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Close or Far?

Affect Explains Conflicting Findings on Motivated Distance Perception to Rewards

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Abstract

Research on motivated perception has yielded conflicting findings: Whereas Balcetis and Dunning (2010) showed that people approaching (vs. avoiding) rewarding objects (e.g. food) see them as closer, Krpan and Schnall (2014a) found the opposite. Furthermore, whereas Balcetis (2016) suggested that people who perceive rewarding objects as closer (vs. farther) should subsequently consume more, Krpan and Schnall (2017) showed that they actually ate less. We introduce affect as the missing link to explain these conflicting findings. Two experiments showed that approach and avoidance can either involve, or lack, an affective experience, which in turn determines how they influence perception, and how perception is related to behavior. Consistent with Krpan and Schnall (2017), *non-affective* approach (vs. avoidance) motivation made candies look farther; seeing candies as farther in turn predicted increased consumption (Experiment 1). In contrast, consistent with Balcetis and Dunning (2010), *affective* approach (vs. avoidance) motivation made these stimuli look closer; seeing candies as closer was associated with more being eaten (Experiment 2). Our findings therefore reconcile previous inconsistencies on motivated perception, and suggest that people's view of their surroundings is more dynamic than previously assumed.

Keywords: approach and avoidance, motivated perception, economy of action, distance perception, eating

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1. Introduction

Traditionally, visual perception researchers have primarily examined how objective physical properties of the environment, such as an object’s texture or geometrical shape, influence what people see (Kaufman, 1974; Michaels & Carello, 1981). Despite this trend, a small group of scholars has approached visual perception from a different angle, by proposing that even subjective psychological states can shape how people visually interpret their environment. Early on, Bruner and Goodman (1947) argued that people’s needs and desires determine what they see. Similarly, Gibson (1979) theorized on the importance of one’s ability to act in visual processing. However, notwithstanding these early theories, researchers have only recently started to more comprehensively investigate the extent to which behaviorally relevant factors indeed shape how people view their environment (for reviews, see Balcetis, 2016; Proffitt & Linkenauger, 2013; Firestone, 2013; Firestone & Scholl, 2016; Schnall, 2017a; Witt, 2017). For example, observers who were able to reach a target object using a reach-extending tool (e.g. a conductor’s baton) judged it to be closer than those who did not have a tool and thus could not reach it (Witt, 2017; Witt, Proffitt, & Epstein, 2005). Moreover, when walking effort increased, as manipulated via a treadmill, participants estimated distances to target objects as farther (Proffitt, Stefanucci, Banton, & Epstein, 2003; White, Shockley, & Riley, 2013; Witt, 2017).

Although numerous studies following this so-called *economy of action* approach (Proffitt, 2006) have been carried out under the assumption that perception is in the service of action (i.e., it provides a read-out about possible actions in a given environment), very few studies probed directly whether perception itself is linked to everyday actions such as walking or eating. To address this issue, Krpan and Schnall (2017) relied on the dual systems account of behavior, according to which people's actions are shaped by two distinct processes—impulsive and reflective (Strack & Deutsch, 2004). The reflective system guides behavior through reasoning and rational thinking, which is cognitively costly (Vohs, 2006). Thus, whenever people's cognitive capacity is diminished (e.g. if they are tired or depleted), impulsive forces such as motivation take over (Hofmann, Friese, & Strack, 2009; Vohs & Faber, 2007). Based on the assumption that perception is shaped by impulses (see Balcetis, 2016; Krpan & Schnall, 2014a), Krpan and Schnall (2017) showed that it predicts actions only when people act impulsively. More precisely, distance estimates to candies predicted consumption for people who were tired or depleted (impulsive system). In contrast, for those who were awake or not depleted eating was predicted by their dietary restraint towards candies (reflective system). Overall, Krpan and Schnall (2017) concluded that using perceptual estimates to predict a behavior requires considering whether it is regulated by impulsive or reflective forces.

