Social Avoidance in Volatile Environments:

An Empirical Evaluation of Behavioral Flexibility and Relapse Following Social Exclusion

by

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Abstract

Resurgence is a relapse phenomenon comprised of the return of a previously reinforced target response (e.g., social avoidance) when conditions worsen for a more recently reinforced alternative response (e.g., approaching others). Laboratory models of resurgence can be used to understand and characterize social-avoidance behavior in Social Anxiety Disorder (SAD), including relapse of social avoidance following unexpected changes in social contingencies. The present study examined behavior of healthy adult participants in a social game with other players purportedly making decisions about whether to share jokes with the participant. In Experiment 1, participants avoided interactions with other players when others viewed jokes only among themselves (exclusion; Phase 1). Participants later approached the same players when they began sharing jokes with the participant (inclusion; Phase 2). Finally, when arranging parametric reductions in social inclusion across groups (Phase 3), we observed resurgence as increased avoidance relative to the inclusion phase. The likelihood of avoidance systematically increased when arranging more ambiguous social outcomes (extinction) versus inclusion. In Experiment 2, we arranged exclusion in Phase 1 before parametrically manipulating inclusion versus extinction between groups in Phase 2. We found that more inclusion in Phase 2 precipitated resurgence of avoidance during extinction testing in Phase 3. Correlation analyses identified relations between avoidance, subjective feelings of inclusion, and self-reported social anxiety. In each experiment, feelings of inclusion were negatively correlated with overall avoidance. Avoidance also tended to increase with greater social anxiety in Phase 1 of both experiments, but the two variables were otherwise uncorrelated. Overall, this novel paradigm and empirical evaluations lay the groundwork for addressing important theoretical questions about relapse following social exclusion and its relation to measures of social anxiety.

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AP-AV	Approach-Avoidance
DASS-21	Depression, Anxiety and Stress Scale – 21 items
DRA	Differential Reinforcement of Alternative Behavior
DRO	Differential Reinforcement of Other Behavior
ITI	Intertrial Interval
NTQ	Need Threat Questionnaire
A-RSQ	Rejection Sensitivity-Adult Questionnaire
SAD	Social Anxiety Disorder
SIAS	Social Interaction Anxiety Scale
VI	Variable Interval
VR	Variable Ratio

"Evolution has instilled a need to belong and feel accepted. We are social to our core." (de Waal, 2005, p. 235).

The tendency to form groups – ranging from temporary aggregations to more permanent social groups – is a widespread phenomenon across organisms as diverse as amoebas, dolphins, elephants, and humans (Parrish & Edelstein-Keshet, 1999; Rubenstein & Kealey, 2010). From an evolutionary perspective, belonging to a group is pertinent to survival, as groups can provide protection and access to essential resources (Baumeister & Leary, 1995; see also Javarone & Marinazzo, 2017). This link between belonging and survival could explain why group affiliation and in-group preferences emerge early in human development and are ubiquitous across cultures (e.g., Brown, 1991; Dunham et al., 2011). Moreover, humans' neural architecture reflects the evolutionary significance of group membership, with specialized neural and cognitive mechanisms both for facilitating normative social behaviors (e.g., cooperation for mutual benefit; Barbey et al., 2009) and detecting threats of both interpersonal and group exclusion (Kerr & Levine, 2008; see also Eisenberger & Lieberman, 2004).

Social Exclusion

Social exclusion (hereafter, *exclusion*) comprises both ostracism and rejection and is broadly defined as "being kept apart from others physically or emotionally" (Wesselmann et al., 2023). Exclusion has been observed in almost all nonhuman social species (e.g., primates, lions, wolves, buffaloes, bees; Williams, 2007) and in human societies around the world (Söderberg & Fry, 2017). In humans, exclusion occurs across the lifespan (e.g., Nida & Saylor, 2016; Rudert et al., 2020), and, for some individuals, on a daily basis (Nezlek et al., 2012).

Among other consequences, exclusion causes emotional distress (see Gerber & Wheeler, 2009; Hartgerink et al., 2015; Williams, 2007; Wesselmann et al., 2023, for reviews; but see also

Blackhart et al., 2009). Emotional distress comprises decreases in self-reported mood and threats to fundamental psychological needs, including the need to be viewed positively by other people (self-esteem), to establish meaningful connections with others (belonging), to make meaningful contributions to society (meaningful existence), and to demonstrate influence over one's social environment (control; see Williams, 2009). These negative effects can be produced by events as varied as imagined scenarios (e.g., imagining not being tagged in a social-media post; Büttner & Rudert, 2022), nonverbal cues (e.g., averted eye gaze; Wesselmann et al. 2012; see also Wirth et al., 2010), and estrangement from friends and family (e.g., Gruter, 1985; Zamperini et al., 2020).

Given the wide range of experiences falling under the umbrella of exclusion, empirical research has examined effects of exclusion using numerous independent variables (see Wirth, 2016, for a review). Therefore, a subsequent section reviews different empirical approaches to studying exclusion. The goal of this section is to provide an overview of independent variables manipulated in exclusion studies, which can be broadly categorized as instructions and written prompts, interactions with other individuals, and interactions with computer avatars (Wirth, 2016). This section concludes with a discussion of strengths and weaknesses of the most widely used paradigm for studying exclusion (*Cyberball*; Williams et al., 2000).

Empirical Approaches to Studying Exclusion (Independent Variables)

Instructions and Written Prompts. Many studies of exclusion use instructions or other written prompts. These prompts vary but include exclusion-themed vignettes (e.g., Büttner & Rudert, 2022; van Beest & Williams, 2011), or instructions to recall (e.g., Chen et al., 2008; Klages & Wirth, 2014) or imagine a future exclusion experience (Chen & Williams, 2012; see also DeWall & Baumeister, 2006; Twenge et al., 2001). As one example, Klages and Wirth (2014) instructed three groups of participants to either write about a typical Wednesday, or a

time laughter made them feel included or excluded. Recalling exclusive laughter caused emotional distress while recalling inclusive laughter (versus a typical Wednesday) led to improved mood and a greater sense of belonging.

Interactions with Other Individuals. Other researchers arrange exclusion during or following face-to-face interactions. For example, confederates in Stroud et al. (2000) isolated participants during a group discussion using both verbal and nonverbal cues (e.g., orienting their bodies away from the participant, vocally disagreeing with their opinions), a manipulation that worsened affect relative to a control condition (see also Pepitone & Wilpizeski, 1960). Another approach involves informing participants that others chose to forgo a second interaction with them (e.g., Çelik et al., 2013; DeWall et al., 2008; Maner et al., 2007; Twenge et al., 2001). In a supposed study of first impressions, Çelik et al. (2013) arranged the first of two planned meetings between a participant and confederate before the confederate either proceeded with the task or refused to continue for ambiguous reasons. The latter manipulation produced emotional effects (increased anger, sadness) relative to the control condition. Finally, some studies simulate common experiences using technology-mediated interaction – for example, by arranging message exchanges with a confederate who suddenly stops responding in a chat room (Williams et al., 2002; see also Gardner et al., 2000) or via text messaging (Smith & Williams, 2004). These studies extend prior findings by demonstrating that even the absence of an expected response is sufficient to produce emotional distress.

Interactions with Avatars. A final category of paradigms uses technology-mediated interaction with avatars instead of humans, typically unbeknownst to participants. These interactions occur during word-association (*Atimia*; Wirth et al., 2014), murder mystery (*Clue*; Jones et al., 2009), or ball-tossing games (*Cyberball*; Williams et al., 2000; see also Kassner et

al., 2012). Across game paradigms, exclusion is arranged by allocating fewer word-association tasks, clues, or ball tosses, respectively, to the participant relative to other players. Excluded participants report emotional distress when receiving fewer opportunities (e.g., Williams et al., 2000; Wirth et al., 2014) or less information (Jones et al., 2009). Similar negative effects occur when avatars are used to simulate common web-based experiences – e.g., receiving fewer "likes" relative to others on social-media platforms (*Ostracism Online*; Wolf et al., 2015) or being ignored during a video-conferencing presentation (*O-Cam*; Goodacre & Zadro, 2010).

Cyberball. Among the multitude of paradigms for examining effects of exclusion, Cyberball – a virtual, ball-tossing game – is the most widely used. As of 2018, it was featured in more than 200 studies of exclusion comprising nearly 20,000 participants (see Hartgerink et al., 2015, for a review; see also Williams, 2018). Cyberball is presented as a study of mental visualization and, as a part of this cover story, participants are instructed to visualize all aspects of the game (e.g., physical setting, other players). Participants ostensibly join other human players over the internet (cf. De Waal-Andrews & van Beest, 2020), but, in reality, other players are computer algorithms. Upon receipt of the ball, participants use keypresses or mouse clicks to throw the ball to another player. Researchers arrange inclusion or exclusion by adjusting the number of tosses to the participant relative to other players. Participants are either included in a fair game, receiving the same number of ball tosses as other players, or they receive comparatively more (overinclusion) or fewer tosses (exclusion).

One of the reasons for Cyberball's popularity is its efficiency: it can be administered online and lasts only a few min. Moreover, in a meta-analysis of Cyberball studies, Hartgerink et al. (2015) found a large effect of receiving fewer ball tosses relative to other players (versus receiving the same number; $d>1.4$). That large effect of exclusion generalized across structural

aspects of the game (e.g., duration of exclusion, number of players) and sample characteristics (e.g., age, sex). Results were also robust across different types of dependent variables, but effects on interpersonal (e.g., aggression) versus intrapersonal measures (e.g., emotional distress) were comparatively weak. In other words, Cyberball exclusion is effective in producing changes in self-report measures, but somewhat less effective in producing changes in behavior. Therefore, Cyberball might not be suitable for researchers specifically interested in behavioral outcomes of exclusion.

Effects of Social Exclusion (Dependent Variables)

Effects of exclusion are multi-dimensional, and can include not only emotional but also physiological, cognitive, and behavioral changes. Thus, this next section comprises a review of dependent variables in exclusion research. This review includes physiological and cognitive effects of exclusion, but the overall goal is to provide a detailed review of behavioral outcomes (e.g., aggressive behavior, avoidance), as well as factors that moderate those outcomes. Given that paucity of research on the link between exclusion and avoidance specifically, this section concludes with a discussion of future research that could enhance our understanding of how exclusion impacts avoidance behavior.

Physiological Effects. Beyond emotional distress, exclusion generally produces a range of physiological effects such as inflammation (Slavich et al., 2010), and increases in systolic and diastolic blood pressure (e.g., Eres et al., 2021; Stroud et al., 2000). Exclusion also produces endocrinological effects among subsets of participants. For example, some excluded individuals experience increases in cortisol, but these effects are moderated by sex (Stroud et al., 2000), self-esteem (Ford & Collins, 2010), and genetic factors (McQuaid et al. 2015), among other variables (see Beekman et al., 2016; Blackhart et al., 2007; but see also Helpman et al., 2017; Seidel et al.

2013; Zöller et al. 2010). Finally, exclusion can modulate testosterone (Seidel et al. 2013; cf. Peterson and Harmon-Jones, 2012; Geniole et al., 2011) and progesterone levels (Dinh et al., 2021; see also Maner et al., 2010; Seidel et al. 2013), with the latter change linked to reduced female fertility (Dinh et al., 2021). Like emotional distress, these physiological changes occur in laboratory-based exclusion manipulations that last only a few min. Thus, even brief exposures to exclusion can negatively impact physical health and well-being.

Cognitive Effects. Brief exclusion manipulations also produce a variety of cognitive effects. For example, just recalling exclusion experiences can enhance the perception of pain (Chen et al., 2008; but see also Bernstein & Claypool, 2012; DeWall & Baumeister, 2006). Moreover, exclusion impairs cognitive performance on tasks measuring selective attention, processing speed, cognitive flexibility, and working memory (e.g., Chen et al., 2008; Fuhrmann et al., 2019). For example, Chen et al. (2008) found that participants recalling a recent betrayal by someone close to them reported more current pain and showed increased reaction time on the Stroop task (Stroop, 1935) relative to participants recalling an experience of physical injury (see Baumeister et al., 2002, for similar findings). Overall, these findings suggest that exclusion can have pervasive and detrimental effects on cognitive functioning (but see Zhang et al., 2021).

Behavioral Effects. Research has elucidated how exclusion can impede optimal functioning, including negative effects on both physiological and cognitive processes. Nevertheless, the exclusion literature is predominated by studies using self-report measures as dependent variables, with a particular focus on emotional reactions and threats to fundamental psychological needs such as belonging, self-esteem, control, and meaningful existence (see Williams, 2009). Comparatively, behavioral responses to exclusion have received much less attention. Extant research suggests a link between exclusion and a variety of maladaptive

behaviors as coping strategies, including substance misuse, self-harm, and violent behavior (e.g., Cawley et al., 2019; Leary et al., 2003; Wesselmann & Parris, 2021). On the other hand, research indicates that exclusion can increase adaptive behaviors. This includes prosocial behavior, defined as voluntary and intentional action(s) that are deemed beneficial to another person by an individual's social group (see Pfattheicher et al., 2022, for a discussion). For example, excluded individuals are more willing to purchase environmentally friendly products (Guo et al., 2020) and to perform volunteer work for charitable organizations (Kandaurova & Lee, 2019; but see Quarmley et al., 2022). The fact that exclusion can produce diametrically opposed responses suggests underlying complexities in the relation between exclusion and behavior. To address these complexities, the sections that follow comprise a review of factors that moderate behavioral outcomes of exclusion.

Adaptive Responses to Exclusion: Prosocial Behavior. Generally speaking, because exclusion is a phylogenetically important event that could threaten social status and reproductive success, it induces a range of behaviors – either adaptive or maladaptive – that might mitigate its effects (see Baum, 2020, for a review). Some studies have examined conditions that could increase the likelihood of adaptive responses to exclusion, including prosocial behavior (Maner et al., 2007). In one such study, Maner et al. recruited participants differing in fear of negative evaluation (Leary, 1983). Fear of negative evaluation has been defined as "apprehension about others' evaluations, distress over their negative evaluations, avoidance of evaluative situations, and the expectation that others would evaluate oneself negatively" (Watson & Friend, 1969, p. 449). Participants in Maner et al. exchanged video messages with a partner (ostensibly another participant) before learning they would not meet their partner face-to-face either because the partner had to leave early (control) or because the partner did not want to meet them (exclusion).

Next, in a reward-assignment task, participants in each group assigned 0-20 creativity points to drawings made by their partner. As part of this evaluation, participants allocated money to the partner, with those donations detracting from their own earnings. Prior to the reward-assignment task, these researchers manipulated situational variables across two experiments. One experiment manipulated past experience with a partner: that is, drawings were supposedly made either by a new partner or the original partner. A second experiment manipulated an anticipated (future) experience: drawings were made by a new partner and participants were told they would or would not meet the new partner face-to-face after the task. Prosocial behavior varied as a function of fear of negative evaluation, past experience with partner, and anticipated interaction. Specifically, excluded individuals allocated more money to their partner than control participants, but this was true only among those low in fear of negative evaluation, with novel partners (i.e., no history of exclusion), and when anticipating a future interaction. In other words, exclusion can increase prosocial behavior, but this effect is moderated both by individual and situational variables.

Adaptive Responses to Exclusion: Affiliative Behavior. A related line of research supports the notion that exclusion can induce a range of affiliative behaviors under some conditions. Affiliative behaviors comprise both verbal and nonverbal behaviors promoting engagement and interpersonal bonding (Garcia et al., 2018). Examples include mimicking others' facial expressions and bodily movements (e.g., Lakin et al., 2008; Cheung et al., 2015), and making physical contact with others (Schaan et al., 2020). Like prosocial behavior, affiliative behaviors could increase rapport and help to re-establish social connections after exclusion (e.g., Cheung et al., 2015). In one relevant study, Schaan et al. (2020) recruited adult women varying in rejection sensitivity, defined as a disposition to "anxiously expect, readily

perceive and overreact to rejection" (Downey & Feldman, 1996, p. 1327). Schaan et al. also manipulated the severity of exclusion using a modified version of the future-life alone paradigm (Twenge et al., 2001). After taking a personality test, participants were told either that they would have many fulfilling relationships throughout their life (control), or that they would likely lose most (moderate exclusion) or all of their close relationships in the future (severe exclusion). Next, in a task developed by Koslov et al. (2010), participants in the Schaan et al. study played a game with the alleged purpose of investigating how people communicate using sign language without visual or auditory interaction. During the game, participants touched a confederate's hand, hidden under a box, in an attempt to guess as many signed letters as possible. Participants with high (versus low) rejection sensitivity sought less physical contact, while those anticipating the loss of most (but not all) relationships sought more physical contact. Thus, as with prosocial behavior, exclusion can induce affiliative behavior in some individuals under specific conditions.

Maladaptive Responses to Exclusion: Aggression. Exclusion-induced aggression is also susceptible to moderation by a number of different variables. For example, individuals high versus low in rejection sensitivity respond to exclusion more aggressively (see Ayduk et al., 2008; Downey et al. 1998). Like prosocial and affiliative responses, aggression refers to a wide range of behaviors. However, in exclusion research, it is often examined using one of two paradigms. In the first, aggression is operationalized as the intensity and duration of aversive noise blasts delivered to an ostensible opponent during a computer game (*Taylor aggression paradigm*; e.g., Twenge et al., 2001; 2007; see Taylor, 1967). In the second, it is operationalized as the amount of hot sauce prepared for another individual who will supposedly have to consume the entire sample despite their distaste for spicey foods (*hot sauce paradigm*; e.g., Warburton et al., 2006; see Lieberman et al., 1999).

Warburton et al. (2006) and Twenge et al. (2007) used the hot sauce and Taylor aggression paradigms, respectively, to examine effects of situational variables on aggressive behavior following exclusion. Warburton et al. recruited participants for what was described as a taste preferences experiment. After the experimenter left – supposedly to make sampling arrangements – two confederates initiated a ball-tossing game, either including or excluding participants in the game across two groups. Participants were then exposed to a series of aversive sounds as part of a separate task; they were told either that they could or could not control the administration and timing of noise. Finally, aggression was evaluated using the hot sauce paradigm. Excluded participants without control over the noise allocated more than four times as much hot sauce to their partner relative to all other groups, while excluded participants with control over the noise allocated no more hot sauce to the partner than included participants. These findings suggest that having little control over some aspects of one's environment could incite exclusion-induced aggression, whereas restoring control could mitigate these effects.

In a related study, Twenge et al. (2007) examined potential moderating effects of another situational variable: social support. First, Twenge et al. arranged either unanimous rejection or acceptance by a group. Specifically, after a brief group interaction, participants were informed that either no one or everyone chose to work with them on a subsequent task (*get-acquainted paradigm*, Nezlek et al., 1997). Next, in one experiment, half of participants experienced a friendly social interaction: an experimenter thanked them for their participation and provided a bag of candy. The other half received a written receipt for participation. In a second experiment, participants wrote for two min about one of two topics: (1) the best friend they ever had or (2) their travel to campus. Therefore, the former condition in each experiment involved access to social connection, either in person or via recall, while the latter condition served as a control.

During a subsequent task, those excluded (versus included) in the get-acquainted task demonstrated more aggression toward a novel partner via noise blasts in the Taylor aggression paradigm. However, those with access to a brief experience or memory of social connection were no more aggressive than non-excluded controls (see also Gardner et al., 2005). Altogether, these findings suggest that, like adaptive responses to exclusion, aggression is moderated both by situational (e.g., control; Warburton et al., 2006; availability of social support; Twenge et al., 2007) and individual factors (e.g., rejection sensitivity; Ayduk et al., 2008; Downey et al. 1998). However, the generality of these findings is limited. For example, the extent to which factors such as availability of social support and rejection sensitivity might moderate other maladaptive responses to exclusion, including avoidance, remains unexplored.

Maladaptive Responses to Exclusion: Avoidance. Exclusion does not always induce attempts to repair damaged relationships via prosocial or affiliative responses, nor does it always induce aggression. In some cases, exclusion induces avoidance (Pepitone & Wilpeski, 1960; see Horney, 1945; Van Kleef et al., 2010) or related behaviors (escape behavior; Williams et al., 2000; see also Ren et al., 2016, 2021). Avoidance generally refers to either postponement or prevention of impending events (see Hineline & Rosales-Ruiz, 2013, for a review). In the context of social exclusion, this might include forgoing opportunities to interact others after being ostracized or rejected.

Only one study provided an opportunity for avoidance following exclusion (Pepitone & Wilpeski, 1960). Pepitone and Wilpeski arranged a group discussion with confederates either vocalizing opinions that were in line with (control) or directly opposed to participants' opinions (exclusion). During a subsequent "break" from the group discussion, exclusion comprised both verbal and nonverbal cues (e.g., offering gum to everyone except for the participant).

Experimenters then asked individuals whether they would like to return for another discussion with the same group. Relative to controls, a greater percentage of excluded participants chose to avoid sources of exclusion by forgoing a second discussion. These findings suggest that exclusion can induce avoidance on a single occasion.

Whether exclusion generally produces transient avoidance or more sustained effects that persist across opportunities for subsequent interactions remains an empirical question. Addressing this question is pertinent for several reasons. First, avoidance that persists over time could perpetuate exclusion and social isolation, ultimately setting the stage for further exclusion (see Cheung et al., 2015; Son & Padilla-Walker, 2020). Second, isolation resulting from social avoidance can have detrimental effects on physical health and well-being, including increased morbidity and mortality (see Friedler et al., 2015, for a review). Third, avoidance plays an important role in mental health and is a defining characteristic of many anxiety disorders, including agoraphobia, specific phobias, and Social Anxiety Disorder (SAD; Hofmann & Hay, 2018). Thus, addressing this gap in the literature could ultimately improve clinical outcomes.

Exclusion, Avoidance, and Anxiety

The next section provides further discussion of the role of avoidance in anxiety disorders, with a specific focus on SAD, given its relevance to social exclusion. Factors that might contribute to the maintenance of avoidance in SAD are also discussed. Subsequent sections review extant research on effects of exclusion among individuals with social anxiety across a range of dependent variables, including avoidance. There is little research on exclusion-induced avoidance among individuals with social anxiety. Therefore, a final goal is to outline directions for future research in this area.

Avoidance in Social Anxiety Disorder

Anxiety disorders are highly prevalent, affecting at least one in three Americans over the course of their lifetimes (Kessler et al., 2012), and representing a leading cause of disability worldwide (Baxter et al., 2014). Avoidance plays an important role in anxiety because it necessarily prevents extinction learning, thereby contributing to the maintenance of anxiety disorders (e.g., Lovibond et al., 2009; see also Smith et al., 2020). Said another way, avoidance prevents one from learning that feared stimuli do not pose a threat.

SAD is an anxiety disorder characterized by fear and avoidance of situations involving possible scrutiny by others (American Psychiatric Association, 2013). Research suggests a complex interplay of biological (e.g., genetic, epigenetic factors) and environmental variables (e.g., parent behavior, peer victimization) are risk factors for SAD and maladaptive patterns of avoidance (see Brook & Schmidt, 2008; Caldiroli et al., 2023; Nikolić et al., 2018; Norton & Abbott, 2017). Once these patterns of behavior develop, avoidance tends to take a chronic course (Keller, 2003), and has a myriad of detrimental effects, including lower educational attainment (Vilaplana-Pérez et al., 2021), higher rates of unemployment (Moitra et al., 2011), and decreased work attendance, productivity, and performance (Wittchen et al., 2000). The negative impact of avoidance also extends to interpersonal relationships: individuals with SAD have fewer friends (Whisman et al., 2000), are more likely to experience bullying (Acquah et al., 2016), and are less likely to marry or have children (Wittchen et al., 2000). Therefore, avoidance leaves individuals with SAD more vulnerable to social isolation and exclusion.

The Role of Behavioral Flexibility. One factor that could contribute to the maintenance of avoidance in SAD is difficulty adapting to changing social circumstances (Ronay & von Hippel, 2015). Unpredictability – sometimes referred to as *volatility* (Beltzer et al., 2019) – is an inherent feature of many social interactions because the same social behavior can often produce

very different results. For example, saying hello to your neighbor might evoke a friendly smile and wave one day, and a curt, disinterested response the next day. Thus, adaptive social behavior requires learning about the probabilities of social reinforcement and punishment, detecting changes in those probabilities, and shifting behavior accordingly. Research has shown that this kind of *behavioral flexibility* predicts competence across varied social contexts, including business negotiations and romantic relationships (Ronay & von Hippel, 2015). It is also a key component of psychological health and well-being. On the other hand, *behavioral inflexibility* manifests in many forms of psychopathology, including SAD (see Kashdan & Rottenberg, 2010, for a review). In contrast with flexible behavior, inflexibility is characterized by deficits in adjusting behavior in accordance with changes in environmental contingencies in order to maximize reinforcement.

Behavioral flexibility is often evaluated in reversal learning paradigms (see Izquierdo et al., 2017, for a review). Evaluations of reversal learning with operant behavior are typically arranged as follows: first, reinforcement is provided contingent upon some response(s) and not others, and participants learn these contingencies through trial and error. After learning is established, these contingencies are reversed without warning, such that response(s) initially producing reinforcement are no longer reinforced (i.e., response[s] are *extinguished*) and vice versa (e.g., Ritchey et al., 2022). Reversal learning can be used to examine behavioral flexibility during changes in social or nonsocial contingencies.

Individuals with social anxiety demonstrate deficits in reversal learning that are specific to social information, indicative of behavioral inflexibility in this context (Zabag et al. 2022, 2023). For example, Zabag et al. (2022) randomly assigned participants to one of two reversal learning tasks with social (neutral faces) or nonsocial stimuli (shapes). Participants then

completed an approach-avoidance (AP-AV) task during which engaging with some stimuli produced points exchangeable for money while engaging with others resulted in point loss. Avoidance resulted in no feedback and the presentation of the next trial. After an unsignaled contingency reversal, accurate performance necessitated both engaging with stimuli previously producing point loss (*negative-to-positive updating*) and avoiding stimuli previously producing point gain (*positive-to-negative updating*). Self-reported social anxiety was associated with impaired negative-to-positive updating and enhanced positive-to-negative updating with social but not nonsocial stimuli (see Beltzer et al., 2019; Haker et al., 2014; Zabag et al., 2023, for similar findings; see also Kimbrel et al., 2010, 2012).

