, reference groups, or injunctive norms measures. For example, studies with consequences-based measures of injunctive norms used items with different contingencies: positive punishment (Cheng et al., 2022; Dillard et al., 2021; Latkin et al., 2022; Smith et al., 2021, 2022), negative reinforcement (Cheng et al., 2022; Dillard et al., 2021) or positive reinforcement (Heiman et al., 2023; Smith et al., 2021, 2022). Heiman et al. (2023) pointed out that in situations such as the COVID-19 pandemic (a highly uncertain situation), people follow descriptive rules more than injunctive ones because they are easier to observe and help to adjust quickly.

Partially as expected, social distance, the interaction between social distance and sociodemographic variables (same sex, age difference), and the interaction between social distance and consanguinity of the other predicted adherence (H5). For mask-wearing, the age difference predicted adherence. The older the other was with one, the more adherence

one reported with the other. People older than one can be elderly or in vulnerable health. One study found protective behaviors increased if the other was elderly or had chronic medical issues (Turk et al., 2023). Also, people reported a greater probability of vaccination with an older adult (Moisoglou et al., 2023). Also, social category significantly predicted adherence. The participant reported more adherence if the other was a nonrelative compared to blood or non-blood relatives. This phenomenon is similar to what Buddiga and Locey (2021b) and Rachlin and Jones (2008) who found that the social discount of ceding money (altruism) was less pronounced with relatives than with non-relatives. Consanguinity may also be a risk factor in the COVID-pandemic or health-related behaviors.

Finally, as expected, the probability of interacting indoors decreased less with social distance than the probability of interacting outdoors (H6). In the indoor context, it is more likely to interact with close others than with distant others, as Study 1 suggested.

5. General Discussion

This thesis aimed to evaluate how some social antecedents and perceived social consequences were related to reported adherence against COVID-19. As the authors suggested, behavior analysis provided a valuable framework for understanding adherence to protective behaviors against COVID-19 (Couto et al., 2020; Shawler & Blair, 2021; Tibério et al., 2020). The results show that social antecedents and consequences did influence adherence. Hence, protective behaviors are partially social behaviors according to the definition of Sampaio and Andery (2010) and Skinner (1953). People reported changing their behavior according to some social antecedents and perceived probability of receiving certain social consequences. During the pandemic, rules and contingencies of social reinforcement and punishment changed the subjective value of adherence, increasing adherence.

Some social antecedents had more control over the adherence behavior, signaling more probability of reinforcing and punishing consequences. Study 1 showed that social situations and physical characteristics of the context changed adherence behavior. Outdoor adherence was higher than indoor adherence. Study 2 helped elucidate the stimulus control topography of these contexts. Study 2 showed that the presence of a person could differentially control adherence according to his/her social distance from the individual. Close people were stimuli that inhibited adherence behaviors, while distant people were stimuli that promoted protective behaviors. The most controlling antecedent was the other's behavior. Also, the other's behavior had more value if it came from someone close than distant.

Adherence may have resulted from simple generalized imitation. People followed the guidelines simply because others did. People adjusted their behavior according to the degree of adherence the person or persons involved have in each situation. Intermittent, probabilistic, or delayed reinforcement (usually social reinforcement) maintained generalized imitation (Deguchi, 1984; Pierce & Cheney, 2017). Social consequences had

these characteristics (Guerin, 1992, 1994; Sampaio & Andery, 2010). Verbal and non-verbal sporadic reactions of people could maintain that. Sometimes reinforcement is so subtle that an observer might not easily notice: a small change in someone's gaze or a gentle gesture. However, not noticing reinforcers does not mean reinforcement does not happen (Locey & Buddiga, 2022). Heiman et al. (2023) suggested that adherence could be due to conditional cooperation. Individuals contributed to the public good and adapted their cooperative behavior according to the degree of cooperation of the population. The thesis's results suggest that adherence behavior in a situation is primarily due to others following the guidelines rather than approval. Approval is only the consequence that maintains generalized imitation. In Study 2, the approval correlated with the other's behavior, but only other's behavior predicted adherence behavior. In Study 1, the main predictor was the context, and the effect of the consequences was slight. Also, the context predicted the probability of social reinforcement.