Although Krpan and Schnall (2017) clarified when perception predicts action, the exact direction of this relationship remains controversial. Indeed, in their research, seeing candies as farther was linked to stronger self-reported motivation to eat them and to increased consumption. This would suggest that perceiving rewards as more distant generally reflects heightened motivation (see also Krpan & Schnall, 2014a). However, other theoretical accounts posit that motivation as a primary component of the impulsive system should have the opposite link to perception, and hence the relationship between visual estimates and behavior should also differ. In particular, Balcetis (2016) theorized that an urge to act toward everyday stimuli makes them appear as closer: In one of the representative findings, the motivational state of desire made people estimate distances to stimuli such as chocolate as smaller relative to less desirable objects such as feces (Balcetis & Dunning 2010). Based on these effects, the authors also argued that perceiving objects as closer should be associated with increased behavioral frequency (e.g. eating more chocolate). Hence, although researchers generally agree that motivated behavior is linked to perception, the exact direction of the effects remains a point of debate. To resolve this issue, we first examine motivational processes that constitute the impulsive system.

1.1. Motivational Underpinnings of the Impulsive System

At the outset it is necessary to provide a definition of motivation. In line with other researchers we use the term as referring to psychological processes that increase the propensity to act regarding stimuli linked to the brain's reward circuitry, such as sugary foods (e.g. Avena, Rada, & Hoebel, 2008; Kelley, 2004). Although different motivational states can be triggered by physiological needs such as hunger, desirability of the target stimulus, or automatic influences from the external environment (e.g. Briers, Pandelaere, Dewitte, & Warlop, 2006; Moskowitz & Grant, 2009; Shah & Gardner, 2008; Strack & Deutsch, 2004), motivation can broadly be organized along a single dimension known as approach-avoidance (e.g. Elliot, 1999, 2006, 2008; Gray & McNaughton, 2003; Harmon-Jones, Harmon-Jones, & Price, 2013; Strack & Deutsch, 2004). Approach refers to any conscious or non-conscious visceral state that enhance the tendency to attain rewarding objects, whereas avoidance minimizes this tendency and makes people more likely to evade them (Hofmann, Friese, & Strack, 2009; Price, Dieckman, & Harmon-Jones, 2012; Strack & Deutsch, 2004).

Given that approach versus avoidance is a fundamental dimension of motivation, it has been placed at the core of the impulsive system. Indeed, in one of the most influential dual-systems accounts, Strack and Deutsch (2004) argued that it constitutes motivational forces directed at either approaching or avoiding everyday stimuli. In order to impact people's behavior, these two motivations need to override rational decision making that is at the core of the reflective system (Strack & Deutsch, 2004). This can occur under two circumstances—when they become strong enough to overcome reflective processes, or when people's ability to act rationally gets impaired because they are tired or depleted (Förster, 2003; Krpan & Schnall, 2017; Schmeichel, Harmon-Jones, & Harmon-Jones, 2010; Strack & Deutsch, 2004; Vohs & Faber, 2007).

Convincing evidence supporting the notion that sufficiently strong motivation can overcome reflective processes comes from research on embodied approach and avoidance motivation (Förster, 2003; Harmon-Jones, Price, & Harmon-Jones, 2014; Streicher & Estes, 2016; Van den Bergh, Schmitt, & Warlop, 2011). Indeed, certain bodily movements associated with getting closer to rewards or moving away from them can induce approach (or avoidance) and thus impact behavior regarding them (Cacioppo, Priester, & Berntson, 1993; Strack & Deutsch, 2004). For example, flexing one's arm—a motor movement evolutionarily linked to pulling desired objects closer—boosted approach motivation and thus increased the consumption of delicious cookies compared to extending the arm—a motor movement linked to pushing them away (Förster, 2003). This influence occurred outside of the realm of the reflective system because people did not consciously consider that arm positions exerted an impact on their eating.