More recent research has shown that individuals with social anxiety demonstrate deficits in positive updating of social information even when the consequences of avoidance are explicitly revealed. For example, Zabag et al. (2024) updated their 2022 task by providing feedback contingent upon avoidance ("Approaching this person would have gained you points" or "Great! You were right to avoid this person."). Even with explicit feedback, participants with higher versus lower social anxiety were slower to approach stimuli previously producing point loss. Altogether, these findings could suggest that an individual with social anxiety might be reluctant to engage with an unfriendly but recently amicable acquaintance (impaired negative-to-positive updating) while at the same time quick to distance themselves from a long-time friend who has recently been uncharacteristically cold and distant (enhanced positive-to-negative updating). Therefore, behavioral inflexibility – as is characteristic of individuals with SAD – could contribute to the maintenance of avoidance when social circumstances change. Exclusion provides one example of a change in social circumstances that could induce avoidance.

Impact of Exclusion on Individuals with Social Anxiety

Few empirical studies have directly examined how exclusion impacts individuals with social anxiety, including the role of behavioral flexibility. Limited findings from studies with nonclinical (Azoulay et al., 2020; Zadro et al., 2006) and clinical populations (see Reinhard et al., 2020, for a review) suggest exclusion differentially impacts individuals with social anxiety across multiple dependent variables. For example, Gutz et al. (2016) reported that, relative to healthy control participants, individuals with SAD were more likely to attribute Cyberball exclusion to internal factors; they also felt less in control during exclusion. Gutz et al. did not examine behavioral responses to exclusion but found that reports of self-attributions were positively correlated with maladaptive behavioral intentions, including escape and self-harm. Similarly, Zadro et al. (2006) found that threats to fundamental psychological needs, including perceived control, persist over longer time periods in individuals with higher versus lower levels of social anxiety. However, it is unclear how this might affect ongoing behavior, including avoidance.

With respect to the role of behavioral flexibility, Azoulay et al. (2020) demonstrated that exclusion exacerbates inflexibility typically observed among those with social anxiety. Specifically, Azoulay et al. presented video clips showing changes in facial expressions, including smiles gradually changing into disgust expressions. Parents with higher social anxiety were quicker to detect the offset of smiles (positive-to-negative updating), and this difference was more pronounced following Cyberball exclusion. While it is possible that these differences in positive-to-negative updating could extend to avoidance behavior, no studies have directly evaluated this possibility.

Exclusion-Induced Avoidance. Only a small number of studies examining the impact of exclusion in social anxiety have incorporated measures of avoidance as dependent variables

(e.g., Beltzer et al., 2019; Gilboa-Schechtman, 2014; Mallott et al. 2009; Weerdmeester and Lange, 2019). These studies have generally demonstrated increases in exclusion-induced avoidance with higher levels of social anxiety, including decreased eye contact, gaze quality (Mallott et al., 2009), and vocal quality (Gilboa-Schechtman, 2014; Mallott et al. 2009). Each of these dependent variables might be considered *direct* measures of avoidance, comprising a shift in observable behavior that occurs as a function of the exclusion manipulation.

Others have reported similar findings using *indirect* measures of avoidance (Beltzer et al., 2019; see also Weerdmeester and Lange, 2019), defined as measures derived from other observable behaviors that serve as the primary dependent variable. For example, Beltzer et al. (2019) arranged a variation of Cyberball with different probabilities of receiving the ball from one of three avatars [hereafter, *p(inclusion)*]. Avatar roles included a "punisher" p(inclusion) = .1, "neutral player" p(inclusion) = .33, and "rewarder" p(inclusion) = .7, and there were several unsignaled role switches throughout the game. Participants with higher levels of self-reported social anxiety were more likely to avoid a previously punishing avatar than those with lower social anxiety, but avoidance was inferred from other behavior. More specifically, participants with higher social anxiety allocated more tosses to a previously neutral versus previously punishing avatar. Nevertheless, throwing exclusively to some avatar(s) and not others does not necessarily indicate avoidance of the latter, because differential allocation of throws could be a function of other controlling variables. For example, throwing more to the rewarder could be a function of differential positive reinforcement. Overall, these findings suggest that Cyberball exclusion might induce avoidance. However, future research should incorporate direct approaches to measuring avoidance to ensure face validity and to fully elucidate the relation between avoidance and exclusion.

Schlund et al. (2021) provide one possible approach to directly measuring avoidance and behavioral processes relevant to social anxiety. Schlund et al. examined university students' responses to social-evaluative threat and social aggression in AP-AV tasks. The tasks included images of faces described as prior research participants. These "prior participants" had ostensibly evaluated photos by indicating (1) the extent to which positive (e.g., kind) and negative descriptors (e.g., ugly) applied to other participants' photos, and (2) their willingness to give money to the participants that were pictured or to take money away from them. These evaluations were then incorporated into the AP-AV tasks.

Specifically, after having their own headshot taken, participants were told that facial recognition software would match characteristics of their photo to those evaluations from prior participants. They were also told that prior participants varied in how favorably or unfavorably they evaluated people who looked like them. Participants first learned to associate nine images of prior participants with different probabilities of receiving positive or negative descriptors. If a photo of a prior participant was consistently presented with a negative descriptor, this suggested that the individual had negatively evaluated photos of people who looked like the participant. Next, in two computer-based AP-AV tasks, participants made choices about whether to approach or avoid mock social interactions with those nine individuals. In one task examining effects of social-evaluative threat, approaching others (pressing one key) presented a positive descriptor or probabilistic negative descriptor – supposedly based on prior participants' evaluations of people who looked like the participant – and avoiding others (pressing a different key) resulted in neither outcome. In a second task examining effects of social aggression, approaching others resulted in either earning money or probabilistic money loss based on prior participants' decisions to give or take money from people who looked like the participant; avoiding others

again resulted in neither outcome. Schlund et al. (2021) found that parametric increases in social-evaluative threat and aggression produced corresponding increases in avoidance.

While negative evaluations and acts of aggression might fall under the broad definition of exclusion (Wesselman et al., 2023), Schlund et al. (2021)'s findings could have limited generality for individuals with social anxiety for three reasons. First, social anxiety was not evaluated as a potential moderating variable. Second, it is unclear whether social-evaluative threat and aggression might produce similar effects on avoidance if these acts were more personal – e.g., if negative evaluations targeted the participant rather than someone who looked like them. Third, social aggression involved monetary loss, and research suggests that people with social anxiety learn about monetary and social consequences differently (Richey et al., 2014). Nevertheless, Schlund et al. demonstrated the validity of their paradigm for research on social approach-avoidance decision making. Future research could expand upon this approach to improve our understanding of how exclusion impacts decision-making processes among individuals with social anxiety.

Summary and Future Research Directions

Extending current research on exclusion-induced avoidance among individuals with social anxiety is important for several reasons. First, high levels of social anxiety are associated with increased rejection sensitivity (Gutz et al., 2015; Staebler et al., 2011) and fear of negative evaluation (Clark & Wells, 1995; Rapee & Heimberg, 1997) as well as lower perceptions of control (see Gutz et al., 2016; see also Gallagher et al., 2014, for a review) and less social support (see Teo et al., 2013, for a review; see also Torgrud et al., 2004). Despite the fact that no studies have examined whether these variables moderate exclusion-induced avoidance, research suggests that greater rejection sensitivity and fear of negative evaluation can incite other

maladaptive responses to exclusion (i.e., aggression: Ayduk et al., 2008; Downey et al. 1998), and could perpetuate exclusion via reduced affiliative (Schaan et al., 2020) and prosocial behaviors (Maner et al., 2007). Similarly, both greater perceptions of control (Warburton et al., 2006) and meaningful social support mitigate the risk of maladaptive responses to exclusion (Twenge et al., 2007). Finally, social anxiety is characterized by behavioral inflexibility, including enhanced positive-to-negative updating when social conditions worsen and reduced negative-to-positive updating when social circumstances improve (e.g., Azoulay et al., 2020; Zabag et al., 2022). These processes could ultimately play a role in the maintenance of avoidance behavior in SAD. Altogether, these findings corroborate the idea that individuals with SAD demonstrate enhanced vulnerability to exclusion: they are more likely to experience it (e.g., Acquah et al., 2016; Whisman et al., 2000) and to respond in ways that could perpetuate it.

There are two important gaps in this literature to be addressed: first, future exclusion research should incorporate direct measures of social avoidance to avoid problems with lack of control and face validity resulting from indirect measures (Beltzer et al., 2019). Second, future research should evaluate exclusion-induced avoidance across repeated opportunities for social interaction (cf. Pepitone and Wilpeski, 1960). This is particularly important given that SAD is characterized by persistent social avoidance (American Psychiatric Association, 2013) that is highly susceptible to relapse after successful treatment (e.g., Bruce et al., 2005; Keller, 2006; see Smith et al., 2020, for a discussion). Incorporating direct measures of avoidance across repeated opportunities for social engagement (e.g., Schlund et al., 2021) will clarify the relation between exclusion and avoidance in SAD. Importantly, this approach could also facilitate evaluation of variables promoting and maintaining more adaptive responses to exclusion. This line of research could ultimately improve clinical outcomes for individuals with SAD.

Relapse

To improve clinical outcomes, it is important not only to understand factors contributing to the persistence of avoidance in SAD, but also factors contributing to the return of avoidance behavior following successful treatment, or relapse. *Relapse* refers to an increase in the number and intensity of symptoms of a psychological disorder following a remission period (Smith et al., 2020), and could be related to behavioral inflexibility. For example, inflexible behavior such as persistent rumination over negative thoughts and emotional states has been shown to play an important role in both the maintenance and recurrence of depression (Nolen-Hoeksema et al., 2008). For individuals with SAD, relapse of avoidance and other SAD symptoms is common, occurring in 1 in 3 individuals who previously responded to treatment (Bruce et al., 2005; Keller, 2006). Given its clinical relevance, the next section reviews extant research on relapse of avoidance in humans. This is followed by a discussion of empirical approaches to studying both behavioral flexibility with changes in avoidance contingencies and relapse of avoidance behavior.

Exclusion and Relapse of Social Avoidance

There is a large body of research dedicated to acquisition, maintenance, and extinction of avoidance behavior (Dymond, 2019; Hineline & Rosales-Ruiz, 2013; LeDoux et al., 2017; Urcelay & Prével, 2019), but comparatively little on relapse of avoidance and its mitigation. Moreover, impairment of approach behaviors diametrically opposed to avoidance – e.g., attending work or school or engaging in social interactions – comprise criteria for almost every documented psychological disorder (American Psychiatric Association, 2013). Yet, like avoidance, there is little research on the role of these approach behaviors in mitigating relapse (see Smith et al., 2020, for a discussion).

Krypotos and Engelhard (2018) provide one example of an empirical study of relapse of humans' avoidance (see also Cameron et al., 2015; Gatzounis & Meulders, 2020; Schlund et al., 2020; Vervliet & Indekeu, 2015; Vervliet et al., 2017; see Nakajima, 2014, for an example with nonhumans). Specifically, in a laboratory task with neurologically healthy adults, Krypotos and Engelhard demonstrated reinstatement of avoidance, defined as the recurrence of avoidance following the presentation of stimuli that previously induced that response. Participants were first exposed to two pictures of spiders that were either always (CS+) or never (CS-) followed by an electric shock (US). Next, participants learned to avoid the US by pressing a button on a computer keyboard. Avoidance subsequently decreased when both CSs were later presented in the absence of the US, indicative of behavioral flexibility with changes in the avoidance contingency. A final phase included three unexpected presentations of the US, resulting in a return – or reinstatement – of avoidance behavior to a greater extent in the presence of the CS+ than in the presence of the CS-.

In a related study, Schlund et al. (2020) demonstrated renewal of avoidance, defined as a return of previously eliminated avoidance following a change in environmental context. Neurologically healthy adults played a computer game that involved making choices about whether or not to board alien spaceships based on threat levels indicated on the screen. In one context – described as "Sector A" – participants first passively watched as alien attacks (and money loss) occurred with escalating threat levels. Next, participants made choices about whether or not to board alien spaceships in that sector. Approaching spaceships (pressing one key) resulted either in monetary gain or probabilistic monetary loss depending on the threat level, while avoiding spaceships (pressing another key) lowered the threat level, prevented monetary loss, and forfeited monetary gain. Overall, participants demonstrated increased

avoidance with escalating threat in Sector A. The passive and active tasks were then re-presented in a different context (Sector B) with no monetary loss irrespective of the threat level (threat extinction). In Sector B, participants demonstrated behavioral flexibility; that is, avoidance decreased and approach increased in accordance with the contingencies. Finally, despite continued threat extinction, when transitioning back to Sector A, avoidance increased relative to the prior phase, and those increases were a function of threat levels in Phase 1. Altogether, these findings suggest that avoidance is susceptible to relapse both during unexpected presentations of stimuli previously inducing avoidance (reinstatement), and following a return to a context where avoidance was previously induced (renewal).

Relapse, including reinstatement and renewal, might also be conceptualized as behavioral inflexibility when it occurs with clinically relevant behavior. For example, individuals with SAD might begin to approach rather than avoid others during exposure therapy in a clinical setting. However, they might return to avoiding others upon returning to a social setting (e.g., work, school) where they previously feared they might be excluded by colleagues or peers. This renewal of avoidance might occur even if exclusion is highly improbable. This could be conceptualized as behavioral inflexibility because individuals return to a well-learned pattern of behavior (avoidance) despite no changes in reinforcement contingencies (approaching others is unlikely to result in exclusion). Nevertheless, it is unclear whether unexpected exclusion might also be an impetus for relapse of avoidance behavior, in addition to other changes in stimulus conditions (Krypotos & Engelhard, 2018; Schlund et al., 2020). We turn next to exclusion contributing to relapse of avoidance.

Resurgence

Beyond renewal and reinstatement, one relapse phenomenon that might be particularly relevant in investigating the relation between social anxiety and exclusion is resurgence. Resurgence comprises increases in a previously reinforced *target response* (e.g., social avoidance) when conditions worsen for an *alternative response* (e.g., approaching others; see Lattal et al., 2017; Podlesnik et al., 2023, for reviews). For example, exposure therapy is an effective treatment for SAD and involves arranging alternatives to avoidance (e.g., initiating a social interaction) in highly controlled virtual environments or with the guidance of a trained therapist (see Chowdhury & Khandoker, 2023, for a review). After successful treatment, if approaching others leads to being ignored or rejected, we might expect to see a resurgence of avoidance that jeopardizes prior improvements in SAD symptoms.

Resurgence is a robust and general phenomenon. It has been observed in several different nonhuman species, including rats (e.g., Leitenberg et al., 1970; Craig & Shahan, 2016), fish (e.g., da Silva et al., 2014; Kuroda et al., 2017), hens (Cleland et al., 2000), mice (Craig et al., 2020), pigeons (e.g., Liddon et al., 2017; Shvarts et al., 2020), and monkeys (Mulick et al., 1976). In humans, resurgence has been demonstrated in the laboratory (e.g., Alessandri et al., 2015; Ritchey et al., 2022) and in crowdsourced studies conducted online (e.g., Ritchey et al., 2021; Podlesnik et al., 2022). Research with humans has also demonstrated resurgence of targeted behaviors such as aggression, self-injury, or substance misuse following discontinuation of effective behavioral treatments in clinical settings (e.g., Sullivan et al., 2020; Silverman et al., 1996). However, no studies have examined resurgence of avoidance, despite important implications for individuals with anxiety disorders.

Experimental Models of Resurgence. Extending research on resurgence to avoidance could facilitate a greater understanding of behavioral processes contributing to relapse of SAD

symptoms following successful treatment. Resurgence provides an ecologically valid model of relapse of social avoidance in SAD because resurgence occurs with unexpected changes in contingencies (volatility). Volatility is an inherent feature of social environments.

When extending the study of resurgence to new phenomena, experimental models provide an important starting point. This is because experimental models allow for isolation and systematic evaluation of independent variables to an extent that would be impractical or unethical in clinical settings. As a result, these models can be used to develop a greater understanding of the fundamental behavioral processes involved in relapse. Experimental models of resurgence typically arrange three phases: Phase 1 simulates a pre-treatment history of reinforcement for targeted behavior, and Phase 2 provides a model of treatment. Typically, Phase 2 arranges reinforcement for an alternative response while simultaneously removing reinforcement for the target. This is referred to as Differential Reinforcement of Alternative Behavior (DRA), an empirically supported treatment for reducing unwanted behavior (Petscher et al., 2009). Finally, tests in Phase 3 simulate common treatment challenges with nonhumans (e.g., Kuroda et al., 2017; Craig et al., 2020), or with humans in nonclinical (e.g., Alessandri et al., 2015; Reed, 2019) or clinical populations (e.g., Podlesnik et al., 2019; Shvarts et al., 2020).

Experimental models with humans typically use behaviors not targeted for clinical treatment as dependent variables, such as using a mouse to click an object on a computer screen (Reed, 2019), or pressing a key on a computer keyboard (Alessandri et al., 2015). For example, Alessandri et al. arranged one of the few laboratory demonstrations of resurgence of negatively reinforced behavior with three university students. Students were instructed to meet a force criterion by continually pressing a force cell with the thumb of their nondominant hand. Phase 1 established a history of reinforcement for pressing a key on a computer keyboard (target

response). Target responses resulted in 3-s breaks from pressing the force cell according to a variable ratio (VR) 23 schedule. In other words, breaks were scheduled to occur, on average, after 23 key presses. Phase 2 comprised a model of treatment with Differential Reinforcement of Other Behavior (DRO). Like DRA, DRO is an empirically supported treatment for reducing unwanted behavior (Weston et al., 2018). DRO generally arranges reinforcement for any behaviors occurring during a set period of time except for the target behavior (e.g., avoidance key presses). Thus, breaks in Phase 2 of Alessandri et al. resulted when key presses did not occur for a specified time period, which was initially 2 s but increased gradually to 20 s (i.e., DRO 20-s schedule). Target responding flexibly decreased under those conditions. In Phase 3, the DRO 20-s schedule was in effect during the first 5 min of the session. During the last 5 min, no breaks were provided (extinction) – a model of discontinuation of treatment – and key pressing resurged for each participant (see also Bruzek et al., 2009, for similar findings). These findings demonstrate that target behavior maintained by negative reinforcement can resurge with removal of alternative reinforcement. The clinical implication is that DRO and similar treatments can effectively reduce targeted behavior, but behavior could return promptly when these treatments are discontinued.

In a related study, Reed (2019) used a laboratory model not only to demonstrate resurgence but also to examine the relation between relapse and psychiatric symptoms under controlled conditions. College students with higher and lower levels of depression and anxiety served as participants. Clicks on one object – the target –initially produced points while clicks on an alternative object did not (Phase 1). Next, clicks on the alternative object produced points while clicks on the target object did not (i.e., DRA; Phase 2). Thus, the first two phases comprised a contingency reversal, a common approach to evaluating behavioral flexibility in

both resurgence and reversal-learning paradigms (e.g., Ritchey et al., 2022). Finally, Phase 3 arranged extinction as a model of discontinuation of DRA. Specifically, points were unavailable irrespective of the object clicked. The rate of clicks on the target object increased (resurged) in Phase 3 relative to the end of Phase 2, and resurgence was greater with lower levels of depression and higher levels of anxiety. With respect to clinical implications, these findings suggest not only that targeted behavior can return when effective treatments are discontinued, but also that psychiatric symptoms could moderate these effects.

Overall, these findings demonstrate how experimental models can be used both to examine conditions that produce resurgence and to facilitate systematic evaluations of a range of independent variables. Extending this approach to the study of behavioral flexibility and resurgence of avoidance behavior could enhance our understanding of the fundamental behavioral processes involved in relapse following successful treatment of SAD. A greater understanding of these fundamental behavioral processes could, in turn, inform clinical practice by suggesting methods both for improving treatment implementation and mitigating relapse to ensure maintenance of treatment effects (see Kimball et al., 2023, for a general review of relapse-mitigation techniques).

Factors Influencing Resurgence and Relevance to Social Avoidance. Experimental models provide insight into behavioral processes that could be relevant not only to understanding behavioral flexibility and resurgence of social avoidance, but also the role that exclusion might play in inducing relapse. What follows is a discussion of three variables known to impact behavioral flexibility and resurgence. These variables include: reductions in alternative reinforcement, punishment of an alternative response, and history of reinforcement for an

alternative response. Implications of these findings for resurgence of social avoidance following exclusion are also discussed.

Worsening of Conditions: Reductions in Alternative Reinforcement. Many studies using experimental models have manipulated reductions in the rate of reinforcement for an alternative response as an independent variable, with those reductions reliably producing resurgence (e.g., Schepers & Bouton, 2015; Shahan et al. 2020b). This is analogous to scaling back reinforcement as clinical treatments progress (i.e., "schedule thinning"), a common approach to ensuring treatment feasibility and long-term maintenance (e.g., Briggs et al., 2018, Muething et al., 2021). To simulate schedule thinning, Shahan et al. (2020b) arranged reductions in alternative-reinforcer rates across five groups of rats. Phases 1 and 2 of their experiments arranged identical contingencies for all groups. Phase 1 established a history of reinforcement for targeted behavior: presses on a target lever produced food for all groups according to a variable-interval (VI) 30-s schedule. A VI 30-s schedule arranges reinforcer deliveries for the first response after, on average, a 30-s interval has passed. In Phase 2, target responses were extinguished, and presses on an alternative lever were reinforced with food according to a rich, VI 10-s schedule. Phase-3 contingencies differed across groups. One control group experienced no change in alternative reinforcement from Phase 2 to Phase 3. For a second control group, all responses were extinguished – that is, they resulted in no reinforcement – in a typical test of resurgence. For the remaining three groups, the rate of alternative reinforcement was reduced to either a VI 20-s, VI 40-s, or a much leaner, VI 80-s schedule.

Shahan et al. (2020b) found that reductions in alternative-reinforcer rates produced resurgence, and the magnitude of resurgence increased with greater reductions (e.g., Lieving & Lattal, 2003; Winterbauer & Bouton, 2012; Volkert et al., 2009, for similar findings). In other

words, a general *worsening* of alternative conditions was sufficient to produce resurgence. Returning to the topic of exclusion-induced avoidance, it is helpful to consider the hypothetical case of an individual with SAD. Historically, social avoidance paid off for this individual – for example, by reducing anxiety. With treatment, this person began to behave more flexibly, initiating social interactions rather than avoiding them. Those attempts resulting in a myriad of positive outcomes, including pleasant interactions. One implication of Shahan et al.'s findings is that even subtle changes in social reinforcement – e.g., a friend is less talkative or less responsive to text messages than usual – could be sufficient to produce a return to well-learned patterns of behavior. In other words, a worsening of social conditions could produce resurgence of social avoidance. However, whether resurgence of avoidance occurs with reductions in social reinforcement – and the extent to which this might differentially impact individuals with social anxiety – remains an empirical question.

Worsening of Conditions: Punishment of an Alternative Response. In addition to reductions in alternative reinforcement, there are many other examples of worsening conditions that produce resurgence (see Lattal et al., 2017, for a review). Like Shahan et al. (2020b), Fontes et al. (2018) reinforced rats' target-lever pressing in Phase 1 followed by extinction and reinforcement of alternative responding in Phase 2. During testing for resurgence in Phase 3, they found that arranging foot-shock deliveries contingent upon alternative responding produced an increase in target responding relative to the prior phase. Those increases in target responding tended to be greatest at higher shock intensities. However, when arranging repeated exposures to Phases 1-3, Fontes et al. found that resurgence occurred even at low shock intensities – that is, when there was little reduction in alternative-reinforcer rate. Therefore, even without changes in alternative reinforcement, punishing an alternative response can produce resurgence (see also

Wilson and Hayes, 1996, for related findings with humans). These findings are particularly relevant to understanding effects of exclusion, which typically comprises social punishment – for example, when one's contributions to a group discussion are met with verbal insults or withdrawal of social attention (e.g., Stroud et al., 2000). One clinical implication is that exclusion could produce a resurgence of social avoidance for individuals with social anxiety, even after successful treatment to increase behavioral flexibility and reduce avoidance behavior.

History of Reinforcement for an Alternative Response. Research clearly demonstrates that worsening of alternative-reinforcement conditions impacts behavioral flexibility and resurgence. Theoretical accounts of resurgence suggest that past experiences – i.e., experiences with rich or lean schedules of alternative reinforcement prior to worsening – continue to influence behavior for a long time, and could differentially impact resurgence (Shahan & Craig, 2017). In line with this idea, empirical research supports the notion that experiences with rich (but not lean) schedules of alternative reinforcement produce resurgence during Phase-3 extinction tests (Craig & Shahan, 2016). Just as with worsening of alternative-reinforcement conditions, these findings by Craig and Shahan could have important implications for resurgence of social avoidance following exclusion.

Craig and Shahan (2016) arranged an experiment with rats, delivering food reinforcement according to either a rich VI 15-s or a lean VI 60-s schedule in Phase 1. In Phase 2, target reinforcement was discontinued and rats either earned no food (extinction control) or food was delivered according to a rich or lean schedule for an alternative nose-poke response. Finally, reinforcement was discontinued for all rats during testing for resurgence in Phase 3. Craig and Shahan found that, compared with the rich schedule of alternative reinforcement, the lean schedule resulted in relatively high rates of target responding by the end of Phase 2. Therefore, in

Phase 3, resurgence of target responding from low to high rates occurred only for groups experiencing the rich schedule of alternative reinforcement in Phase 2. This resurgence effect occurred irrespective of whether subjects experienced a rich or lean schedule of target reinforcement during Phase 1.

With respect to potential clinical implications of these findings, we will return to the hypothetical case example of an individual with SAD. What Craig and Shahan's findings suggest is that the degree to which recent social-interaction attempts have been successful during treatment could affect behavioral flexibility, and ultimately, whether avoidance recurs when a negative social outcome is inevitably experienced (e.g., if the individual is ignored). Paradoxically, experiencing more versus fewer positive outcomes when approaching others during treatment could precipitate relapse during a subsequent social setback. Overall, research presented in preceding sections suggests that several variables (e.g., worsening of alternative-reinforcement conditions, history of alternative reinforcement) could impact behavioral flexibility and resurgence of social avoidance. It is possible that social anxiety moderates these effects, but there is currently no research examining the role of social anxiety in resurgence.

