The Effect of Valence Information from Social Behaviors on Attentional Capture: An Exploration Based on Helping and Hindering Behaviors

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Abstract

Employing a learning-test dual-task paradigm, this study investigated the influence of valence information of social behaviors on attentional capture through three experiments. In the learning phase, participants observed helping behaviors with positive valence (one agent helping another agent climb a mountain) and hindering behaviors with negative valence (one agent hindering another agent climbing a mountain), as well as non-social behaviors matched with their respective motion characteristics, for the purpose of establishing associative relationships between different agent colors and social behavior valence information. In the test phase, the attentional capture effects of colors for actors (helpers and hinderers) and recipients (those being helped and being hindered) in social behaviors were examined separately. Results revealed that in negative social behaviors, both actor and recipient colors were more likely to capture attention, whereas positive social behavior valence information did not alter the attentional capture effect of associated features; moreover, compared to recipients, the attentional capture effect for actor colors associated with negative social behavior valence was stronger. These results suggest that there exists attentional capture driven by negative social behavior valence, and that negative valence information establishes associations with features of all individuals involved in the social behavior, but within this association, the physical features of actors possess higher attentional priority. This finding implies that reputation information and holistic representation of social interaction behaviors may jointly influence attentional selection of social interaction events.

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Influence of Valence Information from Social Actions on Attentional Capture: An Investigation Based on Helping and Hindering Behaviors

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Abstract

This study employed a training-testing paradigm across three experiments to investigate how the valence of social actions influences attentional capture. During the learning phase, participants observed videos depicting positive-valence helping actions (one agent helping another climb a hill) and negative-valence hindering actions (one agent hindering another' s climb), as well as non-social interaction controls matched for motion characteristics, with the aim of establishing associations between agent colors and social action valence information. The testing phase then examined attentional capture effects for colors associated with actors (helpers and hinderers) and recipients (those helped and hindered). Results revealed that colors associated with negative social actions—both for actors and recipients—more readily captured attention, whereas positive social action valence did not alter the attentional capture effect of associated features. Moreover, the attentional capture effect was stronger for actor colors than recipient colors when associated with negative social action valence. These findings suggest that attentional capture driven by negative social action valence exists, and that negative valence information forms associations with features of all individuals involved in the social action, though the actor' s physical features receive higher attentional priority within this association. This discovery implies that reputation information and holistic representations of social interactions may jointly influence attentional selection of social interaction events.

Keywords: attentional capture; social behavior; valence; helping; hindering

1 Introduction

Humans constantly face vast amounts of information from the external world, yet cognitive resources are limited, preventing deep processing of all incoming stimuli (Lavie, 2005). Consequently, the brain has evolved attentional mechanisms that select certain stimuli for deeper cognitive processing while reducing resource allocation to others, enabling flexible use of environmental information for better adaptation (Desimone & Duncan, 1995; Reynolds, Chelazzi, &

Desimone, 1999). How, then, does attention select among external information?

Two classic theories have emerged regarding attentional selection: goal-driven and salience-driven attention (Connor, Egeth, & Yantis, 2004; Egeth & Yantis, 1997; Posner, 1980). Goal-driven selection emphasizes how current task goals influence selection priority, such that task-relevant stimuli more readily capture attention. For instance, Folk, Remington, and Johnston (1992) employed a spatial cueing paradigm and found that even invalid spatial cues matching target features could capture attention. In contrast, salience-driven theory posits that environmental stimuli command attentional resources based on their physical features (Leber, 2010). Research has shown that physically salient non-target stimuli capture attention during visual search, interfering with target responses and prolonging reaction times (Theeuwes, 1994, 2010; Yantis & Jonides, 1984).