In other circumstances approach and avoidance motivations may not be sufficiently strong to override reflective forces and impact actions. However, they can exert control over behavior if people's ability to act rationally is impaired because they are tired, depleted, or habitually low in self-regulatory capacity (Hofmann, Friese, & Strack, 2009; Hofmann, Friese, & Wiers, 2008; Schmeichel et al., 2010). To demonstrate this, researchers assessed the strength of spontaneously occurring motivations regarding desirable beverages and foods by employing implicit association tests specifically designed to probe automatic approach and avoidance tendencies (Hofmann, Friese, & Strack, 2009; Ostafin, Marlatt, & Greenwald, 2008). Whenever people's cognitive capacity was diminished due to ego-depletion, approach resulted in higher quantities of foods and drinks consumed relative to avoidance, whereas this effect did not occur for people who were not depleted. In line with these findings Krpan and Schnall (2017) showed that perception as an impulsive precursor of behavior predicted candy consumption only for depleted participants, but not for those who were rested and thus acted in line with their dietary restraint towards candies.

Overall, previous research indicates that approach and avoidance are core motivational forces that constitute the impulsive system and guide behavior outside of people's deliberate decisions. Given that the present paper aims to resolve discrepant findings regarding how motivation shapes perception and its relationship to behavior, we next outline these discrepancies in relation to approach and avoidance.

1.2. Approach versus Avoidance Motivation, Perception, and Action: A Discrepancy in the Motivated Perception Literature

The critical inconsistency regarding motivational influences on perception is that approach (vs. avoidance) was found to both increase and decrease perceived distance regarding rewarding stimuli. In particular, Balcetis and Dunning (2010) induced the motivation to approach (=drink) water by making participants consume salty pretzels, whereas they evoked avoidance by making participants quenched. Thirsty (vs. quenched) participants subsequently estimated a rewarding stimulus, namely a bottle of water to appear as *closer*. The authors further argued that this perceptual bias has a functional role in propelling action—it should energize people to eventually undertake approach behaviors such as drinking (see Balcetis, 2016). In contrast, Krpan and Schnall (2014a) obtained opposing effects when inducing approach motivation via either arm flexion (Cacioppo et al., 1993) or a cognitive procedure (Friedman & Förster, 2005a): Compared to avoidance, approach *increased* perceived distance to rewarding stimuli such as pleasant words or images of tasty foods. The authors proposed the following explanation behind this effect—whereas approach is a natural reaction to rewards (Strack & Deutsch, 2004), avoiding these stimuli is an incompatible response, thus resulting in a cognitive inconsistency that reduces perceptual estimates (for a more elaborate discussion, see Krpan & Schnall, 2014a, 2017). Overall, based on these findings, it remains unclear how exactly motivation influences perception, and how perception in turn predicts motivated behaviors such as eating.

One possible reason behind this discrepancy is that approach and avoidance can occur in two fundamentally different ways (Friedman & Förster, 2005a). Sometimes, motivation is accompanied by a conscious affective experience. For example, people may feel positive affect when anticipating eating an ice cream, but negative affect when encountering a spider. Such “affective” motivational states can either arise naturally (e.g. the experience of desire to attain a stimulus) or are induced via procedures that require participants to mentally simulate how they feel when responding to a stimulus (Friedman & Förster, 2005a; Lang, Greenwald, Bradley, & Hamm, 1993). However, approach and avoidance can also operate without affective experiences. Indeed, certain bodily movements or mindset priming techniques evoke the two motivations without changing feelings (Friedman & Förster, 2005a; Krpan & Schnall, 2014a, 2014b). For example, approach (vs. avoidance) induced via arm flexion (vs. extension) increased cookie consumption (Förster, 2003) although the arm positions did not influence self-reported affect, thus showing that motivations behind eating were not reflected in mood states.