Patterning is an alternative that explains adherence to protective behaviors rather than generalized imitation. A behavioral pattern is a group of behaviors with a purpose or final cause (Molano Gallardo, 2023). People had to choose between two patterns, a self-controlled pattern of having healthy life of protective behaviors versus an impulsive pattern of maintaining good relationships that composed many COVID-19 contagion risk behaviors. The self-control problem is that a healthy pattern (low value) competes at every moment with a risky pattern (high value) because its behavior produces more short-term reinforcers. Following the compliance pattern was relatively easy in outdoor contexts or with distant people. However, in indoor contexts or with close people, there were other more valuable patterns (e.g., group membership patterns), or following the guidelines in that context was not part of the healthy pattern (e.g., the mask is to be worn outside the home, at home it is not necessary). The patterns explain why there were various typologies of adherence. Smith et al. (2021) found five compliance typologies: adherents, social distancers, hygiene stewards, symptom managers, and refusers. In each typology, people followed certain protective behaviors and had different motives (final causes).

Group membership or cohesion was a pattern that influenced adherence to protective behaviors with those close to them. People identify with groups and adjust their behavior to belong to those groups (an abstract pattern). When individuals feel belonging to a group, they may adopt the group's goals as theirs (Tajfel & Turner, 2001). See Roche et al. (2002) from relational frame theory's behavioral interpretation of social categorization and group cohesion. The probability of not following the guidelines decreases if those close not follow them, as demonstrated in Study 2.

One explanation from the behavioral analysis approach is that close people reinforce disobedience and punish obedience more. Study 1´s results support this; in the indoor context (close people) there was less approval for following the guidelines and more rejection for following them. In Study 2, a close person was more likely not to follow the guidelines and, therefore, approved less for complying and disapproved less for not complying. However, there was contradictory evidence. Study 1 found that correcting behavior was more likely in the indoor context (with close people or care of relatives). Study 2 found that the shorter the social distance from the other, the more approving or disapproving the other gave approval or disapproval. Possibly, this is due to different behavioral and reinforcement patterns. Future clustering analyses may clarify this.

Another behavioral explanation was the loss of social gratification. Study 2 suggested that it was a mediation variable. Individuals lost more valuable interactions with close people and adhered less. Study 1 showed that loss of gratification only affected the indoor context, likely because the interaction was with close others. In addition to social distance, the loss of social gratification depends on the person's values. For example, a person can value the health and well-being of the other (self-controlled choice) more than expressions of affection (impulsive choice). In that case, he/she may not be affected by interacting with masks.

From social psychology, the reactions of closed people could change according to the relative salience of COVID-19 goals for the group (Packer et al., 2021). The authors stated that when protection against COVID-19 is not an important goal that defines the

group, differentiates it from other groups, or does not represent a risk (risk perception), people tend to be gentler with group violations (ignore or downplay). The thesis´s results were concordant with this hypothesis. Participants report receiving less approval for compliance and more disapproval for noncompliance. Cruwys et al. (2020) proposed a social identity model in which shared group membership (social closeness) increases trust and reduces disgust, decreasing risk perception and increasing risky behavior. In the context of COVID-19, this suggests that individuals may have believed that those close to them strictly followed the protective behaviors, were less likely to become infected, and therefore interacting without following the guidelines generated less rejection or dislike. In Study 2, participants reported that others close to them were less adherent to guidelines with the participants. However, there were no measure of how well participants perceived others to follow the rules with the rest. The seemingly contradictory finding of perceived risk is consistent with this model. Participants reported lower risk of contagion when not following the guidelines with those who gave more approving of following guidelines, probably because participants assumed that these people were more trustworthy, more adherent to guidelines with the rest, and therefore less likely to be contagious.