Recent research has demonstrated that stimulus value plays a crucial role in attentional selection (see review, Anderson, 2016a). Not only does search performance for task-relevant items depend on their value, but the attentional priority of task-irrelevant, non-salient stimuli is also influenced by their value —an effect that cannot be explained by goal-driven or salience-driven theories, termed value-driven attentional capture. Anderson, Laurent, and Yantis (2011) used a dual-task paradigm where, during training, different monetary rewards were assigned to correct responses for specific colors, establishing associations between colors and reward values. During testing, reward-associated features appeared as task-irrelevant distractors alongside targets in a visual search task (see Figure 1 [Figure 1: see original paper]). Results showed these reward-associated distractors captured attention, with higher reward values producing stronger interference. Further research revealed that simply providing reward feedback during training could not produce value-driven attentional capture; only when stimulus features predicted reward value did capture occur (Sali, Anderson, & Yantis, 2014). Subsequent studies found that reward associations modulate attentional priority in a context-dependent manner. For example, Anderson (2015) used task-irrelevant background images during training and testing, finding value-driven attentional capture only when background contexts matched between phases. These effects emerge even with minimal training trials (Anderson et al., 2011; Anderson, Laurent, & Yantis, 2012; Sali et al., 2014), and once formed, persist for weeks without reinforcement (Anderson et al., 2011). Additionally, both positive value associations formed through monetary reward and negative value associations formed through monetary punishment can capture attention (Wentura, Muller, & Rothermund, 2014).

Value-driven attentional capture is thought to arise because stimulus value information critically determines survival, making high-value stimuli more likely to capture attention (Anderson, 2013). While value information includes monetary rewards, humans encounter numerous social rewards in daily life. Some studies have begun examining how social rewards influence attentional selection (Anderson, 2016b; Anderson, 2017). Using the same experimental framework, Anderson (2016b) presented genuine smiling faces as rewards for correct responses during training, finding that distractors associated with high social reward captured more attention during testing. Subsequently, Anderson (2017) used genuine angry faces to investigate negative social feedback, finding that distractors associated with negative social feedback also became more likely to capture attention.

In these studies, participants learned stimulus value through direct experience. However, beyond direct learning, people can also acquire knowledge about stimuli by observing others' outcomes, adjusting their own future responses accordingly (Rendell et al., 2010). Observational learning is widespread in nature. For example, rhesus monkeys rapidly acquire fear responses to snakes after observing conspecifics' fearful reactions (Mineka & Ohman, 2002), and humans similarly learn fear responses through observation (Olsson, Nearing, & Phelps, 2007). This learning mode helps observers avoid negative consequences from personal trial-and-error while efficiently acquiring behavior that maximizes benefits (Frith & Frith, 2012). As social animals, humans constantly observe interpersonal interactions to obtain others' social valence information (Earley, 2010; Milinski, 2016)—whether social actions are positive (good) or negative (bad). For instance, someone who helps others is judged as friendlier, influencing decisions about interacting with them. Does such social action valence information influence attentional selection?

Although social action valence is not reward itself, it determines the social reward value of observed agents. By observing others' behavior in social interactions, people form reputation representations (Milinski, 2016; Milinski, Semmann, Bakker, & Krambeck, 2001; Wedekind & Milinski, 2000). More positive social actions lead to higher reputation, and people adjust their interaction decisions based on others' reputations (see review, Milinski, 2016). In indirect reciprocity investment games, individuals who invest more receive more investments from others (Milinski et al., 2001; Semmann, Krambeck, & Milinski, 2005; Wedekind & Milinski, 2000). Importantly, individuals performing negative social actions damage their reputation and receive third-party punishment (Fehr & Fischbacher, 2004; Kurzban, DeScioli, & O' Brien, 2007; Liu, Li, Zheng, & Guo, 2017). Thus, positive actors may yield greater long-term benefits, while negative actors incur punishment. From an observer' s perspective, high reputation suggests cooperative tendencies and likely personal benefit, whereas interacting with low-reputation individuals risks loss (Milinski, 2016).

While observing social behavior provides crucial valence information for social decision-making, no research has examined whether valence information acquired through observational learning influences attentional selection. Social action valence can be positive or negative, and whether these differentially affect attentional selection—whether both can capture attention—remains an open question. Although studies using monetary rewards and punishments found that stimuli associated with equally valenced positive and negative values both captured attention comparably (Wentura et al., 2014), research on observational learning of social behavior suggests a negativity bias: people attend more to negative than positive stimuli, forming more complex cognitive representations (Baumeister, Bratslavsky, Finkenauer, & Vohs, 2001; Rozin & Royzman, 2001). Researchers attribute negativity bias to positive events being more common, shifting the evaluative baseline toward positivity and enhancing the salience of negative events (Rozin & Royzman, 2001). Negative interactions pose greater threats and elicit more sensitive perception (Baumeister et al., 2001; Rozin & Royzman, 2001). Based on this, we predicted that negative-valence social actions would capture attention more readily than positive-valence actions. Since social actions involve both an actor and a recipient, we examined whether valence-associated stimuli properties linked to specific individuals or to all individuals involved. Recent evidence suggests that components of social actions are often selected, processed, and stored as integrated units (Ding, Gao, & Shen, 2017; Yin, Xu, Duan, & Shen, 2018). Therefore, when processing social action valence, associations may form at the holistic action level with all involved individuals, causing features of both actors and recipients to capture attention.