The Present Study

SAD can be chronic (Keller, 2006) and debilitating (e.g., Aderka et al., 2012; Schneier et al., 1994). Even with successful treatment, relapse of social avoidance is highly prevalent (Bruce et al., 2005; Keller, 2006). Although exclusion is generally pervasive (Nezlek et al., 2012), individuals with SAD are more likely to experience it (e.g., Acquah et al., 2016; Voncken et al., 2008), and less likely to respond flexibly and adaptively when exclusion occurs (e.g., Mallott et al. 2009). Despite the significant social and economic burden of SAD (Hidalgo et al., 2001; Nardi, 2003), there is a dearth of literature examining exclusion-induced avoidance and its

recurrence following successful treatment. The present study aimed to address this gap in the literature.

Most prior studies examining effects of exclusion have used the Cyberball paradigm (Williams et al., 2000). The present study adopted a different paradigm for two reasons. First, relative to intrapersonal variables such as emotional distress, Cyberball produces comparatively weak effects on interpersonal measures of behavior (see Hartgerink et al., 2015). Second, Cyberball in its current form facilitates only indirect measurement of avoidance via shifts in allocation of throws to available avatars (e.g., Beltzer et al., 2019). To address these limitations, the present experiments adapted an existing AP-AV task previously used to study behavioral responses to social-evaluative threat and social aggression (Schlund et al., 2021). This task provides direct measures of both approach and avoidance by allowing participants make repeated choices about whether to join others or pass on the opportunity to engage with others in a game-like environment.

Using a modified version of the Schlund et al. (2021) paradigm, the present study arranged a social game, with other "players" making decisions about whether or not to share jokes with the participant. This novel exclusion paradigm manipulated sharing of jokes as an independent variable, given that exclusive laughter is known to induce feelings of exclusion (Klages & Wirth, 2014). Players were controlled by computer algorithms, but participants were told that they are interacting with other humans over the internet (e.g., Williams et al., 2000; but see Zadro et al., 2004). Approaching other players during the game resulted in one of three outcomes. Players either (1) "opted" to share a joke with the participant (inclusion) or (2) viewed the joke only amongst themselves (exclusion). Alternatively, participants were informed that (3) a research assistant overseeing the game did not choose a joke, and, as a result, there was no joke

to be shared (extinction). Avoidance resulted in (1) explicit feedback about whether other players had decided to include or exclude the participant (e.g., Zabag et al., 2024) or (2) extinction. Specific research questions (RQs) were as follows:

RQ 1: Does social approach-avoidance behavior flexibly shift with changes in social contingencies? In other words, does social avoidance increase when approaching others will likely result in exclusion? Does avoidance decrease when approaching others will likely result in inclusion?

RQ 2: Does resurgence of social avoidance occur when approaching others results in less favorable outcomes – for example, when approaching others initially leads to inclusion but later results in extinction?

RQ 3: Does the extent of a social setback impact relapse of social avoidance? We are specifically interested in intermittency of social reinforcement, or the proportion of approach behaviors resulting in extinction versus inclusion. Thus, RQ3 could be restated as follows: does more intermittent social reinforcement (more extinction) for approaching others increase resurgence of social avoidance (e.g., Shahan et al., 2020b)? That is, does more extinction result in more avoidance?

RQ 4: Does greater success in recent social interactions precipitate a greater relapse effect when a person encounters a social setback later (Craig & Shahan, 2016)? For the present purposes, "success" is defined as more experiences of inclusion versus extinction when approaching others. We are specifically interested in whether greater success (more inclusion) results in more avoidance when approaching others later results in extinction.

Using a between-subjects design, Experiment 1 addressed RQ 1-3 and Experiment 2 addressed RQs 1 and 4. Experiments comprised three phases; Table 1 describes contingencies

across phases and Table 2 directly compares the present procedures with other studies of resurgence (Alessandri et al., 2015; Reed, 2019). In Phase 1, each experiment arranged exclusion for approaching other players in order to establish a history of reinforcement for avoidance behavior (target response). Phase 2 arranged inclusion as reinforcement for approaching others (alternative response) across both experiments. As a result, all participants in Experiment 1 experienced inclusion when approaching others in Phase 2. In contrast with Experiment 1, Phase 2 of Experiment 2 parametrically manipulated the intermittency of reinforcement across groups – i.e., the number of approach behaviors resulting in extinction versus inclusion. Thus, although Experiment 2 arranged inclusion for approaching others in Phase 2, inclusion was experienced only on *non-extinction trials* – i.e., trials arranging inclusion as opposed to extinction. Groups varied with respect to the proportion of approach trials resulting in extinction versus inclusion. Finally, Phase 3 parametrically manipulated the intermittency of social reinforcement across groups (Experiment 1) or arranged for all participants to experience extinction irrespective of their choice (Experiment 2).

In Experiment 1, we expected that more intermittent social reinforcement (more extinction) in Phase 3 would produce *greater resurgence of avoidance*, defined as more trials with participants choosing to avoid rather than approach others at the beginning of Phase 3 relative to the end of Phase 2. In Experiment 2, we expected greater resurgence of avoidance in Phase 3 for groups experiencing more frequent social reinforcement (less extinction) in the prior phase. Overall, this AP-AV task facilitated a novel evaluation of behavioral flexibility and relapse within a volatile social environment characterized by changing outcomes of inclusion versus exclusion for approach behavior. As in prior research (e.g., Zabag et al., 2023; cf. Schlund

et al., 2021), we examined whether self-reported social anxiety was correlated with other variables, including avoidance.

General Methods

Participants

We recruited participants using Prolific (https://prolific.co). Prolific offers rapid data collection from large samples at a relatively low cost, while also increasing diversity of samples beyond the typical psychology undergraduate population (e.g., American Psychological Association, 2022). Moreover, Prolific provides high-quality data for behavioral research (Douglas et al., 2023; Peer et al., 2022). As an additional measure to ensure data quality, we recruited participants with at least 95% of submissions accepted by other researchers (approval rating; e.g., Crump et al., 2013; Douglas et al., 2023; Peer et al., 2022). Finally, to control for cultural differences in the expression of social anxiety (e.g., Heinrichs et al., 2006; Hofmann et al., 2010), we recruited only US-based participants.

To determine an appropriate sample size, we first conducted a power analysis using crowdsourced resurgence data (Ritchey et al., 2021). Based on that analysis, we determined that a sample size of at least 20 participants per group – i.e., 80 participants per experiment – would ensure ample power (>.80) to detect resurgence with an effect size (f) of 0.56 using the simplest between/within-group comparison (F test). We recruited 40-50 participants per group because of possible subtle effects and novel manipulations (e.g., Podlesnik et al., 2022; Ritchey et al., 2023). This exceeds the sample size used in prior studies detecting effects of exclusion on avoidance behaviors (e.g., Mallott et al., 2009; Weerdmeester & Lange, 2019). It also exceeds the sample sized used in prior research examining correlations between social anxiety and avoidance in reversal-learning paradigms (e.g., Zabag et al., 2023). As initial studies in a novel research line,

the present experiments were adequately powered to detect correlations between social anxiety and avoidance, but underpowered to evaluate effects of social anxiety in more complex analyses (e.g., as a predictor in mixed-effects regression models; Beltzer et al., 2019). Therefore, we included social anxiety only in exploratory correlation analyses.

In total, we recruited 390 participants for two experiments. Participants ranged in age from 18 to 79 (*M*=39.4 *SD*=11.6). The majority of participants were white individuals (n=249, 63.8%) born in the United States (n=361, 92.6%). Most held a college degree (n=225, 57.7%), and were employed full time (n==226, 57.9%), with an annual household income between $50,000-$100,000 or greater (n==230, 59.0%). Table 3 provides detailed demographic information.

Apparatus and Stimuli

We developed a custom interface using React (https://react.dev), an open-source, front-end JavaScript library. The application programming interface (API) was built in a Node environment with Express (https://expressjs.com). The experimental task will be accessed via Vercel (https://www.vercel.com).

As social stimuli for inclusion and exclusion manipulations, we selected jokes from Reader's Digest (https://www.rd.com/jokes). The full list of jokes is presented in Appendix A. To represent other players, we presented images of men or women with validated, neutral facial expressions. These images were selected from the Radboud Faces Database (Langer et al., 2010; e.g., Zabag et al., 2022, 2023). Prior to beginning the experiment, we asked participants to select one or more terms that best described their gender identity (e.g., male, female, nonbinary, transgender). For participants identifying as male or female, other players were represented by faces of two men or two women, respectively. For participants indicating other gender identities,

we randomly selected whether other players would be represented by faces of two men or two women.

Procedure

Pre-Task Instructions

Prior to beginning the task, participants were provided with the following instructions: "This is a social game. You will be connected to two other people online. In this game, two players are randomly assigned to the role of sharing jokes, and one player is assigned to the role of receiving jokes. YOU HAVE BEEN ASSIGNED TO THE ROLE OF RECEIVING JOKES. A research assistant will oversee the game by choosing jokes in real time and sending them to the two other players. You will never interact with the research assistant, only the two players represented by pictures on the screen. When two buttons appear on the screen, you will have to make a choice. You can "join" the players, or you can "pass" on the opportunity to "interact" with them. If you join, other players could potentially share a joke with you. However, you will only get to see the joke if the other players decided to share it with you. If you pass, you will not see a joke, regardless of the other players' decision. However, you will find out whether the others had decided to share with you. You are free to choose between JOIN and PASS. Choosing JOIN versus PASS will not affect your earnings. You will earn $9.00 for participating, but those earnings could double based on performance during the game and survey."

To check for comprehension of pre-task instructions, a brief quiz followed, comprising five true/false questions. Only after correctly answering all quiz questions, participants completed a series of practice trials (e.g., Zabag et al., 2022, 2023, 2024). During each practice trial, two silhouettes appeared on the screen in place of the other players' images. Participants

were told how to respond (e.g., “press JOIN” or “press PASS”) to ensure they experienced different outcomes across practice trials. Appendix B includes all initial instructions, quiz questions and answers, and instructions and outcomes for each practice trial.

Following completion of the practice trials, participants were asked to indicate the terms best describing their gender identity, as described previously. A blank screen with two silhouettes then appeared with text indicating “Finding other players…” and, after 3 s, “Connecting with other players…” Two images of faces appeared after an additional 3 s, as shown in Figures 1 and 2 (top-left panels). This was to give the impression that other individuals were joining the game remotely over the internet.

Experimental Task

The task included three phases comprising 60 trials each, totaling 180 trials. As in Schlund et al. (2021), each trial began with a 3-s choice period. During the choice period, onscreen text read: “Make a choice.” A timer counted down from 3 s, with the number of seconds appearing in red, as shown in Figures 1 and 2. Participants chose whether to approach or avoid a mock interaction with the others by clicking “JOIN” or “PASS” buttons, respectively. The position of the players’ images (left or right) remained constant throughout the experiment but was counterbalanced across participants.

Each trial ended with a 1-5-s variable intertrial interval (ITI) with a blank screen. The purpose of the variable ITI was to introduce uncertainty about when the next trial would begin in order to decrease rapid responding at the onset of each trial, which could interfere with learning about the contingencies. An attention check preceded each ITI and consisted of one of 108 addition or subtraction problems with answers ranging from 0-9. All math problems are listed in Appendix C. These problems were presented in a semirandom order (with replacement) across

trials. The ITI automatically began contingent upon entry of the correct digit (0-9). Incorrect responses presented a new math problem such that participants could not proceed until they entered the correct answer. The attention checks provided one approach to screening participants' level of engagement with the task as a means of improving data quality (Douglas et al., 2023). Given that we manipulated only social consequences as an independent variable (sharing of jokes), attention checks also provided a monetary incentive for sustained engagement throughout the task ($0.05 per trial, totaling $9). Failure to respond during the 3-s choice period meant forgoing the attention check and opportunity to earn money. As shown in Figures 1 and 2, participants received feedback as follows: "You did not make a choice. You cannot participate or earn money on this trial." The trial ended and a new trial began following the variable ITI.

Approaching other players resulted in one of three outcomes: exclusion, inclusion, or extinction, as shown in Figure 1: first, the two players could share the joke amongst themselves (exclusion; Figure 1A), as indicated by onscreen text: "They did NOT share the joke with you." A second possible outcome for approaching other players was that the others decided to share the joke with the participant (inclusion; Figure 1B). In that case, the joke appeared along with the following text: "They SHARED the joke with you!" Jokes were selected from a list without replacement and presented in a semirandom order across inclusion trials. A third possibility was that the participant did not view a joke, not because of a decision made by the other players, but because the research assistant did not choose a joke (extinction; Figure 1C). Onscreen text read: "They had nothing to share because the research assistant did not choose a joke."

Similarly, avoiding other players resulted in one of three outcomes. The first two possibilities involved revealing the others players' decision to share or withhold a joke (e.g., Zabag et al., 2024). For example, if others had decided to withhold a joke, feedback was

presented as shown in Figure 2A: “Others would NOT have shared the joke if you joined them. You were right to avoid them!” If others had decided to share a joke, no joke was shown, and feedback was presented as in 2B: “Others would have SHARED the joke if you joined them.” As shown in Figure 2C, avoiding others could also result in extinction. After each outcome, pressing ‘PROCEED’ presented the attention check, and total earnings were updated if the participant entered the correct answer to the single-digit math problem.

Pilot Testing. Given the novelty of the present procedures, we first conducted a series of four pilot experiments to ensure that participants would respond in accordance with the experimental contingencies. In each pilot experiment, we examined responding when arranging exclusion for pressing JOIN in Phase 1 and inclusion for JOIN in Phase 2. Pilot testing was important to ensure that our procedures were appropriate for asking questions about resurgence during the final phase of Experiment 1 and in subsequent experiments. Based on prior research examining humans’ reversal learning (e.g., Kuroda et al., submitted; Rayburn-Reeves et al., 2011), we recruited a minimum of 20 participants per pilot experiment. Appendix E provides details of each experiment and results. Overall, results of pilot testing supported inclusion of three procedural features in the final experiments, including:

1. Revealing the other players’ decision as part of the avoidance contingency (e.g., Figures 2A and 2B; see Zabag et al., 2024 for a similar example; cf. Zabag et al., 2022, 2023; Schlund et al., 2021)
2. Arranging non-probabilistic outcomes for responses in Phases 1 and 2: that is, arranging exclusion for each approach (JOIN) response in Phase 1 and inclusion for each JOIN response in Phase 2

3. Including guided practice trials prior to the task (e.g., Zabag et al., 2022, 2023, 2024; see Appendix B)

Questionnaires

Immediately following the AP-AV task, participants completed questionnaires administered via Qualtrics. They were asked to answer 70 questions, including 9 demographic questions. Appendix D lists all questions. The questionnaires took ~20-25 min to complete. Questionnaires were used to evaluate social anxiety, depression, rejection sensitivity, fundamental psychological needs, and background social support, as described in subsequent sections. One question (Question 11) was included as a manipulation check: "To what extent were you included by the other players during the game?" This item is hereafter referred to as *feelings of inclusion* and was rated on a 9-point Likert scale (1=not at all and 9=very much so).

Social Anxiety (17 questions, ~6 min). One purpose of the present study was to examine the relation between social anxiety and resurgence of avoidance. Thus, participants completed the Social Interaction Anxiety Scale (SIAS; Mattick & Clarke, 1998), a widely used measure of social-interaction anxiety with good psychometric properties (e.g., Mattick & Clarke, 1998; Heimberg et al., 1992). Based on recommendations by Rodebaugh et al. (2007), we removed three reverse-scored items, leaving 17 items. Participants evaluated the 17 statements (e.g., "I find myself worrying that I won't know what to say in social situations"), indicating the extent that each applies to them according to a 5-point Likert scale (0=not at all to 4=extremely). We calculated a total score ranging from 0-68 to provide an overall measure of social-interaction anxiety, with higher scores representing greater anxiety.

Depression (7 questions, ~2 min). Although social anxiety was of primary interest in the present study, we also evaluated depression given that comorbidity of SAD and depression is

high (Kessler et al., 2005). For this purpose, we administered the depression subscale of the Depression, Anxiety and Stress Scale – 21 items (DASS-21; Lovibond & Lovibond, 1995). We selected the DASS-21 due to its brevity and good psychometric properties (see Antony et al., 1998). Using a 4-point Likert scale, participants rated the extent that each item on the DASS-21 applied to them during the past week (e.g., "I felt that I had nothing to look forward to."; 0="Did not apply to me at all" and 3="Applied to me very much or most of the time"). A total score ranging from 0-21 represented increasing levels of depression during the week prior to the study.

Rejection Sensitivity (18 questions, ~6 min). High social anxiety is associated with increased rejection sensitivity (Gutz et al., 2015; Staebler et al., 2011), and rejection sensitivity can moderate behavioral responses to exclusion (e.g., Ayduk et al., 2008; Downey et al. 1998). Thus, we evaluated rejection sensitivity using the Rejection Sensitivity-Adult questionnaire (A-RSQ), an adapted version of the Rejection Sensitivity Questionnaire ([RSQ]; Downey & Feldman, 1996) with good psychometric properties (Berenson et al., 2009). The A-RSQ presents nine scenarios (e.g., "You ask your parents or other family members to come to an occasion that is important to you."). For each scenario, participants responded on a 6-point Likert scale, indicating their degree of concern or anxiety (e.g., "How concerned or anxious would you be over whether or not they would want to come?"; 1=very unconcerned and 6=very concerned) and expectation of being rejected (e.g., "I would expect they would want to come."; 1=very unlikely and 6=very likely), with the latter being reverse scored. Rejection sensitivity was calculated as the product of the two measures (range: 1-36), averaged across scenarios, with higher overall scores indicating higher rejection sensitivity.

Fundamental Psychological Needs (13 items, ~4 min). Many studies have evaluated effects of exclusion on emotional distress, including threats to fundamental psychological needs

(i.e., need threat; see Gerber & Wheeler, 2009; Hartgerink et al., 2015, for reviews). In line with this approach, we included a modified version of a need-threat questionnaire (NTQ; Zadro et al., 2004) – see Appendix D for details. The scale has reasonable construct validity (Gerber et al., 2017) and reliably differentiates needs across groups experiencing inclusion or exclusion (e.g., Hartgerink et al., 2015). The need-threat measure includes 12 questions measuring sense of belonging (e.g., "I felt like an outsider during the game."), self-esteem (e.g., "I felt somewhat inadequate during the game."), meaningful existence (e.g., "I felt non-existent during the game."), and control (e.g., "I felt in control during the game."). Each item was rated on a 9-point Likert scale (1=not at all and 9=very much so). Items were reverse scored as necessary, resulting in a total NTQ score ranging from 12-108; lower versus higher scores indicated greater need threat or fulfilment, respectively.

Background Social Support (5 questions, ~2 min). Like rejection sensitivity, social support can moderate behavioral responses to exclusion (Twenge et al., 2007). To evaluate background social support, we included brief version of the Social Provisions Scale (SPS; Cutrona & Russell, 1987; e.g., Dinh et al., 2021). The brief version contains five items and demonstrates good psychometric properties (Orpana et al., 2019). Each question addresses one of five different social needs, as outlined by Weiss (1974), including guidance ("There is someone I could talk to about important decisions in my life."), reliable alliance ("There are people I can count on in an emergency."), reassurance of worth ("I have relationships where my competence and skills are recognized."), attachment ("I have close relationships that provide me with a sense of emotional security and well-being."), and social integration ("I feel part of a group of people who share my attitudes and beliefs."). Items were rated on a 4-point Likert scale (1=strongly

disagree and 4=strongly agree). We calculated an overall score by summing responses from the five questions (range=5 to 20), with higher scores indicating higher levels of social support.

Statistical Analysis

Data Screening

We excluded data sets meeting any of three criteria. First, we excluded data sets with only one type of response (JOIN or PASS) across all 180 trials (n=17; e.g., Zabag et al., 2022). We also excluded data sets with missing responses – defined as no responses on 30 or more trials during the game (n=2) or no survey data (n=9; e.g., Ritchey et al. 2021, 2022; Podlesnik et al., 2022). A total of 28 data sets were excluded from analyses (7.2%). Therefore, the final sample included 362 participants.

Primary Analysis: Choice as a Function of Experimental Contingencies

We next evaluated how multiple aspects of the arranged contingencies (Group, Phase, Trial) influenced the likelihood of avoidance throughout the entirety of each experiment. We used a mixed-effects modeling approach (DeHart & Kaplan, 2019) to account for intercorrelations at the participant and group level while also preserving variability in individual participants' responses to the task. Specifically, we used a multilevel logistic model to evaluate trial-by-trial choice for selecting "PASS" (coded as 1) and "JOIN" (coded as 0). For this purpose, we used the lme method included in the lme4 package (Bates et al., 2015).

In both experiments, an initial model included a random intercept for each participant. The initial model also included fixed effects of Group (None, Low, High, Ext), Phase (1-3), and Trial (1-180), and all possible interactions among those variables. After fitting an initial model, we built on that model across several steps. First, we evaluated more complex random-effects structures using the second-order Akaike Information Criterion (AICc) provided in the MuMIn R

package (Barton, 2009). After establishing the random-effects structure, we evaluated fixed effects using likelihood-ratio tests. As a final step, we conducted pairwise comparisons across different levels of each factor using the emmeans R package (Lenth et al., 2021) with the best-fitting model.

We performed pre-planned post-hoc comparisons to address two questions: (1) whether resurgence of avoidance – defined as an increase in the likelihood of avoidance from Phase 2 to Phase 3 – occurred within each group and (2) whether the overall likelihood of avoidance differed among groups in each phase. To address the first question, we compared the likelihood of avoidance during the last trial of Phase 2 (Trial 120) to the halfway point of Phase 3 (Trial 150) within each group. Due to some groups experiencing intermittent extinction in Phase 3, we chose to evaluate resurgence halfway through that phase to ensure all groups had sufficient exposure to the extinction contingency. To address the second question, we compared the likelihood of avoidance during the last trial of Phases 1 (Trial 60), the last trial of Phase 2, and at the halfway point of Phase 3. To account for multiple comparisons, we report adjusted *p* values after applying Holm corrections.

Exploratory Analysis: Correlations Between Avoidance and Individual Factors

In addition to mixed-effects modeling, we conducted exploratory analyses to examine the relation between avoidance and a wide range of individual factors, including social anxiety. Specifically, we calculated Spearman's rank correlation coefficients to examine the relation between avoidance and the following variables: feelings of inclusion (Question 11) social anxiety (SIAS score), depression (DASS-21 score), rejection sensitivity (A-RSQ score), fundamental psychological needs (NTQ score), and background social support (SPS score). Avoidance was measured as a proportion of trials across all three phases (overall avoidance), and

as a proportion of trials within each phase. Additional measures of avoidance were included within each experiment and are described in greater detail below.

Experiment 1

The purpose of Experiment 1 was threefold. First, we examined whether participants adjusted social approach and avoidance behavior according to arranged social contingencies: i.e., whether participants shifted between avoiding (exclusion) and approaching other players (inclusion; RQ 1). Second, we examined whether resurgence of social avoidance occurred with a worsening of contingencies for approach behavior, a novel contribution to research on both social exclusion and resurgence (RQ 2). Third, across groups, we parametrically manipulated the intermittency of social reinforcement during Phase-3 resurgence tests to evaluate whether resurgence varied as a function of reductions in social reinforcement (RQ 3). Prior studies have demonstrated increased resurgence when conditions for alternative responses are worsened – for example, with downshifts in reinforcer rate (e.g., Shahan et al., 2020b) or magnitude (e.g., Ritchey et al., 2023), and with greater magnitudes of punishment (Fontes et al., 2018). However, no prior studies have examined the relation between resurgence of avoidance and social outcomes generally or as a function of parametric reductions in social reinforcement.

Participants and Procedure

Participants were 212 adults recruited via Prolific, ranging in age from 20 to 73 (M=37.7, SD=10.6). A total of 118 identified as male, 85 as female, and six as neither male nor female. Three participants did not provide demographic information. Thirteen of these data sets met exclusion criteria (6.1%); thus, 199 data sets were included in the final analyses.

Participants were randomly assigned to one of four groups (n~50 per group[1]). The general procedure for all groups was as outlined in the General Methods. Approaching other players by clicking the JOIN button resulted in inclusion (the others shared a joke with the participant) exclusion (the others decided not to share a joke), or extinction (the others do not decide whether to share a joke). Avoiding other players by clicking the PASS button either resulted in feedback about whether others had decided to share the joke or extinction. Outcomes depended upon the phase and group.

Table 1 lists the contingencies in each phase. Contingencies were identical in Phases 1 and 2 across four groups. In Phase 1, exclusion was the consequence for pressing JOIN (Figure 1A). If the participant chose to forgo the mock social interaction by pressing PASS, onscreen text revealed the other players' decision to withhold or share the joke (Figures 2A and 2B). Therefore, in Phase 1, pressing PASS always resulted in learning that others had planned to exclude the participant. In Phase 2, pressing JOIN always resulted in inclusion (Figure 1B). Thus, Phase 2 arranged reinforcement for approaching rather than avoiding others. Pressing PASS always resulted in learning that others had planned to include the participant. Finally, in Phase 3, outcomes for pressing JOIN or PASS were the same as in Phase 2 on non-extinction trials (Figures 1B, 2B). On extinction trials, pressing JOIN or PASS produced feedback that others did not decide whether to share the joke (Figures 1C, 2C). Two groups experienced only non-extinction trials (Group None) or only extinction trials (Group Ext). For the remaining two groups, extinction trials in Phase 3 were arranged semi-randomly: 20 (Group Low) or 40 extinction trials (Group High) were interspersed with non-extinction trials. In summary, participants either experienced greater intermittency of social reinforcement (more extinction)

[1] *n* sizes ranged from 46-52 per group. Participants were not evenly allocated across groups due to completely random assignment.

for approaching others in Phase 3 relative to Phase 2 (Low, High), or they experienced extinction only in Phase 3 (Ext), or no change in contingencies from Phase 2 to Phase 3 (None).

Results

Figure 3 shows the mean percentage of trials with avoidance – i.e., the mean percentage of choosing PASS over JOIN – across 5-trial blocks in each phase. Data are shown for Group Ext (black), High (gray), Low (white), and None (x). When arranging exclusion for approach behavior (pressing JOIN) in Phase 1, avoidance increased across trial blocks. Avoidance then decreased to low levels in Phase 2 when arranging inclusion for approach behavior. In Phase 3, avoidance resurged in groups experiencing intermittent reinforcement for approach behavior. Generally, there was ordinal correspondence between the number of trials with extinction and resurgence: resurgence occurred to the greatest extent in Group Ext (extinction on 60/60 trials), and to a lesser extent in Group High (extinction on 40/60 trials). For None (extinction on 0/60 trials) and Low (extinction on 20/60 trials), avoidance remained relatively low and constant across Phases 2 and 3.