If motivation can indeed be either “affective” or “non-affective”, then it is possible that the inconsistent findings in the motivated perception literature may be due to two distinct types of approach and avoidance. More specifically, findings showing that approach reduces perceived distance relative to avoidance (see Balcetis, 2016) may have involved affective motivation. For example, Balcetis and Dunning (2010) manipulated approach motivation by increasing participants’ desire to drink water, and desire itself is generally considered as a state of positive affect (Bradley & Lang, 1999; Lawton, Conner, & McEachan, 2009). The authors' prediction that a decrease in perceived distance should be associated with increased frequency of behaviors such as drinking, or eating may thus apply to situations that evoke feelings. In contrast, findings showing that approach increases perceived distance to rewarding objects relative to avoidance (Krpan & Schnall, 2014a), and that the increase in perceived distance also predicts more candies eaten (see Krpan & Schnall, 2017) may have involved non-affective motivation. For example, Krpan and Schnall (2014a) used the arm flexion versus extension procedure to evoke approach and avoidance without impacting participants' feelings. Therefore, affect may be the missing ingredient that can explain discrepant findings in motivated perception.

1.3. Overview of the Present Research

Overall, the literature suggests that feelings may change the impact of motivation on visual perception, and accordingly also determine the direction of the relationship between perception and impulsive behavior. We tested this premise in two experiments, by focusing on rewarding stimuli frequently associated with motivated behavior—candies (Krpan & Schnall, 2017). More precisely, in Experiment 1, we investigated how approach versus avoidance motivations evoked via a non-affective procedure (Förster, 2003; Krpan & Schnall, 2014a) influence distance estimates to candies, and in turn, subsequent eating. Moreover, in Experiment 2, we used the same general design but in combination with an affective procedure (Friedman & Förster, 2005a) that we expected to reverse the perceptual effects.

2. Experiment 1

The aim of the first experiment was to probe the link between non-affective motivations, distance estimates, and behavior. We therefore manipulated approach versus avoidance via arm movements (Cacioppo et al., 1993). We selected this procedure because numerous studies have shown that flexion versus extension induce motivational states without changing experienced affect (Friedman & Förster, 2005a, 2005b; Krpan & Schnall, 2014a, 2014b; Van den Bergh et al., 2011). Second, approach and avoidance incited by motor movements are sufficiently strong to impact behavior toward rewards independent of the reflective system strength (e.g. Förster, 2003). In the present experiment, participants were asked to assume either flexion or extension while estimating distances to a bowl of candies (Krpan & Schnall, 2014a, 2017). Then, ostensibly as part of a "consumer taste test", they answered various questions about the candies and were allowed to eat as many of them as they wished (Krpan & Schnall, 2017) while continuing to assume the arm position. Experiment 1 thus served as a synthesis of our previous research on motivation, perception, and behavior. As in Krpan and Schnall (2017), we focused on probing the link between perception and candy consumption under impulsive conditions. However, rather than inducing ego-depletion to make baseline motivations dominant in shaping behavior, we now boosted approach and avoidance directly via arm movements, as in Krpan and Schnall (2014a). This allowed us to more directly examine causal influences of motivation on perception and eating of candies.

Based on previous research (e.g. Förster, 2003; Krpan & Schnall, 2014a, 2017), we made several predictions. First, we hypothesized that approach should make the candies appear as farther compared to avoidance (Krpan & Schnall, 2014a). Second, we expected that under approach people should consume more candies during the taste test compared to avoidance (Förster, 2003). Finally, if an increase in perceived distance indeed reflects approach (vs. avoidance) motivation, then people who see the candies as farther should in turn eat more, thus indicating an association between perception and motivated behavior, as previously documented by Krpan and Schnall (2017). Besides exploring the main hypotheses, Experiment 1 also sought to confirm that arm flexion and extension indeed do not change self-reported affect (Friedman & Förster, 2005a; Krpan & Schnall, 2014a), and that affect is unrelated to participants' perception of candies.

2.1. Method

2.1.1. Participants and Design

Ninety participants (52 female; M_{age} = 20.389 years, *SD* = 3.175) were recruited from a participant pool consisting mostly of students and staff members of the University of Cambridge and some volunteers unrelated to the university. Data were excluded from one participant who failed to comply with the experimental procedure due to language problems. All manipulations and measures are reported. This was the only experiment conducted to test the hypothesis (i.e. we did not conduct other studies that were unsuccessful). The design involved *Non-Affective Motivation* (approach vs. avoidance) as a between-subjects factor.