To address these questions, we used helping and hindering actions—commonly employed to manipulate positive and negative social valence (Camilleri, Kuhlmeier, & Chu, 2010; Hamlin, 2015; Hamlin, Wynn, & Bloom, 2007)—across three experiments to investigate how social action valence influences attentional capture. Experiment 1 examined whether actor colors associated with positive and negative social action valence show altered attentional capture effects and tested for negativity bias. Following Anderson et al. (2011), each experiment comprised a learning phase establishing associations between actor colors and social action valence through video observation, and a testing phase using visual search to assess attentional capture by valence-associated distractors. Experiment 2 tested recipient color attentional capture to determine whether valence forms associations with recipients. Experiment 3 simultaneously examined actor and recipient color capture in negative social actions to compare their effects and explore whether attentional priority differs between individuals in the interaction.

Experiment 1

Experiment 1 investigated whether actor colors' attentional capture effects are influenced by action valence after observational learning establishes associations between social action valence information and actor colors. During learning, participants watched cartoon climbing videos to learn the social action valence of different colored characters (establishing associations between character colors and social action valence). The test phase used a visual search task where distractors contained actor color features. If attentional capture effects differ across social action conditions, this would indicate that social action valence information can influence attentional capture.

Participants

Twenty-seven university students voluntarily participated. Three were excluded for failing to meet accuracy criteria (see Results), leaving 24 valid participants (11 male, 13 female) aged 17-21 years ($M = 19.42$, $SD = 0.93$) with normal or corrected vision and no color blindness. Participants received 20 RMB compensation. Sample size was determined using GPower 3.0.10, setting alpha at 0.05, power at 0.80, and effect size at Cohen' s (1988) medium level of $f = 0.25$ (Cohen' s $d = 0.50$; 2p = 0.15), yielding a planned sample size of approximately 24, consistent with Anderson et al. (2011).

Materials

Experimental stimuli were created using 3D animation software Blender 2.78a, adapted from videos used by Hamlin et al. (2007) to manipulate different social actions. Four 12-second videos depicted different interactions, all containing identical basic elements: a hill with three platforms (low, medium, high) and two eyed, differently colored circular cartoon characters (see Figure 2 [Figure 2: see original paper]). The initial animation sequence was identical across videos: a red character successfully climbed to the middle platform, celebrated with side-to-side swaying, then attempted twice to reach the highest platform but failed, returning to the middle platform. The four videos differed in their depicted interactions:

1. **Valid Helping**: A differently colored character appeared on the lowest platform, moved upward, pushed the red character from the middle to the highest platform, then returned to its starting position.
2. **Valid Hindering**: A differently colored character appeared on the highest platform, moved downward, pushed the red character from the middle to the lowest platform, then returned to its starting position.
3. **Invalid Helping**: After waiting (duration matched the valid helping condition), the red character successfully climbed to the highest platform on its own. Meanwhile, a differently colored character appeared on the lowest platform, moved upward, replicating the helper' s trajectory from the valid helping condition, then returned to its starting position. Thus, both characters' movements matched the valid helping event but were temporally desynchronized, eliminating substantive helping. This controlled for potential low-level motion confounds.
4. **Invalid Hindering**: Created using the same logic as (3) to control for motion information in the valid hindering condition. After waiting (duration matched the valid hindering condition), the red character moved to the lowest platform. Meanwhile, a differently colored character appeared on the highest platform, moved downward, replicating the hinderer' s trajectory from the valid hindering condition, then returned to its starting position.