Figure 4 clarifies this differential-resurgence effect by showing mean differences in the proportion of avoidance across 5-trial blocks from Phase 2 to Phase 3 within each group. Difference measures in Figure 4 were calculated as follows: for each participant, we calculated the proportion of avoidance in the last 5-trial block of Phase 2 and in each 5-trial block of Phase 3. Next, we subtracted the Phase-2 proportion from each Phase-3 proportion. The figure shows that Group Ext demonstrated the greatest increase in avoidance from Phase 2, followed by Group High. The figure also shows a smaller increase in avoidance from Phase 2 in Group Low versus High and Ext (cf. Group None).

Primary Analysis: Choice as a Function of Experimental Contingencies

Table 4 shows the results of Analysis 2. For brevity, only significant factors and interactions are shown in Table 4 and all subsequent statistical tables. The full results are presented in Appendix F. The final model included random effects of Trial, Phase and an interaction between Trial and Phase; fixed effects included Trial, Phase, Group, and all possible interactions among those variables. The Phase (2) and Group (None) factors were used as points of comparison.

The significant interaction between Trial and Phase 1 (β=0.25, p<.001) and between Trial and Phase 3 (β=-0.42, p=.048) indicated that, in Group None, there were differences in how the likelihood of choosing PASS over JOIN changed across trials in each of these phases relative to Phase 2. These findings were generally consistent with different patterns of responding in Group None shown in each phase in Figure 3: that figure shows that the percentage of 5-trial blocks with a choice of PASS increased (Phase 1), decreased (Phase 2), and then remained relatively steady (Phase 3).

The interaction between Phase 3 and Group Ext (β=-6.75, p<.001) indicated different effects of Phase 3 versus 2 in Group Ext relative to Group None. In line with this finding, Figure 3 shows that the percentage of 5-trial blocks with a choice of PASS was low in each group in Phase 2 but higher in group Ext versus None in Phase 3 (see also Figure 4).

The interaction between Phase 1 and Group High (β=2.30, p<.001) indicated different effects of Phase 1 versus 2 in Group High relative to Group None. Similarly, there was a significant interaction of Trial and Group High (β=0.03, p=.003; OR=1.03), indicating differences in how the likelihood of choosing PASS over JOIN changed across trials in Group High relative to Group None. We evaluated these significant interactions further using pairwise comparisons; these findings are presented in a subsequent section.

We also used pairwise comparisons to further elucidate significant three-way interactions between Trial, Phase 3, and Group Ext (β=0.65, *p*=.012) and between Trial, Phase 3, and Group High (β=0.55, *p*=.032). Generally, these three-way interactions indicated differences in the interaction between Trial and Phase 3 – i.e., how the likelihood of choosing PASS over JOIN changed across trials in Phase 3 relative to Phase 2 – in Groups Ext and High relative to None.

Between-group comparisons indicated no differences in the likelihood of choosing PASS over JOIN at the end of Phase 1 (Trial 60; *p*s≥ .999). Therefore, the likelihood of avoidance was comparable across groups when arranging identical contingencies. At the end of Phase 2 (Trial 120), the likelihood of choosing PASS over JOIN was higher in Group High relative to None and Ext (*z*s≥3.05, *p*s≤.012). This difference occurred despite arranging identical contingencies among groups. Nevertheless, no other between-group comparisons were significant at the end of Phase 2 (*p*s≥.052).

Within-group comparisons indicated significant increases in the likelihood of choosing PASS over JOIN from the end of Phase 2 to the halfway point of Phase 3 (Trial 150) in Groups High (*z*=2.56, *p*=.010) and Ext (*z*=5.87, *p*<.001) but not for Groups Low and None (*p*s≥.803). In other words, resurgence of social avoidance occurred when arranging extinction on two-thirds (High) or across all Phase-3 trials (Ext), but not when arranging extinction on one-third of trials (Low) or in a control condition with no extinction (None). These increases in the likelihood of avoidance occurred despite no additional exposure to exclusion in Phases 2 or 3 in any of the groups.

Additional between-group comparisons further elucidated differences in the overall likelihood of avoidance at the halfway point of Phase 3. At that time point, the likelihood of choosing PASS over JOIN was higher in Group Ext relative to all other groups (*z*s≥2.11,

*p*s≤.047), and in Group High versus both Low and None (*z*s≥2.29, *p*s≤.047). The likelihood of choosing PASS versus JOIN was also higher in Group Low versus None (*z*=2.42, *p*=.047). These findings suggest ordinal correspondence between the amount of extinction arranged in Phase 3 and resurgence. Said another way, the likelihood of resurgence increased with more extinction.

Exploratory Analysis: Correlations Among Avoidance and Individual Factors

Table 5 shows the results of this analysis. We first examined correlations between social anxiety and other individual factors. Social anxiety was positively correlated with depression (ρ[182]=.65, p<.001) and rejection sensitivity (ρ[185]=.59, p<.001). In contrast, social anxiety was negatively correlated with fundamental-need fulfilment (ρ[184]=-.35, p<.001) and social support (ρ[185]=-.27, p<.001).

We next conducted exploratory correlation analyses between social anxiety and avoidance, measured as the proportion of trials with a choice of PASS over JOIN. The correlation between social anxiety and avoidance in Phase 1 approached but did not reach statistical significance (ρ[186]=.14, *p*=.061). Social anxiety was not correlated with overall avoidance across all phases, or within Phase 2 or Phase 3 (*p*s≥.167). Therefore, social anxiety did not correspond with the overall tendency to avoid others via the PASS button during the game, nor did it correspond with the tendency to choose PASS when pressing JOIN resulted only in exclusion (Phase 1) or inclusion (Phase 2), or when there were ambiguous social outcomes (i.e., extinction, Phase 3).

Given that contingencies differed among groups in Phase 3, we also examined whether social anxiety was correlated with avoidance as a proportion of all Phase-3 trials in specific groups (Low and None, High and Ext), but these correlations were not significant (*p*s≥.448). We also examined whether social anxiety was correlated with avoidance during the first half of trials

in Phase 3 both overall and within specific groups (Low and None, High and Ext). However, none of these correlations were significant ($ps \geq .526$). Therefore, social anxiety did not correspond with the tendency to avoid others during Phase-3 testing irrespective of the ambiguity of social outcomes.

Among individual variables, avoidance was correlated only with feelings of inclusion – i.e., responses to the question: "To what extent were you included by the other players during the game?" rated on a scale of 1-9. Feelings of inclusion were negatively correlated with overall avoidance across all phases ($\rho[197]=-.30$, $p<.001$), and with avoidance in Phase 2 ($\rho[197]=-.16$, $p=.024$). Feelings of inclusion were also negatively correlated with avoidance during the first half and all Phase-3 trials – these correlations were significant both across all groups and within groups High and Ext only ($\rho s \leq -.31$, $p \leq .001$). These findings suggest that the extent to which participants felt included by other players corresponded with the tendency to choose JOIN over PASS overall and within specific phases and groups. Feeling included corresponded with the tendency to choose JOIN over PASS when that choice resulted in inclusion in Phase 2. Feeling included also corresponded with the overall tendency to choose JOIN over PASS across groups in Phase 3 and within groups experiencing more ambiguous social outcomes (High, Ext).

Discussion

The present experiment was the first to demonstrate resurgence of avoidance behavior. Experiment 1 examined changes in the likelihood of a binary choice – i.e., approach (JOIN) or avoidance (PASS). This is in contrast with prior studies of resurgence examining changes in response rate; in those studies, resurgence has sometimes occurred as a transient increase and then decrease in response rates or bitonic function (Podlesnik & Kelley, 2014, 2015). Instead of a bitonic function, Experiment 1 demonstrated effects more in line with other studies using

discrete-trial preparations (e.g., Ritchey et al., 2022). For example, resurgence in Experiment 1 occurred as an increase in the likelihood of avoidance from Phase 2 to Phase 3, representing an initial shift in response allocation from approach to avoidance behavior. This was followed by stabilization in the likelihood of avoidance, suggesting little further change in allocation as the test phase progressed.

Beyond demonstrating resurgence of avoidance for the first time, the present experiment was the first to demonstrate resurgence of *social* avoidance as a function of parametric reductions in social reinforcement. Therefore, Experiment 1 extends findings from research demonstrating resurgence with parametric reductions in (1) the rate of food-reinforcer deliveries (Shahan et al., 2020b), and (2) the magnitude (amount) of both food (Craig et al., 2017) and points exchangeable for money (Ritchey et al., 2023). As one example, Ritchey et al. (2023) reinforced presses on a target button with points in Phase 1. In Phase 2, only alternative button presses produced points. Across groups, Phase 3 arranged parametric reductions in the number of points available for alternative responses; target responses continued to produce no points. Greater magnitude reductions produced higher rates of target-response resurgence, despite no change to the target-response contingency. In other words, target responses increased despite continued extinction. Similarly, in Phase 3, avoidance (the target response) increased with reduced availability of social reinforcement for approach behavior (the alternative). This occurred despite programming no further exclusion. Thus, target responding increased despite continued extinction, in line with other studies of resurgence.

Analyses collectively demonstrated that the arranged contingencies corresponded with both covert (feelings of inclusion) and overt behavior (choice). Specifically, higher feelings of inclusion (see Question 11, Appendix D) were correlated with less persistent avoidance

following removal of exclusion from Phase 1 to Phase 2, and also with less avoidance during resurgence testing in Phase 3 (High, Ext). With respect to overt behavior, avoidance increased when approaching others resulted in exclusion (Phase 1) and decreased when approaching others resulted in inclusion (Phase 2). Across all participants, the mean percentage of avoidance responses in the last 5-trial block of Phase 1 was 88.9% (SEM=1.9). In the last 5-trial block of Phase 2, the mean percentage of approach responses was 75.6% (SEM=2.8). This suggests response allocation shifted in accordance with arranged social outcomes. These findings are generally in line with prior research showing humans' sensitivity to positive social outcomes. For example, during a group discussion with college students, Borrero et al. (2007) instructed two confederates to deliver statements of agreement (e.g., "I agree with that point") according to independent VI schedules. Borrero et al. found that the relative reinforcer rate controlled the relative frequency of vocalizations directed toward each confederate (see also Conger & Killeen, 1974). In other words, response allocation matched the different schedules of positive reinforcement. Similarly, the present study demonstrates humans' sensitivity to both positive and negative social outcomes.

Nevertheless, is interesting to note that responding conformed less to the contingencies by the end of Phase 2 relative to the end of Phase 1. This could suggest that the inclusion and exclusion outcomes themselves differentially impacted choice allocation. More specifically, Phase 1 arranged exclusion contingent upon approach behavior – a potential punisher – whereas Phase 2 arranged inclusion as social reinforcement. Prior research suggests that punishment can facilitate faster learning relative to reinforcement under some circumstances (e.g., Yin et al., 2023). Therefore, it is possible that learning to avoid exclusion proceeded more rapidly than learning to approach others to take part in viewing a joke. In line with this idea, Zabag et al.

(2022) found that responding was less accurate – i.e., resulted in less point gain – following negative-to-positive versus positive-to-negative reversals. In their AP-AV paradigm, Zabag et al. reinforced approaching some stimuli with point and monetary gain and punished approaching others with point and monetary loss. After a contingency reversal, they found that participants were slower to transition from avoidance to approach behavior for stimuli resulting in punishment in the prior phase. Similarly, in Experiment 1, choice allocation at the end of Phase 2 could have been impacted by the reversal from negative (exclusion) to positive (inclusion) outcomes for approach behavior, resulting in an incomplete shift from avoidance to approach behavior. To address this question directly, future research could arrange simultaneous shifts from both positive-to-negative and negative-to-positive social outcomes across different face stimuli, as in Zabag et al. (2022). This proposed research could more fully address the question of whether Zabag et al.'s findings with monetary outcomes also extend to social outcomes.

Finally, findings regarding the relation between social anxiety and avoidance were inconsistent with prior research. Studies have shown reduced negative-to-positive (e.g., Beltzer et al., 2019; Zabag et al., 2022, 2023, 2024) and enhanced positive-to-negative updating of social information (e.g., Zabag et al., 2022) among those with higher levels of self-reported social anxiety. In contrast with these findings, we found no correlation between social anxiety and the proportion of trials with avoidance. This was true when shifting from negative to positive social outcomes for approach behavior in Phase 2, and also when shifting from positive to negative outcomes for approaching others in Phase 3 (e.g., High, Ext). However, there are many differences between the present study and other studies reporting these relations between social anxiety and avoidance. For example, Zabag et al. (2022, 2023, 2024) also arranged an AP-AV paradigm with social stimuli (cf. Beltzer et al., 2019), but with point and monetary gain or loss as

consequences for AP-AV behavior rather than social outcomes. Therefore, differences between the present and prior research could be related to the different outcomes arranged. Perhaps more importantly, the present study arranged explicit feedback for avoidance (Figure 2A), in contrast with prior studies arranging no feedback for avoidance of social stimuli (e.g., Beltzer et al., 2019; Zabag et al., 2022, 2023; see also Schlund et al., 2021; cf. Zabag et al., 2024). Only Zabag et al. (2024) provided explicit feedback for avoidance ("Great! You were right to avoid this person.") However, they also arranged probabilistic outcomes for AP-AV behavior across ten different stimuli (i.e., ten different images of human faces). Five stimuli were associated with a .8/.2 probability of point gain/loss, and five with a .2/.8 probability of those same outcomes. The contingency reversal then comprised a reversal of these probabilities for six of ten stimuli. In contrast with the Zabag et al. (2024), the present procedures involved (1) a single pair of social stimuli, (2) non-probabilistic outcomes, and (3) explicit feedback for avoidance. As a result, the positive- and negative-outcome contingencies might have been more salient than in past research. This could have eliminated differences in performance among those with higher versus lower levels of social anxiety; however, this represents another question for future research.

Despite revealing no differences in avoidance as a function of social anxiety, the present procedures clearly demonstrated resurgence of social avoidance with parametric reductions in social reinforcement. In general terms, relapse occurred when participants faced a social setback. Our findings from Experiment 1 suggest that the present procedures could be a useful starting point for addressing other related questions about resurgence of avoidance behavior. One important question to address is the influence of one's recent history of social experiences – for example, whether social outcomes that *precede* a social setback might influence resurgence. This was the focus of Experiment 2. Like this first experiment, we recruited healthy participants for

Experiment 2, while also collecting self-report data on social-interaction anxiety. Future iterations of each experiment will be extended to individuals with SAD.

Experiment 2

The purpose of Experiment 2 was to again evaluate whether social approach-avoidance behavior might flexibly shift with changes in social contingencies (RQ 1). In addition to this, Experiment 2 examined how different histories of social reinforcement impact relapse during a subsequent social setback (RQ 4). More specifically, the present experiment evaluated whether more recent experiences of social success (approaching others → inclusion) might paradoxically leave an individual *more* susceptible to relapse when approaching others later results in ambiguous social outcomes (modeled with extinction) rather than inclusion. This is relevant to resurgence because prior research suggests that higher rates of reinforcement in Phase 2 of a typical resurgence paradigm produce resurgence during Phase-3 extinction tests, whereas low rates of reinforcement do not (Craig & Shahan, 2016). As in Experiment 1, we parametrically manipulated the intermittency of social reinforcement for approach behavior by introducing extinction on some trials. However, in the present experiment, this parametric manipulation occurred prior to a final testing phase (in Phase 2).

Participants and Procedure

Participants were 178 adults recruited via Prolific, ranging in age from 18 to 79 (M=41.3, SD=12.4). A total of 90 identified as male, 80 as female, and three as neither male nor female. Five participants did not provide demographic information. Fifteen of these data sets met exclusion criteria (8.4%); thus, 163 data sets were included in the final analyses.

Participants were randomly assigned to one of four groups (n~40 per group). The general procedure for all groups was as outlined in the General Methods. All contingencies were

identical to the previous experiment with two exceptions. First, the outcomes for approach behavior differed across groups in Phase 2 as opposed to Phase 3. Specifically, 0/60 (Group None), 20/60 (Group Low), 40/60 (Group High), or 60/60 trials (Group Ext) resulted in extinction in Phase 2. Second, all groups experienced extinction on all 60 trials in Phase 3.

Results

Figure 5 shows the mean percentage of trials with avoidance via the PASS button across 5-trial blocks in each phase. Data are shown for Group Ext (black), High (gray), Low (white), and None (x). When arranging exclusion for pressing JOIN in Phase 1, avoidance increased across trial blocks. Avoidance then decreased in Phase 2 to varying degrees across groups. More extinction generally resulted in more avoidance: Group Ext demonstrated the most avoidance, followed by Group High; Groups Low and None demonstrated the least avoidance in Phase 2. By the end of Phase 2, the group experiencing extinction on 20 of the 60 Phase-2 trials (Low) demonstrated less avoidance than the no-extinction control group (None). In Phase 3, avoidance resurged above Phase-2 levels in Groups Low and None, but remained relatively steady from the end of Phase 2 to beginning of Phase 3 in Groups High and Ext.

Figure 6 clarifies the differential resurgence effect by showing mean differences in the proportion of avoidance across 5-trial blocks from Phase 2 to Phase 3 within each group. The difference measure was calculated as in the previous experiment. The figure shows that Group None demonstrated the highest initial difference in avoidance from the end of Phase 2, but Group Low demonstrated the greatest increase in the difference measure across Phase-3 trials. The figure also little increase in avoidance from Phase 2 in Groups High and Ext.

Primary Analysis: Choice as a Function of Experimental Contingencies

Table 6 shows the results of Analysis 2. The full results are presented in Appendix F. Consistent with the previous experiment, the final model included random effects of Trial, Phase and an interaction between Trial and Phase; fixed effects included Trial, Phase, Group, and all possible interactions among those variables. The Phase (2) and Group (Ext) factors were used as points of comparison.

The significant interaction between Trial and Phase 1 (β=0.10, p<.001) and between Trial and Phase 3 (β=-0.03, p<.001) indicated that, in Group Ext, there were differences in how the likelihood of choosing PASS over JOIN changed across trials in each of these phases relative to Phase 2. There were also significant interactions between Phase and each group: specifically, there was a significant interaction between Phase 1 and Group None (β=-2.04, p=.003), and between Phase 1 and Group Low (β=-1.98, p=.001). The interaction between Phase 1 and Group High approached but did not reach statistical significance (β=-1.25, p=.050). These interactions indicated different effects of Phase 1 versus 2 in each group relative to Group Ext. Similarly, there were significant interactions between Phase 3 each group: None (β=-4.45, p<.001), High (β=-8.66, p<.001), and Low (β=-12.13, p<.001). These interactions indicated different effects of Phase 3 versus 2 in each group relative to Group Ext.

Finally, a three-way interaction between Trial, Phase 1, and Group None (β=0.11, p=.010) indicated differences in the interaction between Trial and Phase 1 – i.e., how the likelihood of choosing PASS over JOIN changed across trials in Phase 1 relative to Phase 2 – in Group None versus Ext. Moreover, three-way interactions between Trial, Phase 3, and each group: None (β=0.06, p<.001), High (β=0.08, p<.001), and Low (β=0.11, p<.001), indicated differences in the interaction between Trial and Phase 3 in each group relative to Group Ext. As

in the previous experiment, we conducted planned pairwise comparisons to further evaluate these significant interactions.

Between-group comparisons indicated no differences in the likelihood of choosing PASS over JOIN at the end of Phase 1 (Trial 60; *p*s≥ .374). Therefore, the likelihood of avoidance was comparable across groups when arranging identical contingencies. At the end of Phase 2 (Trial 120), the likelihood of choosing PASS versus JOIN was higher in Group Ext relative to all other groups (*z*s≥3.71, *p*s<.001), and higher in Group High versus Low (*z*=2.46, *p*=.042). Differences among remaining groups were not significant (None versus High, None versus Low; *p*s≥.251). Therefore, ordinal correspondence between extinction and avoidance was generally present by the end of Phase 2 among experimental groups (Ext, High, Low), but not with respect to the no-extinction control group (None).

Within-group comparisons indicated significant increases in the likelihood of choosing PASS over JOIN from the end of Phase 2 to the halfway point of Phase 3 (Trial 150) in Groups Low (*z*=4.28, *p*<.001) and None (*z*=3.35, *p*<.001) but not in Groups High and Ext (*p*s≥.905). This suggests that resurgence of social avoidance occurred when groups experienced greater increases in the percentage of trials with ambiguous social outcomes (extinction) across phases – or said another way, when groups experienced greater decreases in availability of social reinforcement. Specifically, resurgence occurred when arranging extinction on 0% (None) or 33% (Low) of trials in Phase 2 and 100% of trials in Phase 3. Resurgence did not occur when arranging extinction on 66% of trials in Phase 2 and 100% of trials in Phase 3 (High) or when arranging extinction on all trials in each phase (Ext). The likelihood of choosing PASS over JOIN did increase by the end of Phase 3 for Group High (Trial 180; *z*=2.07, *p*=.038) but not for

Group Ext (p=.407). Therefore, smaller increases in extinction across phases – i.e., from 66% to 100% of trials across phases – facilitated delayed increases in the likelihood of avoidance.

Additional between-group comparisons further elucidated differences in the overall likelihood of avoidance in Phase 3. In Phase 3, the likelihood of choosing PASS over JOIN did not differ among groups: this was true both at the halfway point (ps≥.078) and at the end of that phase (ps>.999). Therefore, differential resurgence occurred not as differences in the overall likelihood of avoidance during Phase-3 testing, but instead as larger or smaller increases in the likelihood of avoidance from Phase 2 to Phase 3. This finding is reflective of different likelihoods of avoidance among groups at the end of Phase 2.

Exploratory Analysis: Correlations Among Avoidance and Individual Factors

Table 7 shows the results of this analysis. As in Experiment 1, we first examined correlations between social anxiety and other individual factors. These findings were consistent with the previous experiment. Specifically, social anxiety was positively correlated with depression ($\rho[153]=.60$, $p<.001$) and rejection sensitivity ($\rho[152]=.58$, $p<.001$), and negatively correlated with fundamental needs ($\rho[155]=-.35$, $p<.001$) and social support ($\rho[158]=-.35$, $p<.001$).

We next examined correlations between social anxiety and avoidance. The correlation between social anxiety and avoidance in Phase 1 followed the same pattern as in Experiment 1, but reached statistical significance ($\rho[158]=.21$, p=.008). Figure 7 shows the relation between social anxiety (SIAS score) and the proportion of Phase-1 trials with a PASS response. Data are shown for Experiment 1 in the top panel and for Experiment 2 in the bottom panel. These results suggest that, as social anxiety increased, so did the tendency to PASS when JOIN responses resulted in exclusion.

Consistent with Experiment 1, social anxiety did not correspond with the overall tendency to avoid others via the PASS button during the game (p=.562), nor did it correspond with the tendency to choose PASS when JOIN responses resulted in inclusion or ambiguous social outcomes (extinction) in Phases 2 and 3 (ps≥.278). Similarly, social anxiety did not correspond with avoidance as a proportion of all Phase-2 or Phase-3 trials in specific groups (Low and None, High and Ext; ps≥.247). Finally, social anxiety did not correspond with avoidance in the first half of Phase 3: this was true across all groups, within Groups Low and None, and within Groups High and Ext (ps≥.296). Therefore, the only relation between avoidance and social anxiety was in Phase 1, during which individuals with higher scores on the SIAS tended to demonstrate more avoidance of other players.

Among individual variables, avoidance was most reliably correlated with feelings of inclusion, consistent with findings in Experiment 1. Feelings of inclusion were negatively correlated with overall avoidance across all phases ($\rho[159]=-.41$, $p<.001$), and with avoidance in Phase 2. The correlation between feelings of inclusion and avoidance in Phase 2 was significant both across all groups, and within Groups High and Ext ($\rho s \leq -.32$, $p \leq .003$), but not within Groups Low and None (p=.153). Feelings of inclusion were also negatively correlated with avoidance during the first half and all Phase-3 trials – these correlations were significant across all groups ($\rho s \leq -.33$, $p<.001$), within groups High and Ext ($\rho s \leq -.32$, $p \leq .003$), and within Low and None ($\rho s \leq -.27$, $p \leq .014$; cf. Experiment 1). These findings suggest that the extent to which participants felt included by other players corresponded with the tendency to choose JOIN over PASS overall and within specific phases and groups. Feeling included corresponded with the tendency to choose JOIN over PASS within groups experiencing more ambiguous social outcomes – i.e., more extinction tests – in Phase 2 (High, Ext). In Phase 3, feeling included corresponded with

the tendency to choose JOIN over PASS both within groups experiencing more (High, Ext) and fewer ambiguous social outcomes via extinction tests in the prior phase (Low, None).

Finally, in contrast with Experiment 1, other individual factors (Depression, Fundamental Needs) were also correlated with avoidance. Like social anxiety, depression was positively correlated with avoidance in Phase 1 ($\rho[156]=.16$, $p=.049$), such that greater levels of depression corresponded with more avoidance. Fundamental needs were negatively correlated with avoidance overall ($\rho[157]=-.23$, $p=.004$), avoidance in Phase 2 ($\rho[157]=-.24$, $p=.002$), and avoidance during the first half of Phase 3 ($\rho[157]=-.21$, $p=.008$). These findings suggest that lower fulfilment of fundamental psychological needs corresponded with the tendency to choose PASS over JOIN overall, but also when JOIN responses resulted in inclusion (Phase 2) or when JOIN responses resulted in ambiguous social outcomes during Phase-3 extinction tests.

Discussion

Experiment 2 replicated the finding in Experiment 1 that reductions in social reinforcement produce resurgence of social avoidance. The present experiment also extended those findings by demonstrating that removal of social reinforcement produces resurgence following recent experiences of more (Low, None) but not less favorable social outcomes (High, Ext). The latter finding is in line with results of Craig and Shahan (2016) and extends those findings to humans with social outcomes for the first time. These novel findings have important clinical implications for SAD. Specifically, more successful treatments – i.e., those facilitating more positive social encounters – could paradoxically leave an individual more susceptible to relapse when later faced with social ambiguity. However, this is speculative given that the present experiment was conducted with healthy participants under highly controlled conditions.