2.1.2. Power Analyses

Power analyses were based on the findings from Krpan and Schnall (2014a; Experiment 4) and Förster (2003; Experiment 1). In Krpan and Schnall (2014a; Experiment 4), an independent samples t-test showed that participants in the approach condition (*M* = 1.037, *SD* = 0.037) perceived positive stimuli as farther compared to those in the avoidance condition (*M* = 0.979, *SD* = 0.027), $t(54) = 6.745$, $p < .001$, $d = 1.804$. Therefore, a power analysis conducted using G*Power 3.1 (Faul et al., 2007) showed that the present experiment would require a sample size of eight participants per condition to obtain the effect of approach versus avoidance on the perception of candies (power = .90, $\alpha = .05$). Furthermore, in Förster (2003; Experiment 1) participants in the approach condition (*M* = 2.600) ate more cookies than those in the avoidance condition (*M* = 0.900), $t(18) = 2.340$, $p = .031$, $d = 1.047$.[1] A power analysis therefore indicated that the present experiment would require a sample size of 21 participants per condition to obtain the effect of approach versus avoidance

[1] Förster (2003; Experiment 1) did not provide standard deviations of cookies consumed in approach and avoidance conditions.

on candy consumption (power = .90, α = .05). However, given that these sample sizes are relatively small, we decided to collect between 40 to 55 participants per condition to obtain more stable effect sizes (the Point of Stability with 80% confidence, w = .20; Lakens & Evers, 2014). One hundred and ten participants initially signed up for the experiment, but 20 of them did not show up. The power of obtaining the effects of approach and avoidance on distance estimates and candy consumption with a sample of 110 participants exceeds 0.99, thus reflecting a high level of power.

2.1.3. Materials

2.1.3.1. Stimuli

Smarties (roughly 38g per tube) were used as stimuli because of their popularity in the UK where the study was conducted, and because similar candies were employed in previous research (Hofmann & Friese, 2008; Hofmann, Friese, & Roefs, 2009; Hofmann, Gschwendner, Friese, Wiers, & Schmitt, 2008; Hofmann et al., 2007; Krpan & Schnall, 2017; Lang, Bradley, & Cuthbert, 2005). Two tubes of Smarties were used per participant. The exact weight of candies was measured prior to the experiment to serve as a baseline.

2.1.3.2. Non-affective approach versus avoidance motivation and Affect manipulation check

To induce non-affective motivation we employed the manipulation developed by Cacioppo et al. (1993) and also used by Förster (2003) in the context of food consumption. Participants in the approach condition pressed against the underside of the desk, thus enacting "pulling", whereas participants in the avoidance condition pressed toward the edge of the desk, thus enacting "pushing". To probe whether the manipulation had any effect on participants' mood, we asked them to report their affect by indicating how they currently felt on a scale from "1 = very negative" to "7 = very positive".

2.1.3.3. Taste evaluation questionnaire

The questionnaire was adopted from Krpan and Schnall (2017) and consisted of eighteen items, of which fourteen items were fillers assessing different aspects of the taste of Smarties (e.g., sweetness; intensity of chocolate flavor), thus making the cover story of a consumer taste test plausible. Three items were used to compute participants' self-reported attitude towards the candies, and one item assessed how frequently people ate this type of candies (see next section).

2.1.3.4. Potential confounds

Participants' attitudes regarding candies were measured via three items (α = .822) embedded in the taste evaluation questionnaire: (a) Overall, please rate how tasty you find the candies; (b) Overall, please rate how much you like the candies; and (c) How would you describe the candies? Items (a) and (b) were answered on a scale from "1 = not at all" to "6 = very much", and item (c) on a scale from "1 = not delicious" to "6 = very delicious".