In these videos, the first character appearing was the recipient (always red), and the later-appearing character was the actor, with different colors across video types. To control for potential effects of physical color differences, colors were counterbalanced across participants, creating four video versions with color combinations shown in Table 1 .

Validity Check of Experimental Materials To verify the effectiveness of our social action valence manipulation, 30 undergraduates watched the four videos from one version and rated the valence of the actions. Specifically, participants rated "How do you evaluate the behavior of the [color] character?" on a 7-point scale from "very negative" (-3) to "very positive" (3). A 2 (action type: helping vs. hindering) $\times$ 2 (interaction: present vs. absent) repeated-measures ANOVA on valence ratings revealed a significant main effect of action type, F(1, 29) = 53.82, $p < 0.001$, 2p = 0.65, with helping actions (M = 1.30, SD = 1.45) rated more positively than hindering actions (M = -0.58, SD = 1.92). The main effect of interaction was not significant, F(1, 29) < 1. The interaction was significant, F(1, 29) = 70.53, $p < 0.001$, 2 = 0.71. Simple effects analysis showed that valence ratings for valid helping (M = 2.30, SD = 0.92) were significantly higher than for invalid helping (M = 0.30, SD = 1.18), t(29) = 8.18, $p < 0.001$, Cohen' s d = 1.49. Conversely, valence ratings for valid hindering (M = -1.67, SD = 1.79) were significantly lower than for invalid hindering (M = 0.5, SD = 1.38), t(29) = 5.29, $p < 0.001$, Cohen' s d = 0.96. Comparisons with zero (using FDR correction) showed that valid helping and valid hindering ratings differed significantly from zero (ps < 0.001), while their respective control conditions did not (ps > 0.075), as shown in Figure 3 [Figure 3: see original paper]. These results confirm that our video materials effectively manipulated social action valence and were suitable for formal experiments.

Procedure

The experiment comprised learning and testing phases. The learning phase required participants to watch videos of different social interactions to learn associations between colors and social valence. The testing phase used a visual search task to detect attentional capture by valence-associated distractors. All procedures were programmed in PsychoPy 1.84.1.

Learning Phase Four videos (one from each condition) were presented as a set in random order, with participants instructed to watch and memorize the content. After all four videos played, a mountain scene image appeared. This image was either a frame from the memorized videos (original) or a frame with the two characters' colors swapped (novel). Participants judged whether the scene had appeared in the memorized videos ("appeared" meant identical to a moment in the videos). Participants pressed "Y" for "appeared" and "N" for "not appeared," after which the image disappeared. This process repeated 12 times for the four videos in each version. Across all 12 recognition trials, half were original images and half were novel images.

After practice and confirming task comprehension, the formal experiment began. This phase lasted approximately 15 minutes.

Testing Phase The visual search task used an additional singleton paradigm. Each trial began with a central fixation cross (400-600 ms), followed by the search display. Six shapes appeared at six equally spaced positions on a virtual circle (radius = 5° visual angle) centered on the screen. One shape was a form singleton: in half of trials it was a diamond among circles, and in the other half, a circle among diamonds. The form singleton was the search target; the remaining shapes were distractors. The target contained a horizontal or vertical line, while distractors contained lines tilted 45° left or right. Participants located the target as quickly as possible and responded according to the line orientation: press "z" for horizontal, "m" for vertical. The search display lasted 1500 ms or until response, followed by feedback. Incorrect responses elicited a central "Error" message (1000 ms); no response within the time limit triggered a 1000 Hz tone (500 ms); correct responses advanced directly to the next trial. After feedback, a blank screen appeared (500 ms) before the next trial began. The procedure is illustrated in Figure 4 [Figure 4: see original paper].

All stimuli appeared on a gray background (RGB: 128, 128, 128). There were 320 total trials. In half (160 trials), the target and all distractors were white (RGB: 255, 255, 255), called no-singleton trials. In the other half (160 trials), one distractor had a color from the learning phase actor colors (yellow: RGB: 255, 255, 0; cyan: RGB: 0, 255, 255; green: RGB: 0, 255, 0; or purple: RGB: 170, 0, 255), with remaining distractors white—these were additional-singleton trials. Among the 160 additional-singleton trials, each of the four colors appeared 40 times. Target shape, target location, singleton location, target line orientation, and distractor line orientations were randomized. In additional-singleton trials, a 2 (action type: helping vs. hindering) × 2 (interaction: present vs. absent) fully within-subjects design was formed based on the association between singleton color and social action valence from the learning phase. Participants practiced extensively before the formal experiment, with brief breaks every 64 trials. This phase lasted approximately 15 minutes.