Although Experiment 2 replicated key findings from Craig and Shahan (2016), there were important differences in methodology between the two studies that warrant further consideration. Specifically, Craig and Shahan arranged differences in Phase-1 reinforcer rate (cf. Experiment 2) among groups experiencing either high or low reinforcer rates in Phase 2; this facilitated an evaluation of resurgence in Phase 3 as a function of outcomes in each preceding phase. With respect to Experiment 2, one approach to examining the influence of social outcomes in Phase 1 might involve a variation of the present procedures and Craig and Shahan (2016). For example, one could arrange contingencies resulting in high or low levels of avoidance in Phase 1 across two groups. Phase 2 could arrange contingencies producing moderate levels of avoidance for both groups (e.g., Group High, Fig 6) before testing for resurgence in Phase 3. Ultimately, this experiment could help address the question of whether avoidance during testing is influenced by more distal experiences of punishment (exclusion). Existing research by Craig and Shahan suggests that those more distal experiences would not impact resurgence, but whether those findings extend to social outcomes and avoidance behavior remains an empirical question.

Despite replicating Craig and Shahan's findings regarding the influence of recent outcomes on resurgence, some findings in Experiment 2 were inconsistent with prior research. For example, Group Low experienced availability of social reinforcement on two-thirds of Phase-2 trials, whereas Group None experienced continuous availability of social reinforcement across those trials. However, Group Low demonstrated comparatively less avoidance, particularly by the end of Phase 2 (see Figure 5, Trial Blocks 21-24). Said another way, intermittent reinforcement for approach behavior (JOIN) resulted in more choices of JOIN over PASS relative to continuous availability of reinforcement. We examined two aspects of the data

to clarify these findings. First, we examined whether those differences between Low and None in Phase 2 might have occurred due to a disproportionately high number of participants demonstrating insensitivity to the contingencies in Group None. More specifically, in an exploratory analysis (see Appendix G), we revised our original exclusion criteria to eliminate additional participants demonstrating no sensitivity to Phase-2 or Phase-3 contingencies. This was defined as no change in responding from the last Phase-1 trial to the end of the experiment. Overall, we found that removing data sets meeting that criterion reduced but did not eliminate the difference in responding between those groups at the end of Phase 2; Group Low still demonstrated more avoidance than Group None by the end of that phase.

Given that overall differences in sensitivity did not fully explain the different response patterns in Low versus None in Phase 2, we next examined trial-by-trial patterns of responding in those groups. Further examination of the data in Phase 2 revealed differences in *variability*, defined as the number of switches between JOIN and PASS on contiguous trials in each group. More specifically, in Phase 1, both groups demonstrated between eight and nine switches (None: M=9.5, SD=10.5; Low: M=8.1, SD=9.9). However, in Phase 2, Group Low demonstrated twice as many switches (M=10.6, SD=10.5) as None (M=5.4, SD=7.9). It is interesting to note that despite this greater variability in responding, Group Low tended to choose JOIN more often than None on trials where inclusion (rather than extinction) was the programmed outcome. On average, participants chose JOIN on ~38 of 60 inclusion trials (62.8%; None) or ~29 of 40 inclusion trials (73.3%; Low). These findings suggest, first, that intermittent exposure to extinction in Group Low induced more variability in responding relative to the continuous reinforcement experienced by Group None (see Neuringer & Jensen, 2013). Second, and perhaps counterintuitively, this greater variability corresponded with *more* direct contact with the

reinforcement contingency – that is, more experiences of inclusion – in Low versus None. Nevertheless, further research is needed to fully elucidate this relation.

Finally, while correlation analyses generally yielded consistent findings across Experiments 1 and 2, there were some differences. For example, there was no correlation between fundamental needs and avoidance in Experiment 1, whereas fundamental-needs scores were negatively correlated with avoidance overall and within Phases 2 and 3 in the present experiment. One difference between experiments that could explain these findings is that participants in Experiment 2 generally had more contact with ambiguous social outcomes (extinction) in Phases 2 and 3. In line with this idea, the Need-Threat model proposed by Williams (2009) suggests that the negative impact of social exclusion on fundamental psychological needs (self-esteem, belonging, control, and meaningful existence) is moderated by the ambiguity of the situation. Specifically, Freedman et al. (2016) proposed that ambiguous social exclusion can be more harmful to fundamental needs than explicit rejection. According to Freedman et al., the reason for this distinction is that explicit rejection (e.g., Figure 1A) can preserve one's sense of control, allowing an individual to contact rejection and to respond directly and accordingly (e.g., with aggression or avoidance). In contrast, following more ambiguous experiences of social exclusion, an individual might engage in a variety of covert behaviors – for example, one might come to false conclusions about the reason for exclusion, and this could make some of their own negative characteristics more salient. Whether the extinction manipulation arranged in the present study in fact produces these covert behaviors remains an empirical question. However, further examination of this relation – and the relation between ambiguous social exclusion and avoidance – is warranted, especially given the ubiquity of ambiguous social cues and outcomes (see Freedman et al., 2016, for a review).

General Discussion

The present study examined behavior of healthy adult participants in a social game comprising a novel AP-AV paradigm. For the first time, we demonstrated resurgence of social avoidance generally, but also as a function of parametric reductions in social reinforcement (Experiment 1) and parametric manipulations of social-reinforcement history (Experiment 2). Two experiments addressed four research questions. First, we found that social AP-AV behavior flexibly shifted with changes in social contingencies (RQ 1). In Experiment 1, participants avoided interactions with other players when others viewed jokes only amongst themselves (exclusion; Phase 1). Participants later approached the same players when they began sharing jokes with the participant (inclusion; Phase 2). In Phase 3, when social outcomes were more ambiguous – i.e., when there was no joke to share due to a research assistant's error (extinction) – we observed resurgence as increased avoidance relative to inclusion (RQ 2). Moreover, the likelihood of avoidance was greater with more experiences of extinction versus inclusion (RQ 3). In Experiment 2, we found that avoidance resurged during Phase-3 extinction tests only when participants experienced inclusion (versus extinction) on at least two-thirds of Phase-2 trials. Said another way, experiencing more inclusion in a prior phase precipitated relapse of avoidance when social outcomes later became more ambiguous (RQ 4).

In addressing these research questions, it was necessary to adapt extant paradigms for asking questions about the impact of exclusion and factors contributing to social avoidance and relapse. One major distinguishing feature of the present AP-AV task is that it disentangles monetary from social consequences to avoid confounding effects of social inclusion and exclusion. This is in contrast with other AP-AV paradigms that manipulate monetary consequences only (e.g., Schlund et al., 2020, Zabag et al., 2022, 2023, 2024) or monetary and

social consequences simultaneously (e.g., Schlund et al., 2021, social-aggression task). With respect to the present research, simultaneous manipulation of monetary and social consequences would confound effects of social-inclusion and exclusion contingencies on avoidance.

In addition to other AP-AV paradigms, the present task can be distinguished from Cyberball – the most widely used paradigm for evaluating effects of social exclusion – in many ways. The subsequent sections provide a discussion of some of these differences and their implications. In Cyberball, avoidance of a particular avatar is not directly measured but inferred when participants begin allocating fewer throws to that avatar relative to others (e.g., Beltzer et al., 2019). However, participants often have few opportunities to react to exclusion, given the low number of ball tosses received relative to other players. When complete exclusion is arranged – with participants receiving the ball twice and then never again (e.g., Williams et al., 2000) – there are no opportunities to react to exclusion within the game. In other words, there is no overt behavior to measure. For this reason, behavioral outcomes of Cyberball exclusion are often examined in subsequent tasks (e.g., evaluating a job applicant; Twenge et al., 2001; Rajchert et al., 2023). This is in contrast with the present research, which arranges opportunities to react to each instance of exclusion with a choice of JOIN or PASS on a subsequent trial. Therefore, Cyberball is limited to examining behavioral outcomes only to partial (but not complete) exclusion, whereas the present paradigm is not. This feature of the present paradigm presents important opportunities for future research, including sequential analyses with intermittent schedules of social reinforcement. Specifically, sequential analyses could address the question of whether experiences of social inclusion or exclusion might bias responding toward approach or avoidance on subsequent trials. Therefore, the present arrangement facilitates an evaluation of both short- and long-term effects of social outcomes on behavior.

Beyond behavioral outcomes, the independent variable in Cyberball also differs from the present research. In Cyberball, exclusion comprises the collective experience of observing multiple ball tosses between other avatars, but not to one's own avatar. However, the exact number of tosses between other avatars that might constitute an experience of exclusion is not clear, and probably varies among individuals (see Schuck et al., 2018; Williams et al., 2000, for examples of partial exclusion). Table 8 provides a hypothetical example of a series of tosses meeting criteria for Cyberball *inclusion*, as defined by Williams et al. (2000), with each player receiving one-third of total tosses. In this figure, Player C represents the participant, and A and B represent the other players. The figure shows that Players A and B throw exclusively amongst themselves across the first five opportunities to toss the ball. Player C (the participant) does not receive the ball until the sixth opportunity, halfway through this series. Nevertheless, each player receives the ball a total of four times in this series of twelve tosses. The figure helps to clarify the point that Cyberball inclusion and exclusion are not experienced as single, discrete events; instead, these social outcomes are averaged across a series of events. This is in contrast with the present research, which arranges inclusion and exclusion as repeated, discrete events. To briefly summarize, while both paradigms facilitate an evaluation of exclusion-induced behavior at a macro level, only the present paradigm can accommodate sequential analyses – i.e., analyses of trial-by-trial reactions to exclusion and inclusion. This is especially important for evaluating relapse, which can sometimes occur as a transient or bitonic function (see Podlesnik & Kelley, 2014, 2015).

The independent variable arranged in Cyberball differs not only methodologically but also categorically from the present research. More specifically, Cyberball exclusion is generally referred to as ostracism; it is characterized by the feeling of being both ignored and excluded by

others (see Wesselmann & Williams, 2017, for a review). According to Wesselmann and Williams, ostracism-based exclusion is an umbrella term encompassing experiences such as being forgotten after meeting someone (King & Geise, 2011), being explicitly ignored (Williams, 2001), or experiencing more subtle forms of exclusion such as reduced eye contact (e.g., Wesselmann et al., 2012). In contrast with ostracism-based exclusion, Wesselmann and Williams define rejection-based exclusion as more direct indications that one is unwanted (e.g., "No one wanted to work with you"; Twenge et al., 2007). Like ostracism-based exclusion, rejection-based exclusion is an umbrella term, and encompasses experiences of exclusive laughter (Klages & Wirth, 2014), being the target of dehumanizing language (Andrighetto et al., 2016), discrimination, or stigmatization (Smart Richman & Leary, 2009), among other examples. The present paradigm arranges a manipulation more clearly aligned with Wesselmann and Williams' (2017) definition of rejection-based exclusion. That is, the message that others have privately deliberated and decided not to share a joke with the participant is better categorized as a direct (explicit) rather than indirect form of exclusion.

The fact that the exclusion manipulations used in Cyberball and the present research are methodologically and categorically distinct has an important implication. That is, exclusion in each set of procedures could have a different impact on dependent measures such as social avoidance and/or relapse. No studies have directly examined this possibility with social avoidance or relapse. However, prior research suggests that ostracism and rejection can have different effects on other outcome measures. As one example, studies have found that rejection and ostracism have different effects on choice allocation between tasks requiring higher or lower levels of cognitive effort (Peng et al., 2023). Peng et al. (2023) conducted two experiments with participants randomly assigned to experience a rejection versus control manipulation

(Experiment 1) or Cyberball exclusion (ostracism) or inclusion (Experiment 2). In Experiment 1, a confederate working with the participant on a previous task either had to leave due to a purported emergency (control) or stated that they no longer wished to work with the participant (rejection). Next, all participants completed a demand-selection task (DST; Kool et al., 2010). The DST is used in studies of cognitive effort, defined as allocation of mental resources during cognitive processes. More specifically, the DST measures avoidance of cognitive effort, or the tendency to allocate responding to tasks requiring less cognitive effort. In the DST, participants chose one of two pattern cues by hovering a mouse cursor over that image. The cue revealed a random number presented in either yellow or red. Participants then completed one of two tasks involving judging the number's parity (red) or magnitude (yellow). Each cue corresponded to a different probability of switching between the tasks of judging parity and magnitude. For one cue, the task-switching probability was 90% (high demand), and for the other, 10% (low demand). In each experiment, responses on the task were less accurate for participants who were excluded via ostracism or rejection relative to controls. However, only rejected participants demonstrated increased avoidance of cognitive effort relative to controls, measured as greater allocation to the low-demand cue associated with the lower task-switching probability. One implication relevant to the present research is that, compared with ostracism, rejection might differentially increase avoidance of social situations requiring higher (e.g., public speaking) versus lower amounts of cognitive effort (e.g., watching a movie with a long-time friend). This is an important and complex question to address in future research, and will likely involve accounting for several moderating factors, such as social anxiety.

With respect to future research, another important direction is the application of quantitative theories. Using quantitative theories to address empirical questions about social

avoidance, and more specifically, resurgence of social avoidance, is important to ensure that underlying behavioral processes can be precisely formalized and evaluated. When evaluating the impact of social inclusion and exclusion on resurgence, one consideration is selection of a model that can account for both reinforcer (inclusion) and punisher effects (exclusion). However, recent theories of resurgence, such as Resurgence as Choice (RaC; Shahan & Craig, 2017), model only reinforcer effects.

Briefly, RaC builds upon decades of behavioral choice research (see Baum & Rachlin, 1969) and suggests that resurgence is a shift in response allocation that occurs due to a change in the relative value of a recently reinforced option (alternative response) versus an option reinforced in the more distant past (target response). RaC accounts for reinforcement history and its role in determining value (cf. Davison and McCarthy, 1988). Although the quantitative details are beyond the scope of this discussion, reinforcement history is accounted for with a temporal weighting rule. The temporal weighting rule suggests that more recently experienced outcomes exert a greater influence on ongoing behavior relative to more temporally distant outcomes; however, experiences of reinforcement in the distant past continue to influence behavior for a long time. Thus, if a recently reinforced alternative response is devalued with a reduction in the rate (Shahan et al., 2020b) or magnitude of reinforcement it produces (Ritchey et al., 2023), this can increase the relative value of a target response that was reinforced in the past. The result is an increase in the target response, or resurgence.

In studies of resurgence, changes in reinforcement conditions, such as changes in the proportion of inclusion versus extinction for social-approach behavior, can be conceptualized as changes in *context* (e.g., Bouton et al., 2012; Trask et al., 2015). In line with this idea, a more recent version of the RaC model, Resurgence as Choice in Context (RaC^2), quantifies

discriminability of reinforcement contexts and their biasing effects of responding (Shahan et al., 2020a). RaC^2 suggests that repeated exposure to different reinforcement conditions facilitates organisms' learning to discriminate between those conditions. Discriminative effects of those reinforcement conditions can then influence response allocation in addition to changes in relative value. For example, exposure to reinforcement for an alternative response can bias allocation toward that response, but a downshift in the relative value of the alternative can produce a resurgence of target responding. Overall, the RaC^2 model accounts well for human (e.g., Ritchey et al., 2023; cf. Podlesnik et al., 2022) and nonhuman data (e.g., Shahan et al., 2020a, b). Nevertheless, the best way to incorporate effects of punishers such as exclusion in RaC-based models remains unclear (but see Ritchey et al., submitted). Therefore, future research should continue to consider possible modifications to RaC-based models while also exploring alternative quantitative theoretical frameworks.

Reinforcement learning is another quantitative theory describing how one might optimize behavior when choices could result in either reinforcement or punishment (Sutton & Barto, 1998). Despite their relevance (Staddon, 2020), reinforcement-learning models have been largely overlooked in the study of resurgence. With reinforcement learning, optimizing behavior requires making predictions about future action-outcome relations and updating those predictions when recent outcomes are suboptimal. For example, one needs to make predictions about the likelihood of rejection or exclusion when engaging with others and make adjustments to one's own behavior when unexpectedly experiencing exclusion or another negative social outcome. This process is quantified as a *learning rate* (Behrens et al., 2007). At higher learning rates, surprising outcomes have a larger impact on future outcome predictions and behavior. There is growing evidence that learning rate differs as a function of anxiety (e.g., Beltzer et al., 2019;

Browning et al., 2015; Huang et al., 2017): individuals with higher and lower social anxiety differ in how recent social experiences are weighted when predicting future social outcomes (Beltzer et al., 2019). How these differences might contribute to relapse generally, and social anxiety, specifically, remains an important empirical question.

As a first step to addressing this question, future iterations of the present experiments will involve systematic evaluation of procedures that promote different behavioral patterns (e.g., reduced negative-to-positive updating) as a function of social anxiety. These modified procedures might include the use of intermittent/probabilistic social outcomes (e.g., Zabag et al., 2023, 2024) and/or removal of explicit feedback for avoidance behavior (e.g., Zabag et al., 2022, 2023). Once established, these modified procedures could be used to quantify learning rates among those with higher and lower levels of social anxiety (e.g., Beltzer et al., 2019). Quantifying social decision-making processes could enhance our understanding of underlying processes driving resurgence of avoidance behavior and its relation with social anxiety. Ultimately, those findings could inform clinical practice by suggesting novel approaches to treating SAD and mitigating relapse following exclusion. The paradigm and empirical evaluations presented in the present research provide the groundwork for addressing these important theoretical and clinically relevant questions.

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Table 1

Description of Contingencies in Each Phase of Both Experiments

Experiment 1
Phase 1: Exclusion for JOIN responses
AV (PASS) → P avoids exclusion: others' decision to share or withhold joke is revealed.
AP (JOIN) → P is excluded: others see a joke but do not share it with P.
Phase 2: Inclusion for JOIN responses
AV (PASS) → P forgoes inclusion: others' decision to share or withhold joke is revealed.
AP (JOIN) → P is included: others share a joke with P.
Phase 3: 0-100% of trials result in extinction across groups. On remaining trials, JOIN→inclusion.
During non-extinction trials,
AV (PASS) → P forgoes inclusion: others' decision is revealed.
AP (JOIN) → P is included: others share a joke with P.
During extinction trials:
AV (PASS) → RA does not select joke.
AP (JOIN) → RA does not select joke.
Experiment 2
Phase 1: Exclusion for JOIN responses
AV (PASS) → P avoids exclusion: others' decision to share or withhold joke is revealed.
AP (JOIN) → P is excluded: others see a joke but do not share it with P.
Phase 2: 0-100% of trials result in extinction across groups. On remaining trials, JOIN→inclusion.
*During non-extinction trials***,**
AV (PASS) → P forgoes inclusion: others' decision is revealed.
AP (JOIN) → P is included: others share a joke with P.
During extinction trials:
AV (PASS) → RA does not select joke.
AP (JOIN) → RA does not select joke.
Phase 3: 100% of trials result in extinction across groups.
AV (PASS) → RA does not select joke.
AP (JOIN) → RA does not select joke.

Note. AV=avoidance; AP=approach; P=participant; RA=research assistant.

Table 2

Comparison of Experiment-1 Procedures with Other Studies of Resurgence

	Alessandri et al. (2015)	Reed (2019)	Present study
Target response	Key press	Button click (object 1)	Button click (pass)
Alternative response	Any behavior except target (DRO)	Button click (object 2)	Button click (join)
Phase-1 Contingencies	Target→escape from pressing force cell	Target→points	Target→avoidance of social exclusion
	Alternative→no escape	Alternative→no points	Alternative→no avoidance of exclusion
Phase-2 Contingencies	Target→no escape Alternative→escape	Target→no points Alternative→points	Target→no inclusion Alternative→inclusion
Phase-3 Contingencies	Target→no escape Alternative→no escape*	Target→no points	Target→no inclusion or exclusion
		Alternative→no points	Alternative→no inclusion or exclusion

Note. DRO=Differential reinforcement of other behavior; *These contingencies were in place for the last 5 min

(Alessandri et al., 2015). For the present procedures (right-most column), Phase-3 describes contingencies during extinction trials.

Table 3

Participant Demographics (N=390)

	Mean (SD)	Number	%
Age	39.4 (11.6)		
Feelings of inclusion (Question 11)	4.6 (2.2)		
Social anxiety (SIAS)	23.2 (18.4)		
Depression (DASS-21)	4.5 (5.5)		
Rejection Sensitivity (A-RSQ)	9.7 (5.3)		
Fundamental needs (NTQ)	68.0 (19.2)		
Background social support (SPS)	16.2 (3.5)		
Sex			
Male		208	53.3
Female		165	42.3
Neither		9	2.3
Not reported		8	2.1
Race/Ethnicity			
White		249	63.8
Black/African American		59	15.1
Latinx		32	8.2
Asian		31	7.9
Other		10	2.6
Not reported		9	2.3
Place of Birth			
United States		361	92.6
Other		20	5.1
Not reported		9	2.3
Education			
Some high school		4	1.0
High school diploma		51	13.1
Some college		95	24.4
College degree		163	41.8
Professional or graduate degree		62	15.9
Not reported		15	3.8
Annal household income			
Less than $25k		55	14.1
$25k-$50k		97	24.9
$50k-$100k		158	40.5
$100k-$200k		63	16.2
More than $200k		9	2.3
Not reported		8	2.1
Employment			
Full time		226	57.9
Part time		66	16.9
Unemployed (seeking opportunities)		39	10.0
Unemployed (not seeking opportunities)		39	10.0
Retired		11	2.8
Not reported		9	2.3
Clinical diagnoses			
Depression		71	18.2
Social anxiety disorder		36	9.2
Other anxiety disorder		29	7.4
Attention deficit/hyperactivity disorder		15	3.8
Autism spectrum disorder		8	2.1
Other		22	5.6
None/None reported		209	53.6
Currently taking medications			
No		303	77.7
Yes		69	17.7
Not reported		18	4.6
Attrition		124/514	24.1
Experiment 1		62/274	22.6
Experiment 2		62/240	25.8

Note. Possible scores were as follows: feelings of inclusion (Question 11): 1-9; SIAS: 0-68; DASS-21: 0-21; A-RSQ: 1-36; NTQ: 12-108; SPS: 5-20.

Table 4

Results of Mixed-Effects Regression Examining the Influence of Group, Phase, and Trial on Choice in Experiment 1

Fixed effect	Estimate (SE)	Odds Ratio	Probability	*z*	*p*
Intercept	2.27 (0.45)	9.67	0.91	5.06	<.001***
Trial	-0.05 (0.01)	0.95	0.49	-6.62	<.001***
Phase (1)	-2.54 (0.46)	0.08	0.07	-5.51	<.001***
Group (High)	-1.97 (0.60)	0.14	0.12	-3.26	.001**
Trial * Phase (1)	0.25 (0.03)	1.28	0.56	8.13	<.001***
Trial * Phase (3)	-0.42 (0.21)	0.66	0.40	-1.98	.048*
Trial * Group (High)	0.03 (0.01)	1.03	0.51	3.01	.003**
Phase (3) * Group (Ext)	-6.75 (1.31)	1.17E-3	1.17E-3	-5.16	<.001***
Phase (1) * Group (High)	2.30 (0.62)	9.98	0.91	3.69	<.001***
Trial * Phase (3) * Group (Ext)	0.65 (0.26)	1.92	0.66	2.52	.012*
Trial * Phase (3) * Group (High)	0.55 (0.26)	1.74	0.64	2.15	.032*

Note. ***p<.001; **p<.01; *p<.05. Only significant factors and interactions are shown; full results are included in Appendix F.

Table 5

Correlations Among Avoidance and Individual Factors in Experiment 1

Variable	1.	2.	3.	4.	5.	6.	7.	8.	9.	10a.	10b.	10c.	10d.
1.Feelings of Inclusion (Question 11)	--												
2.Social Anxiety (SIAS)	.00	--											
3.Depression (DASS-21)	.05	.65***	--										
4.Rejection Sensitivity (A-RSQ)	.07	.59***	.57***	--									
5.Fundamental Needs (NTQ)	.35***	-.35***	-.30***	-.31***	--								
6.Social Support (SPS)	-.13	-.27***	-.49***	-.57***	.10	--							
Avoidance (Proportion of Trials)													
7.Overall	-.30***	.00	-.04	-.02	.00	.00	--						
8.Phase 1	-.01	.14	.01	-.02	.03	.05	.18**	--					
9.Phase 2	-.16*	-.10	-.07	-.04	.05	-.03	.70***	-.13	--				
Phase 3													
10a.All trials (All groups)	-.32***	.05	.01	.01	-.04	-.03	.88***	-.04	.54***	--			
10b.All trials (Low, None)	-.18	-.08	-.04	.02	.04	-.06	.84***	-.32*	.78***	1.00***	--		
10c.All trials (High, Ext)	-.33***	.06	-.11	-.13	.05	.09	.86***	.17	.40***	1.00***	--	--	
10d.First 30 (All groups)	-.31***	.04	.01	.01	-.04	-.03	.88***	-.05	.55***	.99***	.98***	.98***	--
10e.First 30 (Low, None)	-.18	-.07	-.01	.03	.05	-.04	.83***	-.32	.78***	.98***	.98***	--	1.00***
10f.First 30 (High, Ext)	-.32**	.02	-.14	-.13	.06	.08	.87***	.18	.43***	.98***	--	.98***	1.00***

Note. ***p<.001; **p<.01; *p<.05

Table 6

Results of Mixed-Effects Regression Examining the Influence of Group, Phase, and Trial on Choice in Experiment 2

Fixed effect	Estimate (SE)	Odds Ratio	Probability	*z*	*p*
Trial	0.03 (0.01)	1.03	0.51	4.36	<.001***
Phase (3)	3.23 (0.87)	25.30	0.96	3.71	<.001***
Group (None)	1.56 (0.62)	4.76	0.83	2.53	.011*
Group (High)	1.36 (0.57)	3.90	0.80	2.41	.016*
Group (Low)	1.65 (0.55)	5.19	0.84	2.97	.003**
Trial * Phase (1)	0.10 (0.03)	1.10	0.52	3.54	<.001***
Trial * Phase (3)	-0.03 (0.01)	0.97	0.49	-3.52	<.001***
Trial * Group (None)	-0.05 (0.01)	0.95	0.49	-4.88	<.001***
Trial * Group (High)	0.04 (0.01)	0.96	0.49	-3.93	<.001***
Trial * Group (Low)	-0.06 (0.01)	0.94	0.48	-5.98	<.001***
Phase (1) * Group (None)	-2.04 (0.68)	0.13	0.11	-2.99	.003**
Phase (3) * Group (None)	-4.45 (1.21)	1.17E-2	1.15E-2	-3.68	<.001***
Phase (1) * Group (High)	-1.25 (0.64)	0.29	0.22	-1.96	.050-
Phase (3) * Group (High)	-8.66 (1.25)	1.74E-4	1.74E-4	-6.91	<.001***
Phase (1) * Group (Low)	-1.98 (0.62)	0.14	0.12	-3.18	.001**
Phase (3) * Group (Low)	-12.13 (1.18)	5.41E-6	5.41E-6	-10.28	<.001***
Trial * Phase (1) * Group (None)	0.11 (0.04)	1.11	0.53	2.59	.010**
Trial * Phase (3) * Group (None)	0.06 (0.01)	1.07	0.52	5.66	<.001***
Trial * Phase (3) * Group (High)	0.08 (0.01)	1.08	0.52	6.73	<.001***
Trial * Phase (3) * Group (Low)	0.11 (0.01)	1.12	0.53	10.74	<.001***

Note. ***p<.001; **p<.01; *p<.05; -$p\geq$.05, trending toward significance. Full results are included in Appendix F.