Furthermore, participants' frequency of eating candies was measured via one item embedded in the taste evaluation questionnaire: How often do you eat this type of candies (or some similar candies)? The item was answered on a scale from "1 = never eaten it before" to "6 = often eaten it before". To rule out a difference in effort participants were asked to indicate how effortful and pleasant they found the arm pressing task on a scale from "1 = not at all" to "7 = a great degree" (Förster, 2003; Krpan & Schnall, 2014a). Finally, their hunger was assessed on a scale from "1=not hungry at all" to "7=very hungry" using the following question: How hungry did you feel right at the beginning of this study?

Given that differences between men and women have been observed regarding eating behavior (Kiefer, Rathmanner, & Kunze, 2005), we also asked all participants to report their gender (male vs. female) to probe it as a potential confound.

2.1.4. Procedure

Participants in all experiments were tested individually by a male experimenter (D. K.). They first signed the consent form that also contained a question about their gender. Then each participant was seated at a white desk (dimensions 160cm x 80cm) and told that the purpose of the experiment was to investigate visual and gustatory (taste) perception of candies. The first task involved estimating the distance between a card with participants' own name placed immediately in front of them (see Krpan & Schnall, 2017) and the front edge of a plastic bowl (diameter=10cm). For the first five trials, which were introduced as practice trials, the bowl was empty, whereas in the latter five trials the bowl was filled with Smarties from the pre-weighted tubes. When the experimenter first showed the candies to participants, he made it clear that these were the candies they would later taste. Both the empty bowl and the bowl with candies were presented at predetermined locations (25cm, 30cm, 35cm, 40cm, and 50cm), one at a time. The experimenter placed the bowl to a corresponding location while participants, who had their eyes closed, thought that he was measuring the distance between their name and the bowl. The order of distance positions was counterbalanced across participants.

A perceptual matching task (Krpan & Schnall, 2014a, 2017; Linkenauger, Witt, Bakdash, Stefanucci, & Proffitt, 2009; Stefanucci & Geuss, 2009) was used to assess distance estimates. The experimenter stood behind the desk and held a measuring tape that he adjusted to correspond to perceived distance according to participants' instructions by stretching it in a direction parallel to their eyes and the edge of the desk (for a graphical representation of the distance estimation task, see Figure 1 in Krpan & Schnall, 2017). Only the back of the tape (with no measurement units) was visible to them.

While estimating the distance between themselves and the candies, participants were asked to perform either arm flexion (non-affective approach condition) or extension (non-affective avoidance condition). In describing the arm positions, the experimenter explained the movements in the context of “pressing” but made reference neither to the concepts of approach and avoidance, nor pushing or pulling, to avoid biasing participants. They were allowed to briefly rest their arms while the experimenter was changing the distance position of the plastic bowl. However, they were required to maintain the arm pressure during distance estimation.

Then participants completed the second part of the experiment, which was introduced as the taste evaluation phase. They were given the Smarties used in the distance estimation task and asked to complete the taste evaluation questionnaire. The candies were positioned on the desk immediately behind the upper edge of the questionnaire (printed in landscape format), roughly 25cm from the edge of the desk. The experimenter instructed participants that they could eat as many candies as they wished and had five minutes to answer all questions. Furthermore, participants were instructed to maintain either the approach or avoidance arm position while answering the questionnaire and were allowed to briefly rest the arm if they got tired. Then the experimenter left the room and returned once the allotted time was up. Subsequently he collected the evaluation questionnaire, removed the candies, and weighted the remaining amount in a different room.

Finally, participants completed the post-experiment questionnaire involving the manipulation check and potential confounds: Hunger, and pleasantness and effort of the arm positions.[2] They were also asked the following question to assess compliance with instructions: “Did you perform the desk-pressing task while answering the taste questionnaire as asked by the experimenter (breaks allowed when tired)? Please answer honestly—you will receive payment regardless of your answer.” Three participants failed to maintain the arm

[2] The questionnaires also assessed other variables that were used either for exploratory purposes or as part of other research. In Experiment 1, participants filled in a brief, 15-item version of the Need for Closure Scale (Roets & Van Hiel, 2011), and three items about their uncertainty of liking or wanting the Smarties. In Experiment 2, participants indicated willingness to donate part of their compensation to an environmental charity, and their guilt and joy associated with eating Smarties. These items were included as part of an additional study unrelated to the present investigation.

position during the taste evaluation task, and their data were excluded from analyses. At the end participants were debriefed and probed for suspicion regarding the study objective or hypotheses. Nobody showed any awareness.