Results

Learning Phase Two participants were excluded for recognition accuracy below 10 correct trials (based on pilot data showing most participants scored around 11; scores below 10 indicated insufficient engagement). The remaining participants averaged 11.33 correct trials (SD = 0.82).

A Friedman non-parametric test compared correct recognition trials across the four video types, finding no significant differences, $^2(3) = 6.32$, $p = 0.10$. This indicates equivalent learning across video types, so search performance differences cannot be attributed to differential learning.

Testing Phase One participant was excluded for error rates exceeding 20% (pilot data showed error rates around 10%; rates above 20% indicated insufficient engagement). The remaining 24 participants had an overall mean error rate of 7.60% (SD = 3.54%).

Prior to analyzing reaction times (RTs), we retained correct-response trials and, following Anderson et al. (2011), excluded RTs beyond three standard deviations from each participant' s condition mean. This removed 0.72% of data.

First, we combined the valid helping, invalid helping, valid hindering, and invalid hindering conditions into an additional-singleton condition and compared it to the no-singleton condition to test whether singletons interfered with search—i.e., attentional capture. RTs were significantly longer in the additional-singleton condition (M = 835 ms, SD = 77 ms) than in the no-singleton condition (M = 771 ms, SD = 79 ms), $t(23) = 10.61$, $p < 0.001$, Cohen' s $d = 2.17$, confirming attentional capture and permitting further analysis of social valence effects.

To examine how different social action valence information affected attentional capture, we conducted a 2 (action type: helping vs. hindering) × 2 (interaction: present vs. absent) repeated-measures ANOVA on additional-singleton trial RTs. The main effect of action type was not significant, $F(1, 23) < 1$. The main effect of interaction was marginally significant, $F(1, 23) = 4.18$, $p = 0.053$, 2p = 0.15, with slower target judgments when singleton colors were associated with actors in interactions (M = 842 ms, SD = 88 ms) versus actors without interactions (M = 828 ms, SD = 77 ms), indicating stronger attentional capture in the former. The interaction was significant, $F(1, 23) = 5.69$, $p = 0.026$, 2p = 0.20. Simple effects analysis revealed no significant RT difference between colors associated with valid helping actors (M = 830 ms, SD = 91 ms) and invalid helping actors (M = 833 ms, SD = 80 ms), $t(23) = 0.32$, $p = 0.753$, Cohen' s $d = 0.07$. However, colors associated with valid hindering actors (M = 853 ms, SD = 84 ms) produced significantly slower RTs than colors associated with invalid hindering actors (M = 822 ms, SD = 75 ms), $t(23) = 3.05$, $p = 0.006$, Cohen' s $d = 0.621$. This indicates that when singleton colors were associated with negative social action valence (hindering), they produced stronger interference —greater attentional capture—an effect not attributable to differential learning across conditions. Condition RTs are shown in Figure 5 [Figure 5: see original paper].

We performed identical analyses on error rates. Combining the four conditions into an additional-singleton condition revealed significantly higher error rates (M = 8.57%, SD = 4.67%) than in the no-singleton condition (M = 6.64%, SD = 3.06%), $t(23) = 2.71$, $p = 0.012$, Cohen' s $d = 0.55$, confirming singleton interference. A 2 × 2 repeated-measures ANOVA on additional-singleton error rates showed no significant main effects or interaction, $Fs(1, 23) < 1$. Thus, no speed-accuracy trade-off existed.

Discussion

Experiment 1 demonstrated the classic additional-singleton effect: physically salient, task-irrelevant distractors captured attention, increasing search RTs and error rates. Critically, despite equivalent learning across the four video types, attentional capture by additional singletons changed after forming associations with different social action valence information. Specifically, attentional capture was significantly enhanced for features associated with negative social actions, while no significant change occurred for positive social action associations. These results indicate that through observational learning, social action valence information can form associations with actors' physical features and alter those features' attention-capturing potency, with this change appearing only for negative social actions. This suggests a negativity bias in how social action valence influences attentional capture.