Table 7

Correlations Among Avoidance and Individual Factors in Experiment 2

Variable	1.	2.	3.	4.	5.	6.	7.	8.	9a.	9b	9c	10a.	10b	10c	10d
1.Feelings of Inclusion (Question 11)	--														
2.Social Anxiety (SIAS)	-.04	--													
3.Depression (DASS-21)	-.10	.60***	--												
4.Rejection Sensitivity (A-RSQ)	.02	.58***	.46***	--											
5.Fundamental Needs (NTQ)	.54***	-.35***	-.34***	-.21**	--										
6.Social Support (SPS)	.19*	-.35***	-.58***	-.42***	.31***	--									
Avoidance (Proportion of Trials)															
7.Overall	-.41***	-.05	.03	.02	-.23***	-.05	--								
8.Phase 1	-.15	.21**	.16*	.13	-.13	-.14	.50***	--							
Phase 2															
9a.All trials (All groups)	-.41***	-.09	.01	.00	-.24**	-.05	.88***	.23**	--						
9b.All trials (Low, None)	-.16	-.13	-.13	-.03	-.08	.15	.74***	.16	1.00***	--					
9c.All trials (High, Ext)	-.32**	.02	.12	.06	-.13	-.11	.92***	.28*	.86***	--	--				
Phase 3															
10a.All trials (All groups)	-.33***	-.02	.05	.05	-.16	-.06	.91***	.36***	.71***	.50***	1.00***	--			
10b.All trials (Low, None)	-.28*	-.10	-.08	-.01	-.15	.05	.87***	.41***	.50***	.50***	--	1.00***	--		
10c.All trials (High, Ext)	-.32**	.02	.12	.06	-.13	-.11	.92***	.28*	.86***	--	1.00***	1.00***	--	--	
10d.First 30 (All groups)	-.38***	-.01	.07	.07	-.21**	-.07	.90***	.33***	.74***	.56***	.95***	.96***	.98***	.95***	--
10e.First 30 (Low, None)	-.27*	-.12	-.10	-.05	-.18	.07	.89***	.38***	.56***	.56***	--	.98***	.98***	--	1.00***
10f.First 30 (High, Ext)	-.37***	.05	.17	.11	-.18	-.12	.87***	.26*	.82***	--	.95***	.95***	--	.95***	1.00***

Note. ***p<.001; **p<.01; *p<.05.

Table 8

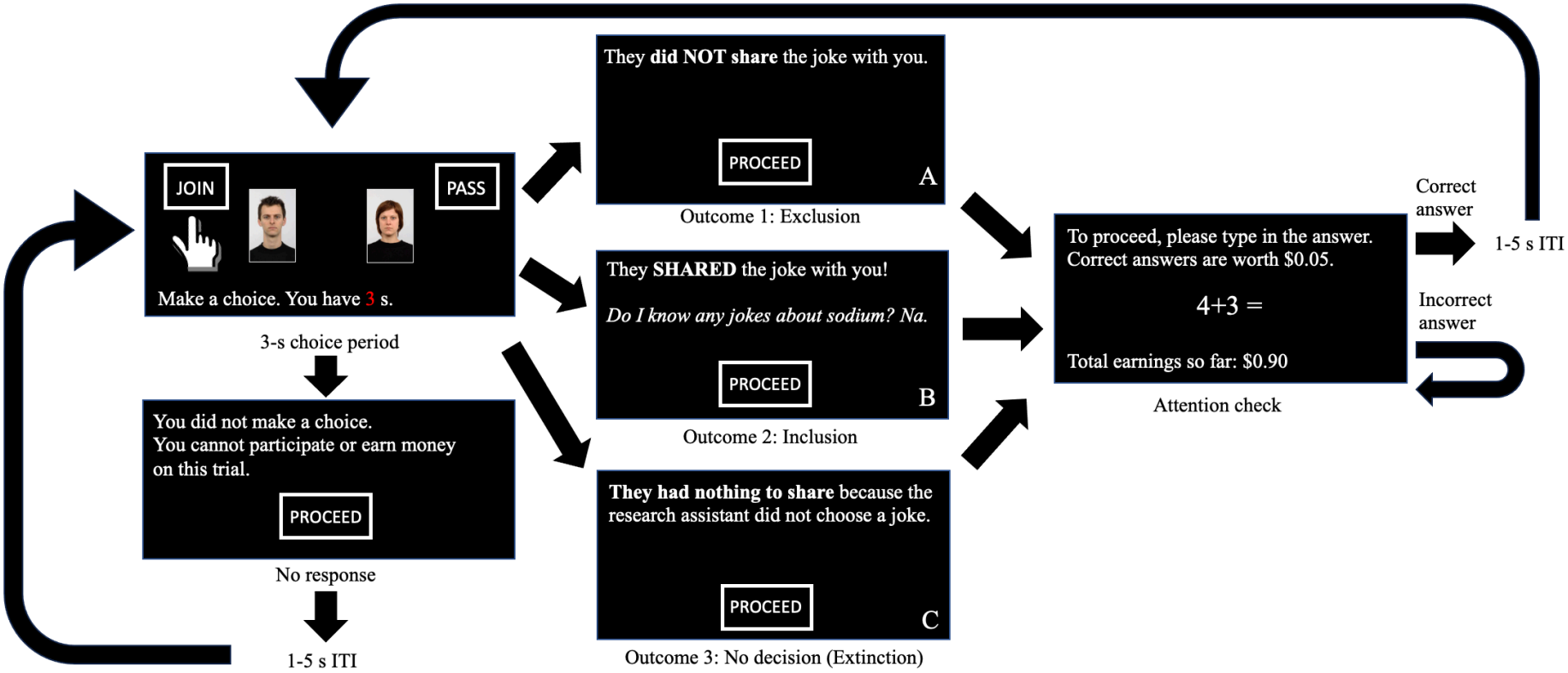
Hypothetical Scenario in Cyberball

Ball Toss Number	Starting Player > Receiving Player
1.	A > B
2.	B > A
3.	A > B
4.	B > A
5.	A > B
6.	B > C
7.	C > A
8.	A > C
9.	C > B
10.	B > C
11.	C > A
12.	A > C

Note. C represents the participant, A and B represent other players.

Figure 1

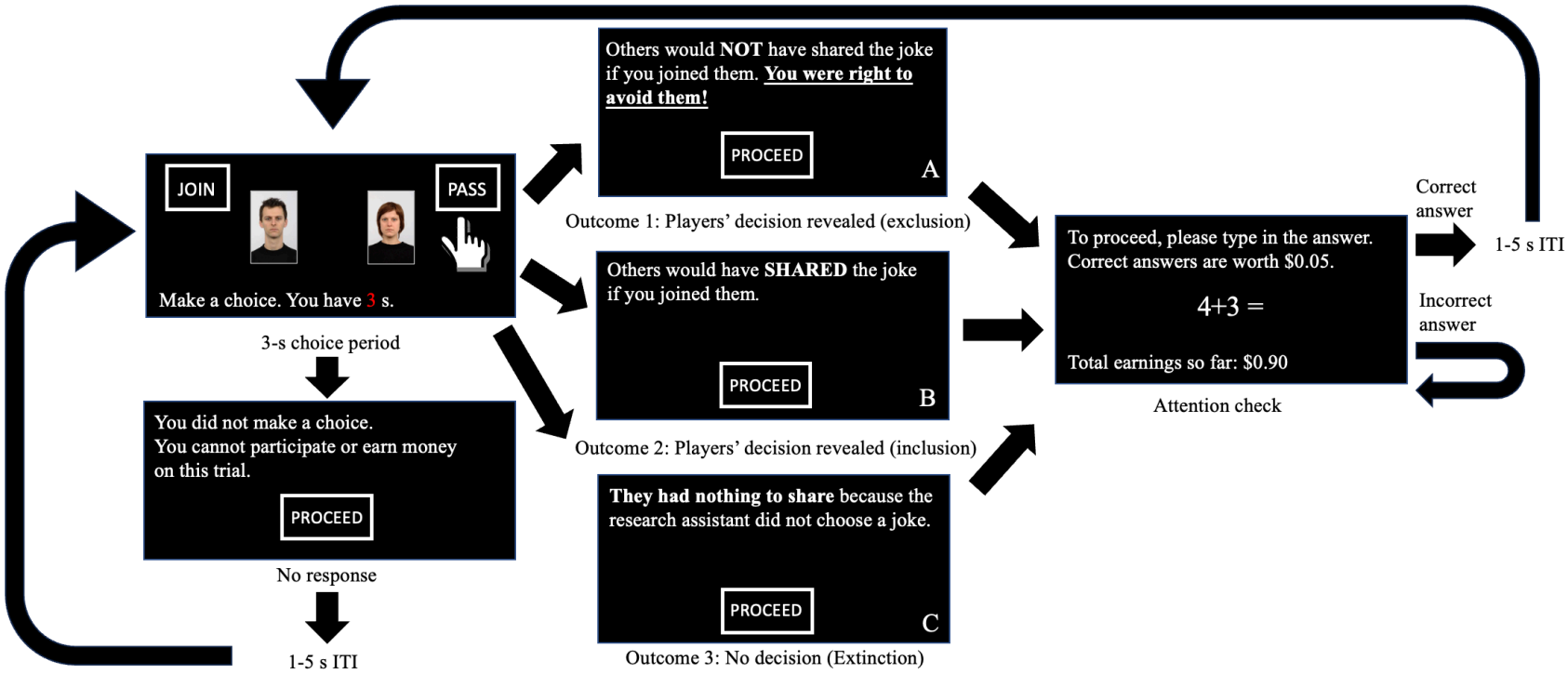
Task Interface and Outcomes for Approach Behavior (JOIN)



Note. This figure shows the task interface and possible outcomes for clicking the JOIN button (center panels). Note that players will be two males or two females (cf. top-left panel).

Figure 2

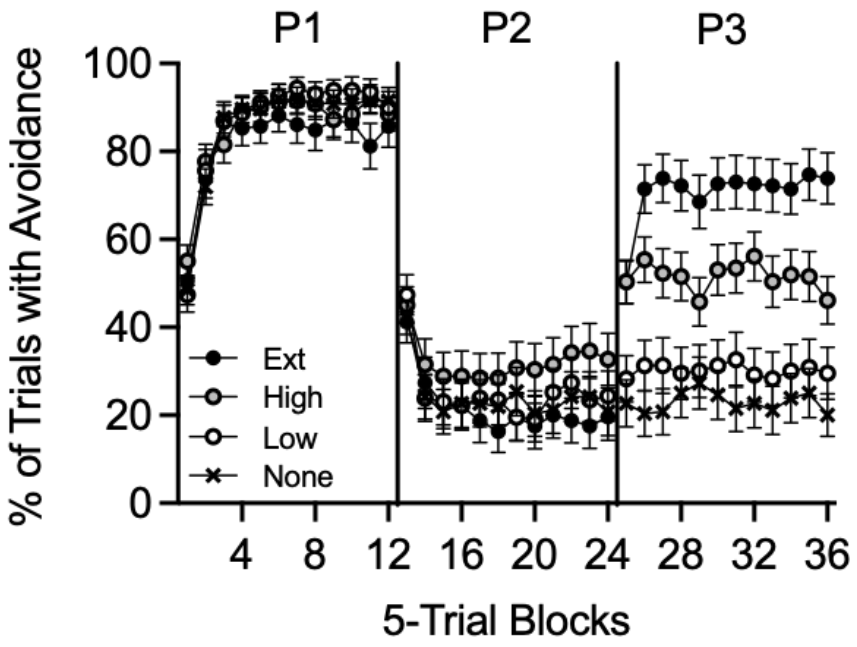
Task Interface and Outcomes for Avoidance Behavior (PASS)



Note. This figure shows the task interface and outcome for clicking the PASS button (center panels). Note that players will be two males or two females (cf. top-left panel).

Figure 3

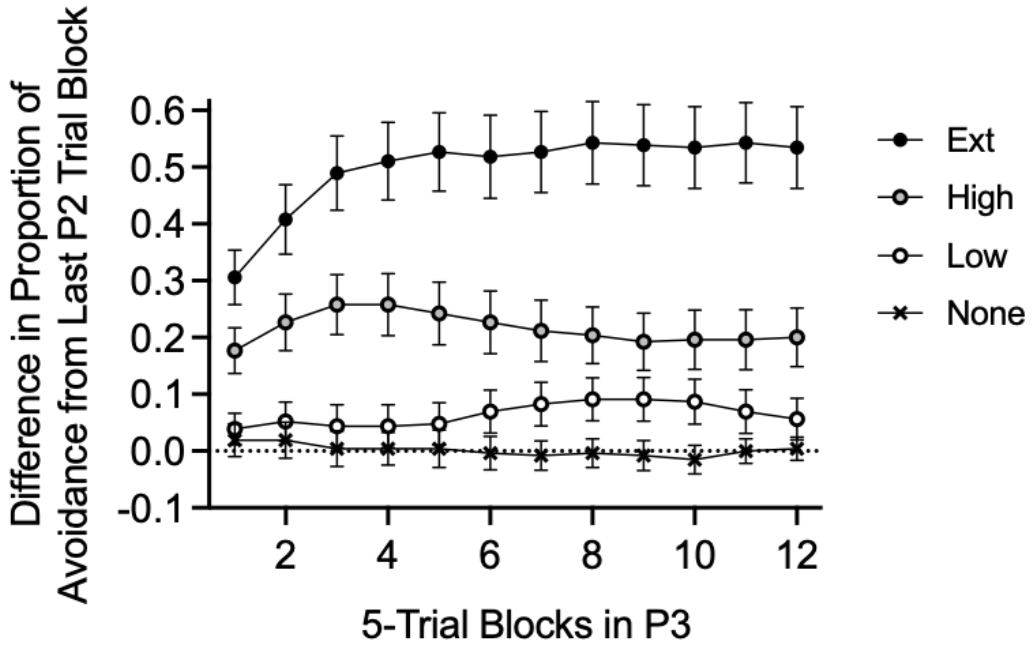
Avoidance Across Trials, Phases, and Groups in Experiment 1



Note. This figure shows mean percentage of 5-trial blocks with avoidance of other players (PASS). P1=Phase 1; P2=Phase 2; P3=Phase 3. Error bars represent standard errors of the mean.

Figure 4

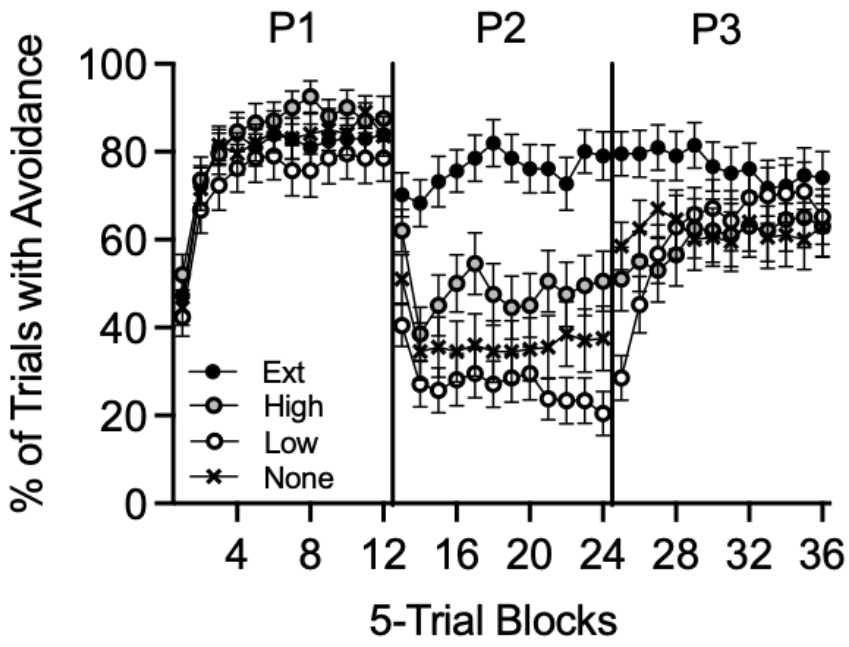
Difference in Avoidance from Phase 2 to Phase 3 in Experiment 1



Note. For each participant, the proportion of avoidance in the last 5-trial block of Phase 2 was subtracted from the proportion of avoidance in each 5-trial block of Phase 3. This figure shows mean differences across participants within each group. Error bars represent standard errors of the mean.

Figure 5

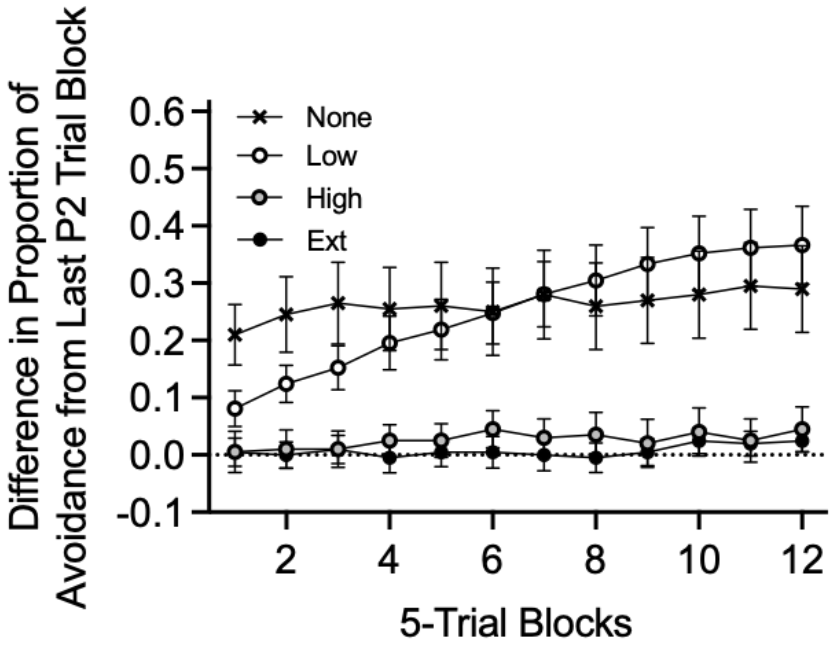
Avoidance Across Trials, Phases, and Groups in Experiment 2



Note. The figure shows mean percentage of 5-trial blocks with avoidance of other players (PASS). P1=Phase 1; P2=Phase 2; P3=Phase 3. Error bars represent standard errors of the mean.

Figure 6

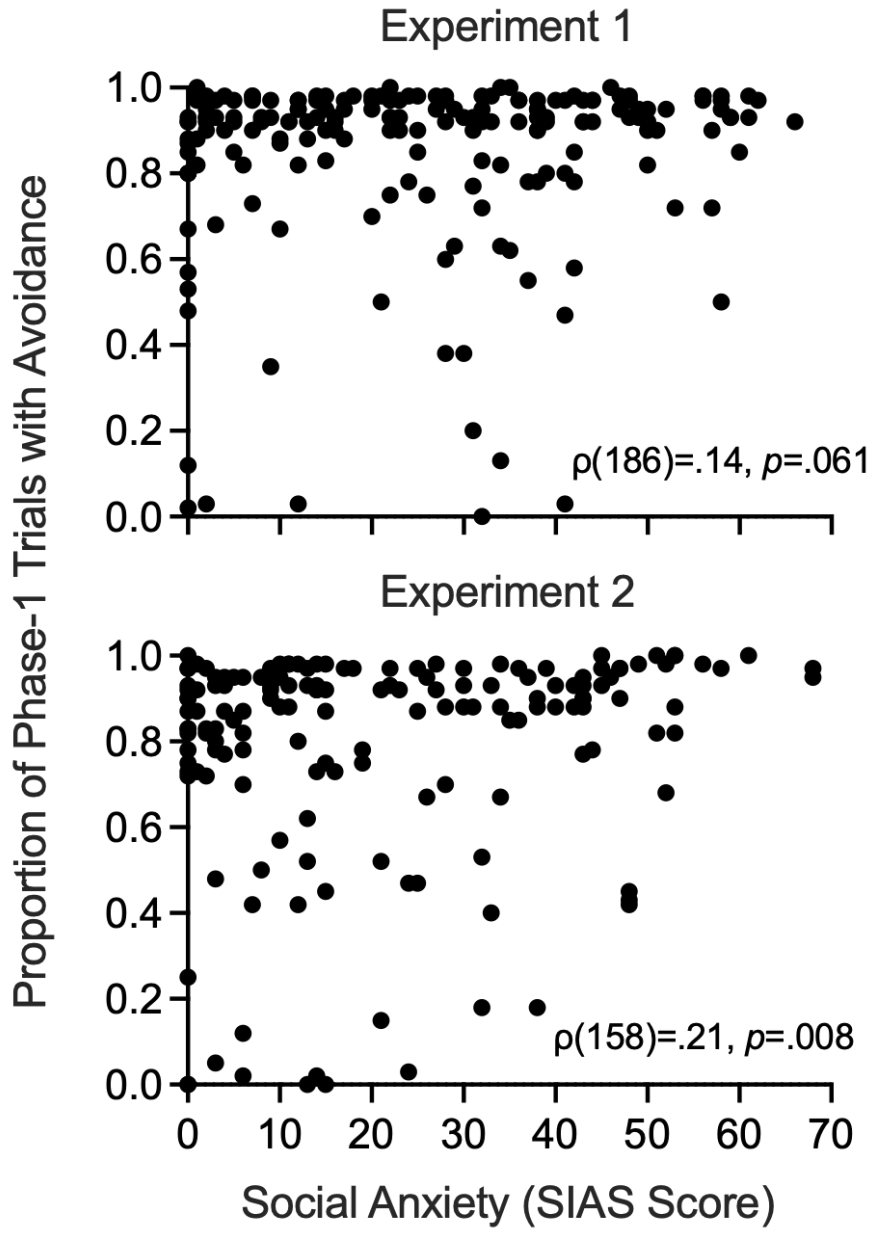
Difference in Avoidance from Phase 2 to Phase 3 in Experiment 2



Note. For each participant, the proportion of avoidance in the last 5-trial block of Phase 2 was subtracted from the proportion of avoidance in each 5-trial block of Phase 3. This figure shows mean differences across participants within each group. Error bars represent standard errors of the mean.

Figure 7

Correlation Between Social Anxiety and Avoidance in Phase 1



Note. SIAS=Social Interaction Anxiety Scale; scores ranged from 0-68, with higher scores indicating higher social anxiety.

Appendix A

1. I have an inferiority complex, but it's not a very good one.
2. I told my doctor that I broke my arm in two places. He told me to stop going to those places.
3. Q: What vegetable is cool, but not *that* cool?
   A: Rad-ish.
4. I was wondering why the baseball kept getting bigger and bigger, and then it hit me.
5. Q: Why did the employee get fired from the calendar factory?
   A: She took a day off.
6. Worrying works! Case in point: 90% of the things I worry about never happen.
7. My teachers told me I'd never amount to much because I procrastinate. I told them, "Just you wait!"
8. Q: Why do seagulls fly over the sea?
   A: If they flew over the bay, they would be bagels.
9. I ordered a chicken and an egg from Amazon. I'll let you know which comes first.
10. Q: What do you call a magician who lost his magic?
    A: Ian.
11. I broke my finger last week. On the other hand, I am OK.
12. I went to the doctor with a suspicious-looking mole. He told me they all look that way and I should have left it in the garden.
13. Two men are on opposite sides of the river. The first man shouts, "How do I get to the other side of the river?" The other man yells, "You *are* on the other side of the river!"
14. Q: Why would a pig dressed in black never get bullied?
    A: Because Batman has sworn to protect Goth-ham.
15. Every morning, I announce that I'm going running, but then I don't. It's a running joke.
16. Q: Why is a swordfish's nose 11 inches long?
    A: Because if it were 12 inches, it would be a foot.
17. Q: What state is known for its small drinks?
    A: Minnesota.
18. Q: What do you call a line of men waiting to get haircuts?
    A: A barberqueue.
19. I was going to tell a time-traveling joke, but you didn't like it.
20. I can't take my dog to the pond anymore because the ducks keep attacking him. That's what I get for buying a pure bread dog.
21. My wife and I laugh about how competitive we are. But I laugh more.
22. Q: Why did the hipster burn his mouth?
    A: He drank the coffee before it was cool.
23. I know they say money talks, but all mine says is "goodbye."
24. Q: Why should you never fall in love with a tennis player?
    A: Because to them, love means nothing!
25. I gave up my seat to an elderly person on the bus. And that's how I lost my job as a bus driver.
26. How do you find Will Smith in the snow? Look for the fresh prints.
27. Do I know any jokes about sodium? Na.