5.1. Limitations

The self-report methodology used in this thesis did not allow for differentiating whether protective behaviors were rule-governed or contingency-shaped. Both the social feedback and the rules about it that people had could change the subjective value of adherence. For example, in the absence of specific campaigns, in the indoor context, adherence could be controlled by the host's reactions. However, in the outdoor context, a pliance rule may have controlled adherence (i.e., following the rules is the right thing to do). Identifying whether adherence is rule-governed is essential because some people become insensitive to contingencies by following inconsistent rules with the contingencies (Clavijo, 2004; Törneke et al., 2008). In some situations, a rule may have controlled low adherence, even if social contingencies favored adherence.

The accuracy of self-reporting may be another limitation. However, like all IFA, the results are a first approach and should be verified with a direct functional assessment (Peterson & Neef, 2020). The degree to which these perceived consequences match actual contingencies is unknown. Future studies can explore how accurately people perceive and report social consequences. Also, future studies can explore if a self-report IFA can successfully identify causal and maintaining variables, as Callaghan and Darrow (2015) stated, or the opposite, as Nelson-Gray (1999) stated.

The lack of operationalization of social approval and disapproval could have been difficult when people participated in the study. Each person has idiosyncrasies of what he or she considers approval and what social consequences he or she values in others (reinforcement history). Future studies may try to identify what people mean by approval, what specific behaviors they mention, and which they perceive as controlling their behavior. For some people, approval could be verbal messages; for others could be nonverbal reactions.

A. Appendix A:

Table 8.
Social consequences descriptive statistics and factorial analysis

Protective Behavior	Social Consequence	Social context	Adherence	Difference	Factor Loading		
					1	2	3
Mask-wearing	RSA	Outdoor	4.15 (1.16)	0.34 (1.16)	0.07	0.66	0.28
		Indoor	3.81 (1.33)		0.15	0.80	0.13
	ABJ	Outdoor	3.64 (1.38)	0.51 (1.25)	0.15	0.26	0.72
		Indoor	3.14 (1.46)		0.29	0.44	0.62
	RSR	Outdoor	2.28 (1.32)	-0.03 (1.12)	0.74	0.31	0.04
		Indoor	2.41 (1.37)		0.79	0.20	0.18
	LGSR	Outdoor	2.93 (1.34)	-0.13 (0.98)	0.68	0.09	0.18
		Indoor	2.96 (1.38)		0.69	0.02	0.33
Physical distancing	RSA	Outdoor	3.93 (1.23)	0.30 (1.05)	0.13	0.69	0.38
		Indoor	3.63 (1.40)		0.16	0.83	0.20
	ABJ	Outdoor	3.43 (1.39)	0.28 (1.06)	0.31	0.30	0.74
		Indoor	3.14 (1.45)		0.36	0.50	0.56
	RSR	Outdoor	2.50 (1.39)	-0.11 (0.98)	0.81	0.24	0.13
		Indoor	2.58 (1.37)		0.81	0.19	0.20
	LGSR	Outdoor	2.91 (1.34)	-0.08 (0.87)	0.76	0.11	0.28
		Indoor	3.02 (1.34)		0.71	0.03	0.39