Experiment 2

Experiment 1 showed that after observational learning, negative social action information formed effective associations with actor colors, enhancing their attentional capture. Experiment 2 swapped the actor and recipient roles in the videos to test whether recipient colors showed similar attentional capture effects. If recipient color capture effects changed consistently, this would suggest that social action valence information forms associations with all individuals involved in the social action.

Participants

Thirty university students voluntarily participated. Six were excluded for failing to meet accuracy criteria (see Results), leaving 24 valid participants (10 male, 14 female) aged 18-24 years (M = 19.50, SD = 1.22) with normal or corrected vision and no color blindness. Participants received 20 RMB compensation.

Materials and Procedure

Materials and procedures were identical to Experiment 1, except that the two cartoon characters' roles were swapped.

Results

Learning Phase Three participants were excluded for recognition accuracy below 10 correct trials. The remaining participants averaged 10.92 correct trials (SD = 0.78). A Friedman test found no significant differences in recognition accuracy across the four video types, $^2(3) = 0.56$, $p = 0.91$, indicating equivalent learning.

Testing Phase Three participants were excluded for error rates exceeding 20%. The remaining 24 participants had an overall mean error rate of 9.22%

(SD = 3.72%). We retained correct-response trials and excluded RTs beyond three standard deviations from each participant' s condition mean, removing 0.57% of data.

As in Experiment 1, we first combined the four conditions into an additional-singleton condition and compared it to the no-singleton condition. RTs were significantly longer in the additional-singleton condition (M = 826 ms, SD = 72 ms) than in the no-singleton condition (M = 764 ms, SD = 73 ms), $t(23) = 11.04$, $p < 0.001$, Cohen' s d = 2.25, confirming singleton interference and attentional capture.

A 2 (action type: helping vs. hindering) × 2 (interaction: present vs. absent) repeated-measures ANOVA on additional-singleton RTs revealed no significant main effect of action type, $F(1, 23) < 1$, and no significant main effect of interaction, $F(1, 23) = 2.68$, $p = 0.115$. However, the interaction was significant, $F(1, 23) = 5.07$, $p = 0.034$, 2p = 0.18. Simple effects analysis showed no significant RT difference between colors associated with valid helping recipients (M = 827 ms, SD = 69 ms) and invalid helping recipients (M = 826 ms, SD = 81 ms), $t(23) = 0.12$, $p = 0.902$, Cohen' s d = 0.03. However, colors associated with valid hindering recipients (M = 837 ms, SD = 78 ms) produced significantly slower RTs than colors associated with invalid hindering recipients (M = 814 ms, SD = 82 ms), $t(23) = 2.62$, $p = 0.015$, Cohen' s d = 0.53, showing stronger interference—greater attentional capture. This pattern mirrors Experiment 1. Condition RTs are shown in Figure 6 [Figure 6: see original paper].

Error rate analyses mirrored RT analyses. The additional-singleton condition showed significantly higher error rates (M = 10.05%, SD = 4.00%) than the no-singleton condition (M = 8.39%, SD = 3.79%), $t(23) = 3.53$, $p = 0.002$, Cohen' s d = 0.72, confirming singleton interference. A 2 × 2 ANOVA on additional-singleton error rates revealed no significant main effects or interaction, $Fs(1, 23) < 1$. Thus, no speed-accuracy trade-off existed.

Discussion

Building on Experiment 1, Experiment 2 swapped actor and recipient colors to test recipient color attentional capture in the same social action contexts. Results showed that recipient colors in negative social actions produced attentional capture effects consistent with actor colors, suggesting that social action valence information forms associations with all individuals involved in the action, rendering both actors' and recipients' physical features more likely to capture attention.

Experiment 3

Experiments 1 and 2 found that both actor and recipient colors in negative social interactions captured attention, but could not address whether valence affects both equally. Because actor and recipient color manipulations were separate across experiments, capture effects might reflect not only social valence but also color manipulation itself. Experiment 3 therefore simultaneously examined actor and recipient color attentional capture in negative social action contexts to explore whether attentional priority differs between individuals in the interaction.