28. 70% of the earth is water, and virtually none of it is carbonated. So, the earth is, in fact, flat.
29. Q: If you have six oranges in one hand and eight bananas in another, what do you have?
A: Big hands.
30. My wife told me to stop impersonating a flamingo. I had to put my foot down.
31. Q: What did zero say to eight?
A: Nice belt.
32. What's the difference between ignorance and apathy? I don't know, and I don't care.
33. The past, the present and the future walked into a bar. It was tense.
34. I just found out the company that produces yardsticks won't be making them any longer.
35. Geology rocks, but geography is where it's at.
36. What's the difference between black-eyed peas and chickpeas? Black Eyed Peas can sing us a song. Chickpeas can hummus one.
37. Q: What did the duck say when she bought lipstick?
A: Put it on my bill.
38. Did you hear that Larry got a new job working for Old MacDonald? He's the new CIEIO.
39. Apparently, you can't use the words "beef stew" as a password. It's just not stroganoff.
40. What's the best thing about Switzerland? I don't know, but the flag is a big plus.
41. I invented a new word! Plagiarism!
42. Did you hear about the mathematician who's afraid of negative numbers? He'll stop at nothing to avoid them.
43. Q: Why do we tell actors to "break a leg?"
A: Because every play has a cast.
44. Helvetica and Times New Roman walk into a bar. "Get out of here!" shouts the bartender. "We don't serve your type."
45. Yesterday I saw a guy spill all his Scrabble letters on the road. I asked him, "What's the word on the street?"
46. Knock! Knock!
Who's there?
Control Freak.
Con…
OK, now you say, "Control Freak who?"
47. Hear about the new restaurant called Karma? There's no menu: You get what you deserve.
48. A woman in labor suddenly shouted, "Shouldn't! Wouldn't! Couldn't! Didn't! Can't!"
"Don't worry," said the doc. "Those are just contractions."
49. A bear walks into a bar and says, "Give me a whiskey and … cola." "Why the big pause?" asks the bartender. The bear shrugged. "I'm not sure; I was born with them."
50. Did you hear about the actor who fell through the floorboards? He was just going through a stage.
51. Did you hear about the claustrophobic astronaut? He just needed a little space.
52. Q: Why don't scientists trust atoms?
A: Because they make up everything.
53. Q: Where are average things manufactured?
A: The satisfactory.
54. Q: How do you drown a hipster?

A: Throw him in the mainstream.

55. Q: What sits at the bottom of the sea and twitches?
A: A nervous wreck.

56. Q: What does a nosy pepper do?
A: Gets jalapeño business!

57. Q: Why can't you explain puns to kleptomaniacs?
A: They always take things literally.

58. Q: How do you keep a bagel from getting away?
A: Put lox on it.

59. A man tells his doctor, "Doc, help me. I'm addicted to Twitter!" The doctor replies, "Sorry, I don't follow you …"

60. Q: What kind of exercise do lazy people do?
A: Diddly-squats.

61. Q: Why don't Calculus majors throw house parties?
A: Because you should never drink and derive.

62. Q: What do you call a parade of rabbits hopping backwards?
A: A receding hare-line.

63. Q: What does Charles Dickens keep in his spice rack?
A: The best of thymes, the worst of thymes.

64. Q: What's the different between a cat and a comma?
A: A cat has claws at the end of paws.

65. Q: What did the Tin Man say when he got run over by a steamroller?
A: "Curses! Foil again!"

66. Q: What did the bald man exclaim when he received a comb for a present?
A: Thanks— I'll never part with it!

67. Q: What did the left eye say to the right eye?
A: Between you and me, something smells.

68. Q: What do you call a fake noodle?
A: An impasta.

69. Q: How do you make a tissue dance?
A: Put a little boogie in it.

70. Q: What do you call a pony with a cough?
A: A little horse.

71. Q: What did one hat say to the other?
A: You wait here. I'll go on a head.

72. Q: What did the shark say when he ate the clownfish?
A: This tastes a little funny.

73. Q: Why can't you hear a pterodactyl go to the bathroom?
A: Because the "P" is silent.

74. Q: What did the pirate say when he turned 80?
A: Aye matey.

75. Q: Why did the frog take the bus to work today?
A: His car got toad away.

76. Q: What did the buffalo say when his son left for college?
A: Bison.

77. Q: Why did the yogurt go to the art exhibition?

A: Because it was cultured.

78. Q. What do you call an apology written in dots and dashes?
A: Re-Morse code.

79. I told my wife she was drawing her eyebrows too high. She looked at me surprised.

80. Did you hear about the two people who stole a calendar? They each got six months.

81. Q: What's Forest Gump's password?
A: 1Forest1.

82. Q: How do poets say hello?
A: Hey, haven't we metaphor?

83. Q: Why did the Oreo go to the dentist?
A: Because he lost his filling.

84. Q: What do you get from a pampered cow?
A: Spoiled milk.

85. Q: Why is it annoying to eat next to basketball players?
A: They dribble all the time.

86. Q: Why did the M&M go to school?
A: It wanted to be a Smartie.

87. Q: Why do bees have sticky hair?
A: Because they use honeycombs.

88. I got my daughter a fridge for her birthday. I can't wait to see her face light up when she opens it.

89. Q: Why aren't koalas actual bears?
A: They don't meet the koalafications.

90. Rest in peace to boiling water. You will be mist.

91. Q: What do you call a rooster staring at a pile of lettuce?
A: A chicken sees a salad.

92. Q: Why did the nurse need a red pen at work?
A: In case she needed to draw blood.

93. Q: How do you throw a space party?
A: You planet.

94. The numbers 19 and 20 got into a fight. 21.

95. Q: Why did it get so hot in the baseball stadium after the game?
A: All of the fans left.

96. Q: Why did the math textbook visit the guidance counselor?
A: It needed help figuring out its problems.

97. Want to hear a construction joke? Oh never mind, I'm still working on that one.

98. Talk is cheap? Have you ever talked to a lawyer?

99. Q: Why did the gym close down?
A: It just didn't work out!

100. Two artists had an art contest. It ended in a draw!

101. I tried to sue the airport for misplacing my luggage. I lost my case.

102. I have a fear of speed bumps. But I am slowly getting over it.

103. Q: What did one traffic light say to the other?
A: Stop looking! I'm changing!

104. Q: What type of sandals do frogs wear?
A: Open-toad!

105. Q: Why was six afraid of seven?
A: Because seven ate nine.
106. Q: What starts with E, ends with E, and has only 1 letter in it?
A: Envelope.
107. Q: Why doesn't the sun go to college?
A: Because it has a million degrees!
108. Q: Why are skeletons so calm?
A: Because nothing gets under their skin.
109. Q: Why is England the wettest country?
A: Because so many kings and queens have been reigning there.
110. Did you hear about the kidnapping at school? It's okay. He woke up.
111. Q: Can February march?
A: No, but April may.
112. Q: Why are ghosts such bad liars?
A: Because they are easy to see through.
113. Q: How do trees get online?
A: They just log on!
114. Q: What do you call a bear with no teeth?
A: A gummy bear.
115. Q: Why couldn't the leopard play hide and seek?
A: Because he was always spotted.
116. A pair of cows were talking in the field.
One says, "Have you heard about the mad cow disease that's going around?"
"Yeah," the other cow says. "Makes me glad I'm a penguin."
117. Q: Why don't pirates take a shower before they walk the plank?
A: They just wash up on shore.
118. Two hunters are out in the woods when one of them collapses. He's not breathing and his eyes are glazed. The other guy whips out his cell phone and calls 911.
"I think my friend is dead!" he yells. "What can I do?"
The operator says, "Calm down. First, let's make sure he's dead."
There's a silence, then a shot. Back on the phone, the guy says, "OK, now what?"
119. A highway patrolman pulled alongside a speeding car on the highway. Looking at the car, he was astounded to see that the elderly woman behind the wheel was knitting. The trooper cranked down his window and yelled to the driver, "Pull over!"
"No!" the woman yelled back, "Cardigan!"
120. I quit my job working for Nike. I just couldn't do it anymore.
121. Sad after the funeral of a friend, my wife and I ducked into a Chinese restaurant for a pick-me-up. The feel-good session ended when I read the fortune cookie: "You will soon be reunited with a good friend."
122. I tried to organize a hide-and-seek tournament, but it was a complete failure. Good players are hard to find.
123. A vegan said to me, "People who sell meat are gross!"
I said, "People who sell veggies are grocer."
124. A mom texts, "Hi! Son, what do IDK, LY and TTYL mean?"
He texts back, "I don't know, love you and talk to you later."
The mom replies, "It's OK, don't worry about it. I'll ask your sister. Love you too."

125. Why do they lock gas station bathrooms? Are they afraid someone will clean them?
126. Interesting fact: a shark will only attack you if you're wet.
127. A guy spots a sign outside a house that reads "Talking Dog for Sale." Intrigued, he walks in.
"So what have you done with your life?" he asks the dog.
"I've led a very full life," says the dog. "I lived in the Alps rescuing avalanche victims. Then I served my country in Iraq. And now I spend my days reading to the residents of a retirement home."
The guy is flabbergasted. He asks the dog's owner, "Why on Earth would you want to get rid of an incredible dog like that?"
The owner says, "Because he's a liar! He never did any of that!"
128. A poodle and a collie are walking together when the poodle suddenly unloads on his friend. "My life is a mess," he says. "My owner is mean, my girlfriend ran away with a schnauzer, and I'm as jittery as a cat."
"Why don't you go see a psychiatrist?" suggests the collie.
"I can't," says the poodle. "I'm not allowed on the couch."
129. The easiest time to add insult to injury is when you're signing somebody's cast.
130. I decided to sell my vacuum cleaner. All it was doing was gathering dust.
131. Is there rehab for gossiping? I don't need it, but I'll tell you who does…
132. A skeleton walks into a bar. The bartender says, "What'll you have?"
The skeleton says, "Gimme a beer and a mop."
133. I like an escalator because an escalator can never break. It can only become stairs.
134. The village blacksmith finally found an apprentice willing to work hard for long hours. The blacksmith instructed the boy, "When I take the shoe out of the fire, I'll lay it on the anvil; and when I nod my head, you hit it with this hammer."
The apprentice did just as he was told. Now he's the village blacksmith.
135. Doctor: "I'm sorry but you suffer from a terminal illness and have only 10 to live."
Patient: "What do you mean, 10? Ten what? Months? Weeks?!"
Doctor: "Nine."
136. Two men were driving home one night when one asked the other to check if the car's indicators are working. He promptly sticks his head out the window and says: "Yes, no, yes, no, yes, no, yes, no."
137. A man is on trial for armed robbery. The jury comes back with the verdict. The foreman stands, clear his throat and announces, "Not guilty."
The defendant leaps to his feet. "Awesome!" he shouts. "Does that mean I get to keep the money?"
138. The manager of a jewelry store nabs a shoplifter trying to steal a necklace.
"Listen," the crook says, "you don't want any trouble, and neither do I. What do you say I just buy the necklace and we forget this ever happened?" The manager agrees and writes up a sales slip. "You know," says the crook, "this is more than I wanted to spend. Got anything less expensive?"
139. Snake 1: Are we poisonous? Snake 2: I don't know. Why? Snake 1: I just bit my lip.
140. What did the green grape say to the purple grape? Breathe! Breathe!
141. "I think my goldfish has seizures," a man tells the veterinarian.
"He seems fine now," says the vet.
"Now, sure. But wait till I take him out of the bowl."

142. Q: You're riding a horse at full speed. You're being chased by a lion and there's a giraffe in the way in front of you. How will you escape this highly dangerous situation?
A: Get off the carousel.

143. A woman walked up to an elderly man rocking in a chair on his porch. "I couldn't help noticing how happy you look," she said. "What's your secret for a long, happy life?"
"I smoke three packs of cigarettes a day," he said. "I also drink a case of whisky a week, eat fatty foods and never exercise."
"That's amazing," the woman said. "How old are you?"
"Thirty-six."

144. The other day I was thinking, "I must be the most unobservant person in the world." Then I thought, "Well, maybe other people are equally unobservant, and I just haven't noticed before."

145. A couple of cockroaches are munching on the contents of a garbage can in a deserted alley. "Have you popped into that new coffee shop across the street yet?" asks one. "The floors are so shiny you can see your antennae in them. The walls are so clean you can't run up them. The air is so fresh it smells like flowers."
"Stop!" cries the second cockroach. "Please, not while I'm eating."

146. Q: How many college students does it take to screw in a light bulb?
A: One, but he waits until the last minute to cram it in.

147. A husband texts his wife on a frosty winter morning: "Window's frozen!"
His wife texts back, "Pour lukewarm water over it."
Five minutes later he replies: "Computer completely messed up now."

148. One friend complains to another, "All my husband and I do any more is fight. I've been so upset, I've lost 20 pounds."
"If it's that bad, why don't you just leave him?" asks the other friend.
"I'd like to lose another 15 pounds first."

149. You know, people don't usually compliment me on my driving, so I was very pleased this morning when I saw a note on my car that said, "Parking fine." That was very nice of them!

150. Q: What did the gingerbread man put on his bed?
A: Cookie sheets.

151. Q: Where do loose tea leaves go to rest while they're camping?
A: A steeping bag.

152. Did you hear about the identical twins who robbed a bank? After they were caught, they finished each other's sentences.

153. Fortune tellers are so easy to buy clothes for—they're all mediums.

154. A man is recovering from a minor surgery when a nurse comes in to check on him.
"How are you feeling?" she asks.
"I'm okay," he says, "but I didn't like the four-letter word the doctor used during surgery."
"What did he say?" the nurse asks.
"Oops."

155. Change is inevitable, except from a vending machine.

156. There is a lot of competition for parking at the local dental office, hence the sign: "Dental office parking only. Violators will be extracted."

157. Green beans are the most zen of all the vegetables because they've found their inner peas.
158. I went to the butcher's the other day and bet him $50 that he couldn't reach the meat on the top shelf. "No," he responded. "The steaks are too high."
159. The trouble with jogging is that by the time you realize you're not in shape for it, it's too far to walk back.
160. My IQ test results came back. They were negative.
161. Q: What did one DNA say to the other DNA?
A: "Do these genes make me look fat?"
162. Q: What do you get when you cross a polar bear with a seal?
A: A polar bear.
163. Q: What's the difference between an outlaw and an in-law?
A: Outlaws are wanted.
164. Before you marry a person, you should first make them use a computer with a slow Internet connection to see who they really are.
165. Did you hear about the shepherd who drove his sheep through town? He was given a ticket for making a ewe turn.
166. Among the things that are so simple even a child can operate them are parents.
167. Q: Why aren't dogs good dancers?
A: Because they have two left feet.
168. Q: Why did Beethoven get rid of his chickens?
A: All they said was, "Bach, Bach, Bach …"
169. I spent a lot of time, money and effort childproofing my house … but the kids still get in.
170. Q: What do you call a mobster who's buried in cement?
A: A hardened criminal.
171. Did you hear about the nurse who was chewed out by the doctor because she was absent without gauze?
172. Did you hear about the crustacean accused of promoting his own shellfish interests?
173. Did you hear about the cat who ate a ball of yarn? She had mittens.
174. Q: Where does a winemaker get his gossip?
A: Through the grapevine.
175. Q: How many telemarketers does it take to change a light bulb?
A: Only one, but he has to do it while you are eating dinner.
176. Q: How much did Santa pay for his sleigh?
A: Nothing, it was on the house.
177. Q: What do you call Santa's helpers?
A: Subordinate Clauses.
178. Q: What do you call a chicken who crosses the road, rolls in the mud and then crosses back again?
A: A dirty double-crosser.
179. I used to believe that all things must pass—until I got stuck behind a school bus.
180. Q: Why don't cats play poker in the jungle?
A: Too many cheetahs.

Appendix B

Note: notes to the reader are italicized, while actual text presented to participants is not.

The following text appeared at the top of Pages 1-3:

IMPORTANT INSTRUCTIONS
PLEASE READ TO ENSURE YOU RECEIVE PAYMENT
*****There will be a short quiz at the end.*****

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PAGE 1:

Please remember you can stop the task at any time if you do not wish to continue. Please complete the research study in a private location and close your browser when you're finished.

'Next' button appeared at the bottom of the page.

--
PAGE 2:

This is a social game. You will be connected to two other people online. In this game, two players are randomly assigned to the role of sharing jokes, and one player is assigned to the role of receiving jokes. YOU HAVE BEEN ASSIGNED TO THE ROLE OF RECEIVING JOKES.

A research assistant will oversee the game by choosing jokes in real time and sending them to the two other players. You will never interact with the research assistant, only the two players represented by pictures on the screen.

'Back' and 'Next' buttons appeared at the bottom of the page.

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PAGE 3:

When two buttons appear on the screen, you will have to make a choice. You can "join" the players, or you can "pass" on the opportunity to "interact" with them.

If you join, other players could potentially share a joke with you. However, you will only get to see the joke if the other players decided to share it with you.

If you pass, you will not see a joke, regardless of the other players' decision. However, you will find out whether the others had decided to share with you.

You are free to choose between JOIN and PASS. Choosing JOIN versus PASS will not affect your earnings.

You will earn $9.00 for participating, but those earnings could double based on performance during the game and survey.

'Back' and 'Next' buttons appeared at the bottom of the page.

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PAGE 4:

Quiz
You must answer all questions correctly to move on.

1. Players are randomly assigned to the roles of sharing or receiving jokes. You have been assigned to the role of SHARING jokes. True/False (*ANSWER: False*)
2. The research assistant's role is to select jokes and send those jokes to two of the players in this game. True/False (*ANSWER: TRUE*)
3. If you choose JOIN, other players could share a joke with you. However, you will only get to see it if they decide to share it with you. True/False (*ANSWER: TRUE*)
4. If you choose PASS, you will still find out whether others chose to share a joke with you. True/False (*ANSWER: TRUE*)
5. You could double your earnings from $9 to $18 - this is based on your performance. In other words, you could earn more if you pay attention to the task and complete all survey questions. True/False (*ANSWER: TRUE*)

'Check Answers' button appeared at the bottom of the page.

If all answers were correct, the text: "Your answers are correct!" appeared on the screen, along with a 'Proceed' button.

Entering one or more wrong answers produced a popup message: "Some answers are incorrect, please try again." Then, a 'Show Instructions Again' button appeared to the left of 'Check Answers' at the bottom of the screen. Clicking 'Show Instructions Again' presented instructions from Page 1.

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PAGE 5: Beginning of Practice Trials

You will now practice before connecting with real players online.

Keep in mind that if you do not pay attention and follow instructions during the practice session, the task will end **IMMEDIATELY**, and you will **NOT** receive payment.

Are you ready to practice? If so, click next to proceed.

'Back' and 'Next' buttons appeared at the bottom of the page.

--
PAGE 6: PRACTICE TRIAL 1

You can JOIN or PASS on the opportunity to "interact" with the other players. Let's try joining them first to see what happens. **Press "JOIN"**

'PASS' and 'JOIN' buttons appeared at the bottom of the page.

*If participants pressed JOIN, the following text appeared: "They **SHARED** the joke with you!" A joke also appeared on the screen.*

If participants pressed PASS, the following text appeared: "Incorrect response. The experiment has not been completed conscientiously." Participants could not proceed with the experiment.

--
PAGE 7: PRACTICE TRIAL 2:

Now you have another chance to JOIN or PASS on the opportunity to "interact" with the other players. They just shared the joke with you. So, you JOIN. **Press "JOIN"**

'PASS' and 'JOIN' buttons appeared at the bottom of the page.

*If participants pressed JOIN, the following text appeared: "They **SHARED** the joke with you!" A joke also appeared on the screen.*

If participants pressed PASS, the following text appeared: "Incorrect response. The experiment has not been completed conscientiously." Participants could not proceed with the experiment.
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PAGE 8: PRACTICE TRIAL 3:

Great! Let's try again. You can JOIN or PASS, just like in previous trials. The players have been sharing jokes with you, so you JOIN. **Press "JOIN"**

'PASS' and 'JOIN' buttons appeared at the bottom of the page.

*If participants pressed JOIN, the following text appeared: "They **did NOT share** the joke with you."*

If participants pressed PASS, the following text appeared: "Incorrect response. The experiment has not been completed conscientiously." Participants could not proceed with the experiment.

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PAGE 9: PRACTICE TRIAL 4:

Last time, the others DID NOT share the joke with you. So, this time, you PASS on the opportunity to interact with them. Remember that choosing JOIN or PASS does not affect your earnings. **Press "PASS"**

'PASS' and 'JOIN' buttons appeared at the bottom of the page.

*If participants pressed PASS, the following text appeared: "They **would NOT have shared** the joke if you joined them. **You were right to avoid them!**"*

If participants pressed JOIN, the following text appeared: "Incorrect response. The experiment has not been completed conscientiously." Participants could not proceed with the experiment.

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PAGE 10: PRACTICE TRIAL 5:

Great! You PASSED last time. When you PASSED, you learned what the others had decided to do on that trial: they had decided NOT to share the joke with you. So, you PASS on this trial. **Press "PASS"**

'PASS' and 'JOIN' buttons appeared at the bottom of the page.

If participants pressed PASS, the following text appeared: "They ***would NOT have shared*** *the joke if you joined them.* ***You were right to avoid them!***"

If participants pressed JOIN, the following text appeared: "Incorrect response. The experiment has not been completed conscientiously." Participants could not proceed with the experiment.

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PAGE 11: PRACTICE TRIAL 6:

You PASSED last time. When you PASSED, you learned what the others had decided to do on that trial: they had decided NOT to share the joke with you again. So, you PASS on this trial again. **Press "PASS"**

'PASS' and 'JOIN' buttons appeared at the bottom of the page.

If participants pressed PASS, the following text appeared: "They would have ***SHARED*** *the joke if you joined them.*"

If participants pressed JOIN, the following text appeared: "Incorrect response. The experiment has not been completed conscientiously." Participants could not proceed with the experiment.

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PAGE 12: PRACTICE TRIAL 7:

You PASSED last time because the others had not been sharing the joke. When you PASSED, you learned what the others had decided to do on that trial: the others had planned to SHARE the joke with you. So, you JOIN this time. **Press "JOIN"**

'PASS' and 'JOIN' buttons appeared at the bottom of the page.

*If participants pressed JOIN, the following text appeared: "They **SHARED** the joke with you!" A joke also appeared on the screen.*

If participants pressed PASS, the following text appeared: "Incorrect response. The experiment has not been completed conscientiously." Participants could not proceed with the experiment.

--
PAGE 13

Great! Now you're ready to play the game with real players online.

Remember: during the real game, you have to respond within 3 seconds, or **YOU WILL NOT EARN MONEY ON THAT TRIAL.**

'PROCEED' button appeared at the bottom of the page.

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PAGE 14

The game will take approximately 30 minutes. Next, there will be a survey. The survey will take approximately **30 minutes**. Total time is approximately **1 hour**. Are you ready to proceed?

'PROCEED' button appeared at the bottom of the page.

Appendix C

1. 0+1
2. 0+2
3. 0+3
4. 0+4
5. 0+5
6. 0+6
7. 0+7
8. 0+8
9. 0+9
10. 1+0
11. 1+1
12. 1+2
13. 1+3
14. 1+4
15. 1+5
16. 1+6
17. 1+7
18. 1+8
19. 2+0
20. 2+1
21. 2+2
22. 2+3

23. 2+4

24. 2+5

25. 2+6

26. 2+7

27. 3+0

28. 3+1

29. 3+2

30. 3+3

31. 3+4

32. 3+5

33. 3+6

34. 4+0

35. 4+1

36. 4+2

37. 4+3

38. 4+4

39. 4+5

40. 5+0

41. 5+1

42. 5+2

43. 5+3

44. 5+4

45. 6+0

46. 6+1

47. 6+2

48. 6+3

49. 7+0

50. 7+1

51. 7+2

52. 8+0

53. 8+1

54. 9+0

55. 1-0

56. 1-1

57. 2-0

58. 2-1

59. 2-2

60. 3-0

61. 3-1

62. 3-2

63. 3-3

64. 4-0

65. 4-1

66. 4-2

67. 4-3

68. 4-4

69. 5-0

70. 5-1

71. 5-2

72. 5-3

73. 5-4

74. 5-5

75. 6-0

76. 6-1

77. 6-2

78. 6-3

79. 6-4

80. 6-5

81. 6-6

82. 7-0

83. 7-1

84. 7-2

85. 7-3

86. 7-4

87. 7-5

88. 7-6

89. 7-7

90. 8-0

91. 8-1

92. 8-2

93. 8-3

94. 8-4

95. 8-5

96. 8-6

97. 8-7

98. 8-8

99. 9-0

100. 9-1

101. 9-2

102. 9-3

103. 9-4

104. 9-5

105. 9-6

106. 9-7

107. 9-8

108. 9-9

Appendix D

Bold titles will not appear in the final version of the questionnaire. *=reverse-scored items.

Demographic Questions

1. What is your age?

Sliding scale: 1-99

2. What gender/sex do you identify with?

Female

Male

Other

I prefer not to answer.

3. What is your race/ethnicity?

American Indian/Alaska Native

Asian

Black/African American

Hawaiian/Pacific Islander

Latinx

White

Other

I prefer not to answer.

4. What is your place of birth (country)?

5. What is the highest level of education you have completed?

Some high school

High school diploma

Some college/vocational training

College degree

Professional or graduate degree

I prefer not to answer.

6. What is your annual household income?

Less than $25,000

$25,000 - $50,000

$50,000 - $100,000

$100,000 - $200,000

More than $200,000

I prefer not to answer.

7. What is your employment status?

Full-time

Part-time

Unemployed but seeking opportunities

Unemployed (not currently seeking opportunities)

Retired

I prefer not to answer.

8. Have you received any clinical diagnoses?

Depression

Social anxiety disorder

Other anxiety disorder

Autism spectrum disorder

Attention deficit/hyperactivity disorder

Other

I prefer not to answer.

9. Are you currently taking any medications? If yes, please list (medication name(s), dose, frequency).

Study Purpose

10. What do you think was the overall purpose of the study you just completed? If you do not know, please feel free to respond, "I don't know." Leave the question blank if you prefer not to answer.

Manipulation Check

11. To what extent were you included by the other players during the game?

Sliding scale: 1=not at all to 9=very much so

Social Anxiety

For each item, please circle the number to indicate the degree to which you feel the statement is characteristic or true for you. The rating scale is as follows:

0=Not at all characteristic or true of me.

1=Slightly characteristic or true of me.

2=Moderately characteristic or true of me.

3=Very characteristic or true of me.

4=Extremely characteristic or true of me.

1. I get nervous if I have to speak with someone in authority (teacher, boss, etc.).
2. I have difficulty making eye contact with others.
3. I become tense if I have to talk about myself or my feelings.

4. I find it difficult to mix comfortably with the people I work with.
5. I tense up if I meet an acquaintance in the street.
6. When mixing socially, I am uncomfortable.
7. I feel tense if I am alone with just one other person.
8. I have difficulty talking with other people.
9. I worry about expressing myself in case I appear awkward.
10. I find it difficult to disagree with another's point of view.
11. I have difficulty talking to attractive persons of the opposite sex.
12. I find myself worrying that I won't know what to say in social situations.
13. I am nervous mixing with people I don't know well.
14. I feel I'll say something embarrassing when talking.
15. When mixing in a group, I find myself worrying I will be ignored.
16. I am tense mixing in a group.
17. I am unsure whether to greet someone I know.

Depression

Please read each statement and indicate a number (0, 1, 2 or 3) representing how much the statement applied to you over the past week. There are no right or wrong answers. Do not spend too much time on any statement.