Hand-washing	RSA	Outdoor	4.19 (1.20)	0.09 (0.88)	0.09	0.68	0.39
		Indoor	4.10 (1.26)		0.09	0.69	0.39
	ABJ	Outdoor	3.59 (1.49)	0.13 (0.98)	0.28	0.30	0.77
		Indoor	3.47 (1.52)		0.29	0.32	0.74
	RSR	Outdoor	2.33 (1.44)	-0.02 (0.73)	0.83	0.33	0.01
		Indoor	2.37 (1.44)		0.83	0.32	0.03
	LGSR	Outdoor	2.56 (1.50)	-0.03 (0.68)	0.80	0.34	0.04
		Indoor	2.58 (1.49)		0.80	0.34	0.04
Correcting others	RSA	Outdoor	3.43 (1.31)	-0.17 (0.96)	0.32	0.75	0.00
		Indoor	3.60 (1.28)		0.21	0.81	0.10
	ABJ	Outdoor	3.02 (1.31)	-0.08 (0.94)	0.46	0.53	0.30
		Indoor	3.10 (1.36)		0.39	0.53	0.44
	RSR	Outdoor	3.04 (1.25)	0.15 (0.97)	0.67	-0.01	0.34
		Indoor	2.80 (1.30)		0.75	0.11	0.24
	LGSR	Outdoor	3.07 (1.30)	0.24 (0.98)	0.69	0.05	0.32
		Indoor	2.92 (1.31)		0.75	0.12	0.27

Note. Scores for social consequences are on a frequency scale of 1 to 5. The higher the score, the more people perceive receiving the specific social consequence for adhering to the protective behavior. RSA = Receive Social Approval; ABJ = Avoid Being Judged; RSR = Receive Social Rejection; LGSR = Lose Gratification in Social Relationships.

Table 9.
People distribution

		No behavioral change		Behavioral change		
Social consequence	**Protective behavior**	**No change in consequence**	**insensitivity to consequence**	**Reinforcement**	**No change in consequence**	**Punishment**
RSA	Mask	190 (69.3%)	84 (30.7%)	137 (43.8%)	141 (45.0%)	35 (11.2%)
	Distance	234 (75.0%)	78 (25.0%)	108 (39.3%)	135 (49.1%)	32 (11.6%)
	Hands	299 (75.3%)	98 (24.7%)	43 (22.6%)	120 (63.2%)	27 (14.2%)
	Correct	229 (68.6%)	105 (31.4%)	83 (32.8%)	136 (53.8%)	34 (13.4%)
ABJ	Mask	165 (60.2%)	109 (39.8%)	151 (48.2%)	128 (40.9%)	34 (10.9%)
	Distance	210 (67.3%)	102 (32.7%)	106 (38.5%)	138 (50.2%)	31 (11.3%)
	Hands	283 (71.3%)	114 (28.7%)	43 (22.6%)	118 (62.1%)	29 (15.3%)
	Correct	221 (66.2%)	113 (33.8%)	64 (25.3%)	147 (58.1%)	42 (16.6%)
RSR	Mask	166 (60.6%)	108 (39.4%)	67 (21.4%)	161 (51.4%)	85 (27.2%)
	Distance	216 (69.2%)	96 (30.8%)	51 (18.5%)	150 (54.5%)	74 (26.9%)
	Hands	296 (74.6%)	101 (25.4%)	21 (11.1%)	142 (74.7%)	27 (14.2%)
	Correct	230 (68.9%)	104 (31.1%)	43 (17.0%)	158 (62.5%)	52 (20.6%)
LGSR	Mask	194 (70.8%)	80 (29.2%)	44 (14.1%)	181 (57.8%)	88 (28.1%)
	Distance	227 (72.8%)	85 (27.2%)	36 (13.1%)	182 (66.2%)	57 (20.7%)
	Hands	307 (77.3%)	90 (22.7%)	17 (8.9%)	154 (81.1%)	19 (10.0%)
	Correct	236 (70.7%)	98 (29.3%)	44 (17.4%)	147 (58.1%)	62 (24.5%)

Note. Mask = Mask-wearing; Distance = Physical distancing; Hands = Hand-washing; Correct = Correcting others; RSA = Receive Social Approval; ABJ = Avoid Being Judged; RSR = Receive Social Rejection; LGSR = Lose Gratification in Social Relationships.

Influence of social antecedents and others' behavior on adherence to protective behaviors against COVID-19

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Influence of social antecedents and others' behavior on adherence to protective behaviors against COVID-19