Participants

Twenty-six university students voluntarily participated. Two were excluded for failing to meet accuracy criteria (see Results), leaving 24 valid participants (5 male, 19 female) aged 17-21 years (M = 19.29, SD = 1.08) with normal or corrected vision and no color blindness. Participants received 20 RMB compensation.

Materials and Procedure

In Experiment 3' s learning phase, participants viewed only the valid hindering cartoon videos 24 times. Actor and recipient colors were counterbalanced across participants, with color combinations shown in Table 2 . In the testing phase visual search task, only distractors colored as the hindering actor or recipient appeared (40 trials each), with 80 no-singleton trials. Except for these differences, procedures and stimulus settings matched Experiment 1.

Results

Learning Phase All participants scored above 20 correct recognition trials, averaging 22.67 correct trials (SD = 1.52).

Testing Phase Two participants were excluded for error rates exceeding 20%. The remaining 24 participants had an overall mean error rate of 9.53% (SD = 4.26%). We retained correct-response trials and excluded RTs beyond three standard deviations from each participant' s condition mean, removing 0.55% of data.

First, we combined actor-color and recipient-color distractor trials into an additional-singleton condition and compared it to the no-singleton condition. RTs were significantly longer in the additional-singleton condition (M = 845 ms, SD = 105 ms) than in the no-singleton condition (M = 768 ms, SD = 98 ms), $t(23) = 8.49$, $p < 0.001$, Cohen' s d = 1.73, confirming singleton interference and attentional capture.

A paired-samples t-test compared RTs between actor-color and recipient-color distractors in additional-singleton trials. RTs were significantly slower when actor colors served as distractors (M = 860 ms, SD = 117 ms) than when recipient colors served as distractors (M = 831 ms, SD = 103 ms), $t(23) = 2.28$, $p = 0.032$, Cohen' s d = 0.46, indicating stronger interference—greater attentional capture—for actor features. Condition RTs are shown in Figure 7 [Figure 7: see original paper].

Error rate analyses mirrored RT analyses. Combining actor and recipient distractor trials, additional-singleton error rates (M = 10.64%, SD = 5.78%) did not differ significantly from no-singleton error rates (M = 8.44%, SD = 4.71%), $t(23) = 1.72$, $p = 0.098$, Cohen' s $d = 0.35$. Thus, no speed-accuracy trade-off existed.

Discussion

Experiment 3 suggests that although action valence forms associations with all objects in the scene to capture attention, the actor' s physical features receive higher attentional priority in negative interactions.

General Discussion

Using a training-testing paradigm based on Anderson et al. (2011), three experiments associated social action valence (helping and hindering) with colors of actors and recipients to investigate how social action valence influences attentional capture. Results showed that colors associated with negative social actions—both for actors and recipients—more readily captured attention, while positive social action valence did not alter attentional capture of associated features. Moreover, actor colors associated with negative social action valence produced stronger capture effects than recipient colors. These findings indicate that attentional capture driven by negative social action valence exists, that negative valence forms associations with features of all individuals involved, and that actors' physical features receive higher attentional priority.

Notably, only negative social actions enhanced attentional capture, while positive actions did not. This contrasts with Anderson (2016b; 2017), where both positive (smiling faces) and negative (angry faces) social feedback enhanced attentional capture of associated features. This discrepancy may be explained as follows: In Anderson' s studies, participants directly experienced social reward feedback to learn stimulus-value associations. In our study, participants learned through observation without direct reward or punishment, requiring deeper cognitive processing and evaluation to infer stimuli' s potential value. This evaluative process may involve negativity bias. According to the negativity bias hypothesis, neglecting potential dangers carries greater costs than missing opportunities, making negative environmental information more attention-grabbing (Baumeister et al., 2001; Rozin & Royzman, 2001). This hypothesis implies that people must evaluate observed positive and negative information for its adaptive significance (Camilleri et al., 2010; Premack & Premack, 1997) to guide attentional allocation. For direct learning of positive and negative feedback, both have immediate adaptive impact without requiring deep evaluation (Achterberg, van Duijvenvoorde, Bakermans-Kranenburg, & Crone, 2016; Beston, Barbet, Heerey, & Thierry, 2018), as ignoring feedback prevents immediate rewards and incurs punishment.