The rating scale is as follows:

0 =Did not apply to me at all

1 =Applied to me to some degree, or some of the time

2 =Applied to me to a considerable degree or a good part of time

3 =Applied to me very much or most of the time

1. I couldn't seem to experience any positive feeling at all.
2. I found it difficult to work up the initiative to do things.
3. I felt that I had nothing to look forward to.
4. I felt down-hearted and blue.
5. I was unable to become enthusiastic about anything.
6. I felt I wasn't worth much as a person.
7. I felt that life was meaningless.

Rejection Sensitivity

The items below describe situations in which people sometimes ask things of others.

For each item, imagine that you are in the situation, and then answer the questions that follow it.

1. You ask your parents or another family member for a loan to help you through a difficult financial time.
    a. How concerned or anxious would you be over whether or not your family would want to help you?
    b. *I would expect that they would agree to help as much as they can.
2. You approach a close friend to talk after doing or saying something that seriously upset him/her.
    a. How concerned or anxious would you be over whether or not your friend would want to talk with you?
    b. *I would expect that he/she would want to talk with me to try to work things out.
3. You bring up the issue of sexual protection with your significant other and tell him/her how important you think it is.
    a. How concerned or anxious would you be over his/her reaction?

b. *I would expect that he/she would be willing to discuss our possible options without getting defensive.

4. You ask your supervisor for help with a problem you have been having at work.
    a. How concerned or anxious would you be over whether or not the person would want to help you?
    b. *I would expect that he/she would want to try to help me out.
5. After a bitter argument, you call or approach your significant other because you want to make up.
    a. How concerned or anxious would you be over whether or not your significant other would want to make up with you?
    b. *I would expect that he/she would be at least as eager to make up as I would be.
6. You ask your parents or other family members to come to an occasion important to you.
    a. How concerned or anxious would you be over whether or not they would want to come?
    b. *I would expect that they would want to come.
7. At a party, you notice someone on the other side of the room that you'd like to get to know, and you approach him or her to try to start a conversation.
    a. How concerned or anxious would you be over whether or not the person would want to talk with you?
    b. *I would expect that he/she would want to talk with me.
8. Lately you've been noticing some distance between yourself and your significant other, and you ask him/her if there is something wrong.

a. How concerned or anxious would you be over whether or not he/she still loves you and wants to be with you?

b. *I would expect that he/she will show sincere love and commitment to our relationship no matter what else may be going on.

9. You call a friend when there is something on your mind that you feel you really need to talk about

a. How concerned or anxious would you be over whether or not your friend would want to listen?

b. *I would expect that he/she would listen and support me.

Need Threat

*1. I felt poorly accepted by the other ~~participants~~ players.

2. I felt as though I had made a "connection" or bonded with one or more of the ~~participants~~ players during the ~~Cyberball~~ game.

*3. I felt like an outsider during the ~~Cyberball~~ game.

4. I felt that I was able to ~~throw the ball~~ see jokes with others as often as I wanted during the game.

*5. I felt somewhat frustrated during the ~~Cyberball~~ game.

6. I felt in control during the ~~Cyberball~~ game.

7. During the ~~Cyberball~~ game, I felt good about myself.

*8. I felt that the other ~~participants~~ players failed to perceive me as a worthy and likeable person.

*9. I felt somewhat inadequate during the ~~Cyberball~~ game.

10. I felt my ~~performance [e.g., catching the ball, deciding whom to throw the ball to]~~ choices had some effect on the direction of the game.

*11. I felt non-existent during the ~~Cyberball~~ game.

*12. I felt as though my existence was meaningless during the ~~Cyberball~~ game

Background Social Support

1. I have close relationships that provide me with a sense of emotional security and well-being.
2. There is someone I could talk to about important decisions in my life.
3. I have relationships where my competence and skills are recognized.
4. I feel part of a group of people who share my attitudes and beliefs.
5. There are people I can count on in an emergency.

Appendix E

Summary of Procedural Differences Across Pilot Experiments

Each pilot experiment included ~20 participants recruited via Prolific. Participants had a Prolific approval rating of ≥95% and were currently living in the United States. All aspects of the procedure were identical to Experiment 1 with several exceptions. First, each pilot experiment included only two phases, and extinction was never arranged; responding was evaluated only with respect to the initial contingency reversal. Second, some pilot experiments included no practice trials (Appendix B) and/or probabilistic outcomes (Pilot Experiments 1-3). In the latter case, the probability of exclusion for JOIN responses was .75 in Phase 1 and .1 in Phase 2. Finally, instead of arranging explicit feedback regarding other players' decision contingent upon a PASS response (Figures 2A, 2B), some pilot experiments presented neutral feedback: "You passed and will not find out whether they shared the joke." (Pilot Experiments 2-4).

Summary of Procedures in Each Pilot Experiment

Procedural elements changed from the preceding experiment are shown in bold.

Pilot Experiment 1

- *No practice trials, probabilistic outcomes, and neutral feedback for PASS responses*

Pilot Experiment 2

- *No practice trials, probabilistic outcomes, and* ***explicit feedback for PASS responses***

Pilot Experiment 3

- ***Practice trials****, probabilistic outcomes, and explicit feedback for PASS responses*

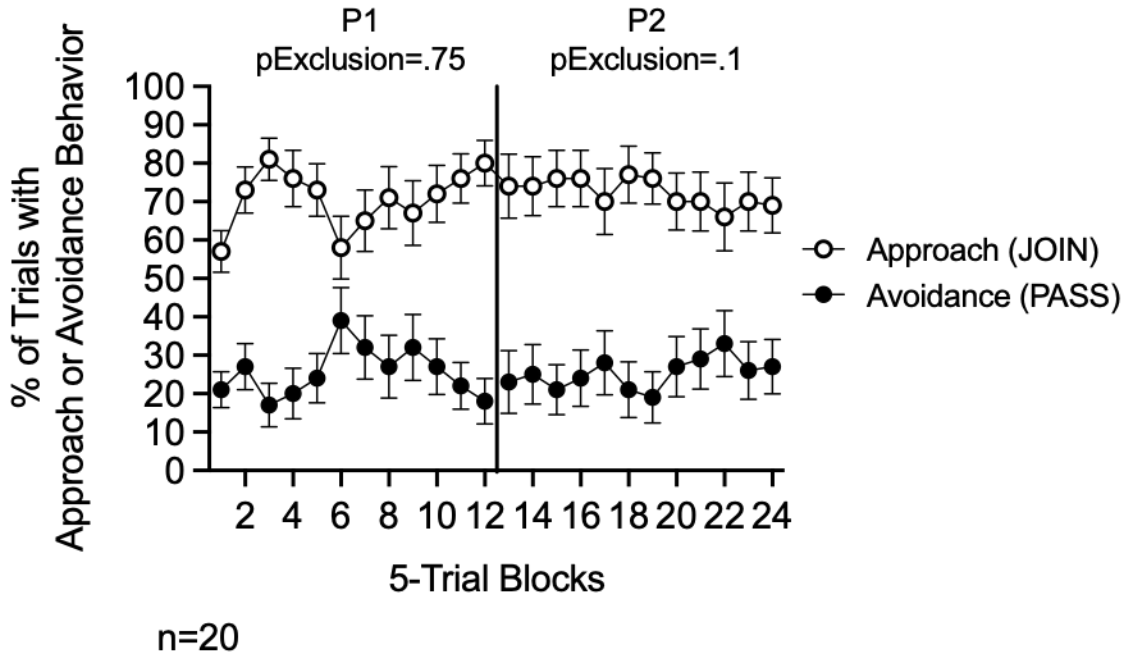
Pilot Experiment 4

- *Practice trials,* ***non-probabilistic outcomes****, and explicit feedback for PASS responses*

Results

Figure E1

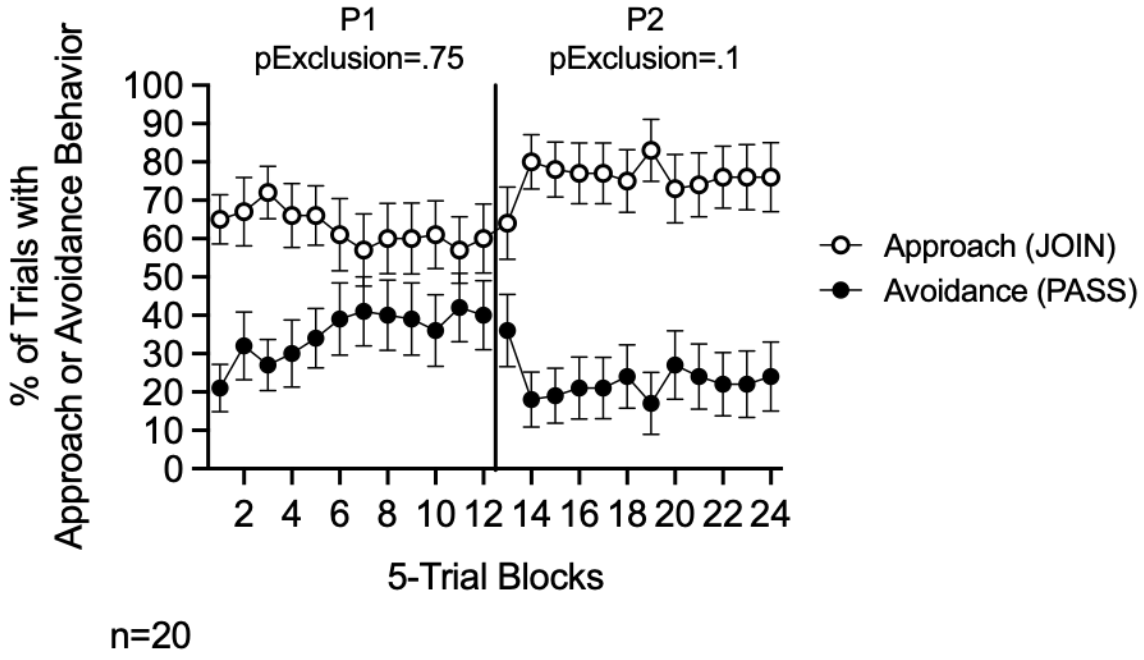
Results of Pilot Experiment 1



Note. pExclusion=probability of exclusion; P1=Phase 1, P2=Phase 2. In Pilot Experiment 1, there were **no practice trials** before beginning the experiment. Outcomes for JOIN were arranged **probabilistically. No feedback was provided about other players' decision** contingent upon avoidance ("You passed and will not find out whether they shared the joke.")

Figure E2

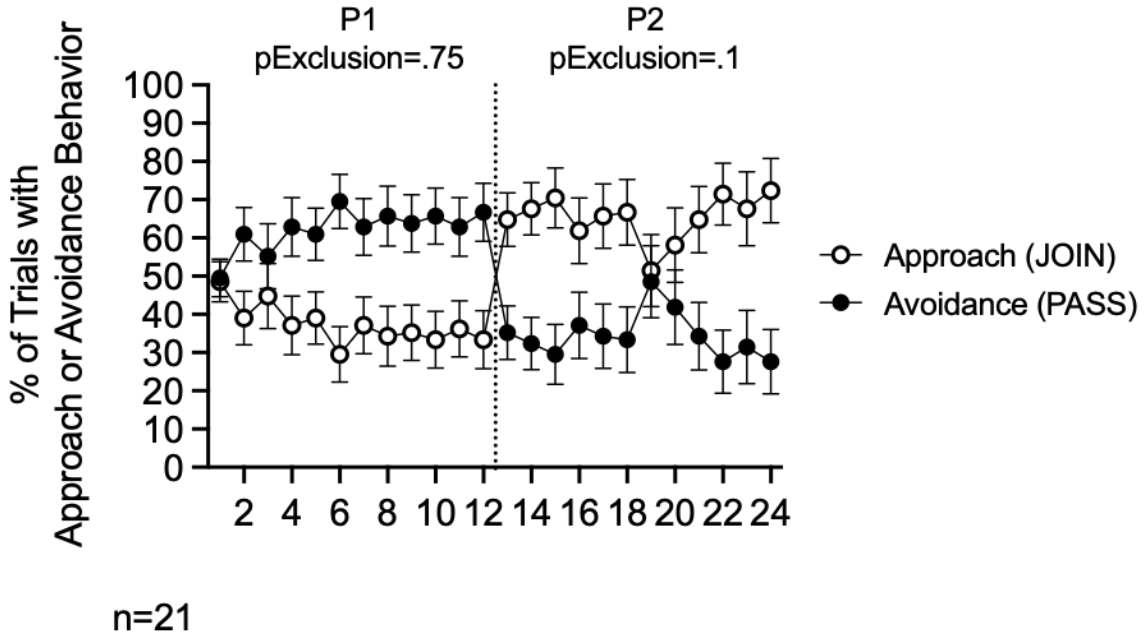
Results of Pilot Experiment 2



Note. pExclusion=probability of exclusion; P1=Phase 1, P2=Phase 2. In Pilot Experiment 2, there were **no practice trials** before beginning the experiment. Outcomes for JOIN were arranged **probabilistically. Explicit feedback was provided about the other players' decision** contingent upon avoidance (see Figures 2A, 2B; cf. Pilot Experiment 1).

Figure E3

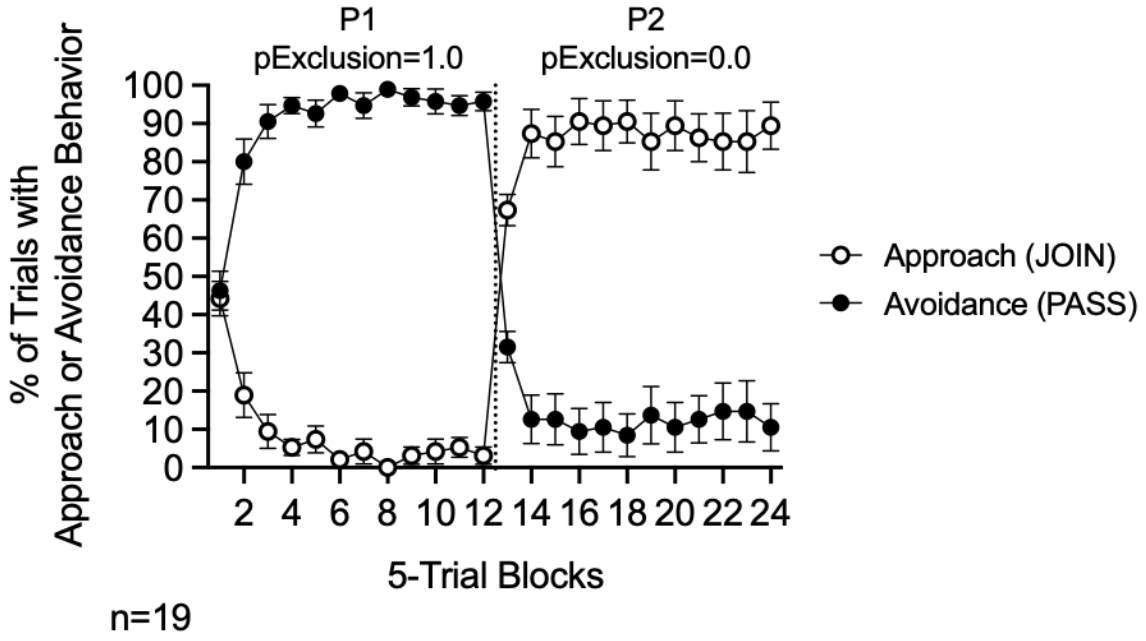
Results of Pilot Experiment 3



Note. pExclusion=probability of exclusion; P1=Phase 1, P2=Phase 2. In Pilot Experiment 3, we included **practice trials** before beginning the experiment (cf. Pilot Experiments 1-2). Outcomes for JOIN were arranged **probabilistically. Explicit feedback was provided about the other players' decision** contingent upon avoidance (see Figures 2A, 2B; cf. Pilot Experiment 1).

Figure E4

Results of Pilot Experiment 4



Note. pExclusion=probability of exclusion; P1=Phase 1, P2=Phase 2. In Pilot Experiment 4, we included **practice trials** before beginning the experiment (cf. Pilot Experiments 1-2). Outcomes for JOIN were **not arranged probabilistically** (cf. Pilot Experiments 1-3)**. Explicit feedback was provided about the other players' decision** contingent upon avoidance (see Figures 2A, 2B; cf. Pilot Experiment 1).

Appendix F

Table F1

Results of Mixed-Effects Regression Examining the Influence of Group, Phase, and Trial on Choice in Experiment 1

Fixed effect	Estimate (SE)	Odds Ratio	Probability	*z*	*p*
Intercept	2.27 (0.45)	9.67	0.91	5.06	<.001***
Trial	-0.05 (0.01)	0.95	0.49	-6.62	<.001***
Phase (1)	-2.54 (0.46)	0.08	0.07	-5.51	<.001***
Phase (3)	-0.96 (1.00)	0.38	0.28	-0.96	.339
Group (Ext)	1.01 (0.67)	2.75	0.73	1.52	.129
Group (High)	-1.97 (0.60)	0.14	0.12	-3.26	.001**
Group (Low)	-0.52 (0.62)	0.60	0.37	-0.83	.405
Trial * Phase (1)	0.25 (0.03)	1.28	0.56	8.13	<.001***
Trial * Phase (3)	-0.42 (0.21)	0.66	0.40	-1.98	.048*
Trial * Group (Ext)	-0.01 (0.01)	0.99	0.50	-1.15	.250
Trial * Group (High)	0.03 (0.01)	1.03	0.51	3.01	.003**
Trial * Group (Low)	0.01 (0.01)	1.01	0.50	0.84	.404
Phase (1) * Group (Ext)	-0.76 (0.69)	0.47	0.32	-1.12	.265
Phase (3) * Group (Ext)	-6.75 (1.31)	1.17E-3	1.17E-3	-5.16	<.001***
Phase (1) * Group (High)	2.30 (0.62)	9.98	0.91	3.69	<.001***
Phase (3) * Group (High)	1.18 (1.17)	3.25	0.76	1.01	.314
Phase (1) * Group (Low)	0.67 (0.64)	1.96	0.66	1.05	.292
Phase (3) * Group (Low)	-0.43 (1.27)	0.65	0.39	-0.34	.732
Trial * Phase (1) * Group (Ext)	-0.01 (0.04)	0.99	0.50	-0.33	.744
Trial * Phase (3) * Group (Ext)	0.65 (0.26)	1.92	0.66	2.52	.012*
Trial * Phase (1) * Group (High)	-0.06 (0.04)	0.94	0.49	-1.32	.188
Trial * Phase (3) * Group (High)	0.55 (0.26)	1.74	0.64	2.15	.032*
Trial * Phase (1) * Group (Low)	-0.02 (0.04)	0.98	0.49	-0.51	.611
Trial * Phase (3) * Group (Low)	0.40 (0.27)	1.49	0.60	1.45	.148

Note. ***p<.001; **p<.01; *p<.05.

Table F2

Results of Mixed-Effects Regression Examining the Influence of Group, Phase, and Trial on Choice in Experiment 2

Fixed effect	Estimate (SE)	Odds Ratio	Probability	*z*	*p*
Intercept	-0.73 (0.41)	0.48	0.32	-1.80	.072
Trial	0.03 (0.01)	1.03	0.51	4.36	<.001***
Phase (1)	0.76 (0.46)	2.13	0.68	1.66	.097
Phase (3)	3.23 (0.87)	25.30	0.96	3.71	<.001***
Group (None)	1.56 (0.62)	4.76	0.83	2.53	.011*
Group (High)	1.36 (0.57)	3.90	0.80	2.41	.016*
Group (Low)	1.65 (0.55)	5.19	0.84	2.97	.003**
Trial * Phase (1)	0.10 (0.03)	1.10	0.52	3.54	<.001***
Trial * Phase (3)	-0.03 (0.01)	0.97	0.49	-3.52	<.001***
Trial * Group (None)	-0.05 (0.01)	0.95	0.49	-4.88	<.001***
Trial * Group (High)	0.04 (0.01)	0.96	0.49	-3.93	<.001***
Trial * Group (Low)	-0.06 (0.01)	0.94	0.48	-5.98	<.001***
Phase (1) * Group (None)	-2.04 (0.68)	0.13	0.11	-2.99	.003**
Phase (3) * Group (None)	-4.45 (1.21)	1.17E-2	1.15E-2	-3.68	<.001***
Phase (1) * Group (High)	-1.25 (0.64)	0.29	0.22	-1.96	.050
Phase (3) * Group (High)	-8.66 (1.25)	1.74E-4	1.74E-4	-6.91	<.001***
Phase (1) * Group (Low)	-1.98 (0.62)	0.14	0.12	-3.18	.001**
Phase (3) * Group (Low)	-12.13 (1.18)	5.41E-6	5.41E-6	-10.28	<.001***
Trial * Phase (1) * Group (None)	0.11 (0.04)	1.11	0.53	2.59	.010**
Trial * Phase (3) * Group (None)	0.06 (0.01)	1.07	0.52	5.66	<.001***
Trial * Phase (1) * Group (High)	0.05 (0.04)	1.05	0.51	1.14	.256
Trial * Phase (3) * Group (High)	0.08 (0.01)	1.08	0.52	6.73	<.001***
Trial * Phase (1) * Group (Low)	0.05 (0.04)	1.05	0.51	1.15	.251
Trial * Phase (3) * Group (Low)	0.11 (0.01)	1.12	0.53	10.74	<.001***

Note. ***p<.001; **p<.01; *p<.05.

Appendix G

Groups Low experienced availability of social reinforcement versus extinction on 40 of 60 Phase-2 trials. Group None experienced continuous availability of social reinforcement in Phase 2. However, Group Low demonstrated less avoidance than None by the end of Phase 2 (e.g., Figure 5, Trial Blocks 24). With respect to JOIN responses, this suggests that intermittent reinforcement for JOIN resulted in *more* choices of JOIN over PASS relative to continuous reinforcement. Thus, we examined whether these differences between Low and None might have occurred due to a disproportionately high number of participants demonstrating insensitivity to the arranged contingencies in Group None. To test this possibility, we revised exclusion criteria as follows: rather than removing data sets with only one type of response across all 180 trials (e.g., Zabag et al., 2022), we removed data sets with only one type of response for the last 121 trials (beginning with the last Phase-1 trial). For example, this less stringent criterion would remove data from participants who showed some variability in their choices in Phase 1, but never deviated from avoidance after Phase 1[2]. The revised exclusion criterion resulted in removal of nine additional data sets, including four each in Groups None and Low, and one in Group High. Figure G1 shows the results as a revised version of Figure 5, and Table G1 shows revised mean percentages with avoidance in the last 5-trial block of Phase 2. No additional data sets were removed from Group Low (*M*=20.48, *SEM*=4.98). Relative to Group Low, the mean percentage of trials with avoidance was higher in Group None with (*M*=30, *SEM*=7.10) and without the revised criteria (*M*=37, *SEM*=7.22). Overall, this suggests that the difference among groups was not solely a function of the distribution of participants who were insensitive to the contingencies.

[2] This was for exploratory purposes; however, in practice, we prefer removing data based on the more conservative criteria proposed used by Zabag et al. (2022). Although not the case here, an exclusion criterion based on performance in Phase 2 might leave some groups more susceptible to exclusion than others (e.g., Ext versus None).

Table G1

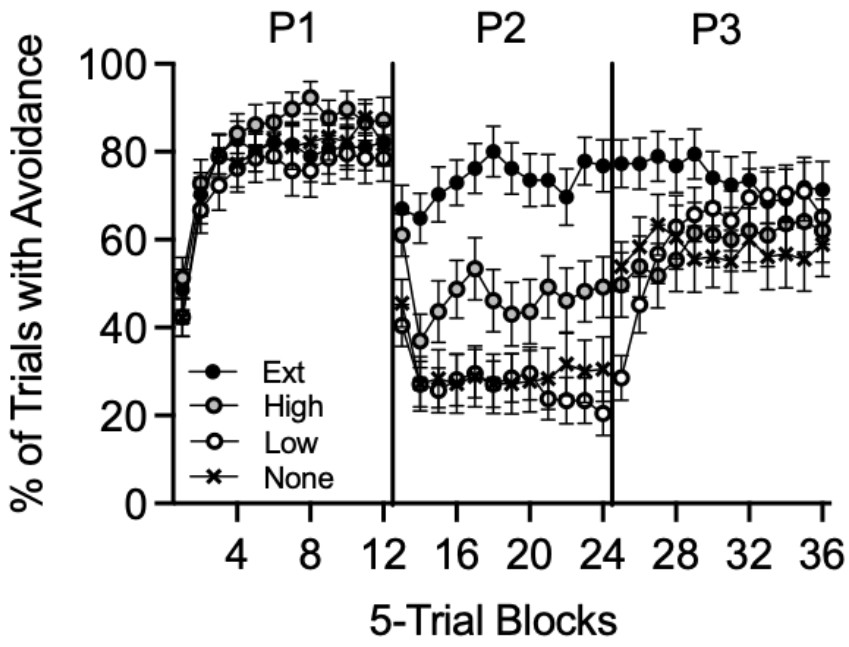
Mean Percentage of Avoidance Responses in the Last 5-Trial Block of Phase 2: Comparison of Two Exclusion Criteria

Group	Original Exclusion Criteria		Revised Criteria	
	n	Mean (SEM)	n (Number of Additional Exclusions)	Mean (SEM)
None	40	37.00 (7.22)	36 (4)	30.00 (7.10)
Low	42	20.48 (4.98)	42 (0)	20.48 (4.98)
High	40	49.50 (6.91)	39 (1)	48.21 (6.96)
Ext	41	80.00 (4.99)	37 (4)	77.84 (5.14)

Note. Original Exclusion Criteria: 1. Only one type of response (JOIN or PASS) across all 180 trials. 2. Missing responses – i.e., no responses on 30 or more trials or no survey data. Total exclusions=15 (8.4%). Revised Criteria: Includes original criteria and a revision to #1: only one type of response (JOIN or PASS) across the last **120** trials (i.e., beginning in Phase 2). Total exclusions=24 (13.5%).

Figure G1

Revision of Figure 5 with New Exclusion Criteria



Note. The figure shows mean percentage of 5-trial blocks with avoidance (PASS). P1=Phase 1; P2=Phase 2; P3=Phase 3. An additional nine data sets were removed relative to Figure 5: four each from Groups None and Ext, and one from Group High. We removed data with only one type of response (JOIN or PASS) across the last 120 (versus all 180) trials.