In humans' unique social environment, observing social actions and utilizing valence information enables reputation formation, helping identify high- and low-reputation individuals to increase interaction benefits (Milinski, 2016). Observational learning' s role extends beyond informing behavioral decisions; our study reveals that cognitive systems form associations between social action valence—especially negative information—and physical features of involved individuals, altering those features' attentional priority. Features associated with negative social action valence more readily capture attention. Although social action valence is not direct reward or punishment, it signals whether interacting with involved individuals will yield gains or losses—information critical for self-interest maintenance. According to value-driven attention theory, attentional selection functions to increase individual benefit (Anderson, 2013). Thus, our finding that negative social action information enhances attentional capture aligns with value-driven attention theory' s functional perspective. This mechanism suggests that prioritizing attention to stimuli associated with negative social action information helps efficiently identify low-reputation individuals and avoid losses. Neuroimaging evidence supports this: objective information value drives information-seeking behavior, sharing neural coding with reward value (Kobayashi & Hsu, 2019). Whether social action valence influences attentional capture through similar brain regions (e.g., striatum, ventromedial prefrontal cortex) requires future investigation.

Reputation theory emphasizes that actors are the primary targets for reputation acquisition in social interactions (Milinski, 2016), seemingly inconsistent with our finding that recipient colors' attentional capture was also affected by valence. However, attributing rewards or punishments based on actors' reputations involves higher-level cognition (Liu et al., 2017; Milinski et al., 2001; Semmann et al., 2005), whereas association learning affecting attention operates implicitly at lower levels, producing instantaneous, involuntary attentional behavior (Anderson et al., 2011; Anderson et al., 2012; Sali et al., 2014). Recent findings show that all objects constituting social interactions are often selected as integrated units (Yin et al., 2018) and stored holistically in working memory (Ding et al., 2017). Therefore, when forming associations between social action valence and physical features, actors and recipients may be automatically bound together as a cognitive unit, similar to binding within-object features. Combined influences from low-level holistic social interaction representations and high-level reputation information may produce an organizational pattern where social action valence associates with all interaction-involved individuals, enabling both actors' and recipients' features to capture attention in negative interactions.

Alternative mechanisms could explain similar capture effects for actors and recipients in negative interactions without invoking reputation or holistic representation. Specifically, for negative interactions, people may be sensitive to all feature information due to survival significance (Baumeister et al., 2001; Rozin & Royzman, 2001), similar to threat stimuli. This perceptual mechanism might indiscriminately link all individuals' features to valence, guiding subsequent attention. This negativity sensitivity might also attract more attention during learning, allocating more cognitive resources to forming associations in negative social scenes and strengthening capture by both actors' and recipients' colors. However, the latter pathway likely contributed minimally here, as memory performance was equivalent across positive and negative interaction scenes during learning. Thus, perceptual-level specificity in processing negative information offers an alternative explanation.

Both accounts can explain why actor and recipient features capture attention. However, the reputation mechanism emphasizes the actor' s dominant role, whereas negativity-specific perceptual mechanisms do not differentiate between actors and recipients. The reputation perspective predicts higher attentional priority for actors' features in negative interactions, consistent with Experiment 3' s finding that actor features produced stronger capture effects than recipient features. Therefore, the reputation mechanism better fits our results, though future research should further explore these potential mechanisms.

Previous research indicates that social actions can be evaluated at both intention and outcome levels, with distinct processing mechanisms (Buon, Jacob, Loissel, & Dupoux, 2013). Our study did not differentiate these sources of social valence information. Future research should examine how social valence information formed from behavioral intentions (e.g., helpful intention without success) versus outcomes (e.g., unhelpful intention but helpful result) influences attentional capture. Since adults focus more on intentions in social interactions (Cushman, 2008; Guglielmo, Monroe, & Malle, 2009; Young, Cushman, Hauser, & Saxe, 2007), social valence formed at the intention level may determine valence-driven attentional capture.

Conclusion

Using a training-testing paradigm, this study investigated how social action valence information influences attentional capture. We conclude that: (1) attentional capture driven by negative social action valence exists; (2) negative valence forms associations with features of all individuals involved in social actions; and (3) actors' physical features receive higher attentional priority within these associations.

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Note: Figure translations are in progress. See original paper for figures.