2.2. Results

2.2.1. Preliminary Analyses

2.2.1.1. Computing candy consumption and distance perception

Following earlier work (Hofmann & Friese, 2008; Hofmann, Friese, & Roefs, 2009; Hofmann, Gschwendner, et al., 2008; Hofmann et al., 2007; Krpan & Schnall, 2017), participants' candy consumption was computed by subtracting the weight of Smarties remaining after the taste evaluation task from the baseline weight measured prior to the experiment.

Given that perceived distance to neutral stimuli is not affected by approach and avoidance, Krpan and Schnall (2014a, 2017) used these stimuli as baseline to compute perceived distance regarding rewarding stimuli, thus reducing error variance and enhancing the power to detect the hypothesized effects (Cohen 1988; Ellis, 1999). Similarly, we used distance estimates to the empty bowl as baseline to assess the perception regarding candies (see Krpan & Schnall, 2017). More precisely, we first divided distance estimates to the bowl with candies by distance estimates to the empty bowl for each of the five predetermined distance positions (25cm, 30cm, 35cm, 40cm, and 50cm). Furthermore, we computed an average score across the five distance positions and used it as a measure of perceived distance. Therefore, perceived distance values higher than 1 indicate that the bowl with Smarties was on average perceived as further away than the empty bowl, whereas values lower than 1 indicate that the candies were perceived as relatively closer. Candy consumption and perceived distance were computed using identical procedures in Experiments 1 and 2.

2.2.2. Main Analyses

2.2.2.1. Manipulation check

To ascertain that the experimental manipulation did not change self-reported affect we performed an independent t-test (two-tailed). As expected, approach ($M = 5.205$, $SD = 1.047$) and avoidance ($M = 5.357$, $SD = 0.958$) did not differ regarding mood, $t(84) = -0.704$, $p = .483$, $d = -0.152$. Furthermore, there was no correlation between affect and distance estimates, $r = -.066$, $p = .549$.

2.2.2.2. Approach versus avoidance, distance estimates, and candy consumption

To investigate the hypotheses regarding the influence of approach versus avoidance on perceived distance to candies and on subsequent consumption, we performed two independent t-tests (two-tailed). As predicted, compared to avoidance, inducing approach made participants see the bowl of candies as farther, $t(84) = 4.003$, $p < .001$, $d = 0.864$, and eat more candies, $t(84) = 3.111$, $p < .003$, $d = 0.671$ (Figure 1, Panels A & B). A correlation analysis further showed that perceived distance regarding candies was positively related to their consumption, $r = .486$, $p < .001$ (Figure 1, Panel C). Therefore, in line with predictions, the farther participants saw the candies, the more they ate.

2.2.3. Confound Tests

To show that hunger, attitudes regarding Smarties, effort and pleasantness associated with the arm positions, the frequency of eating candies, and gender did not confound the influence of approach versus avoidance on either distance perception or candy consumption, we performed one-way ANOVAs with Non-Affective Motivation as a fixed factor while simultaneously including all the potential confounds as covariates. Both the effect of approach versus avoidance on perceived distance, $F(1, 78) = 19.053$, $p < .001$, $\eta_p^2 = .196$, and on candy consumption, $F(1, 78) = 12.746$, $p = .001$, $\eta_p^2 = .140$, remained significant. To further demonstrate the robustness of the relationship between perceived distance and candy consumption, we performed a partial correlation while simultaneously controlling for all the potential confounds. Distance estimates and candy consumption remained strongly correlated, $r = .470$, $p < .001$, thus showing no confounding effects.

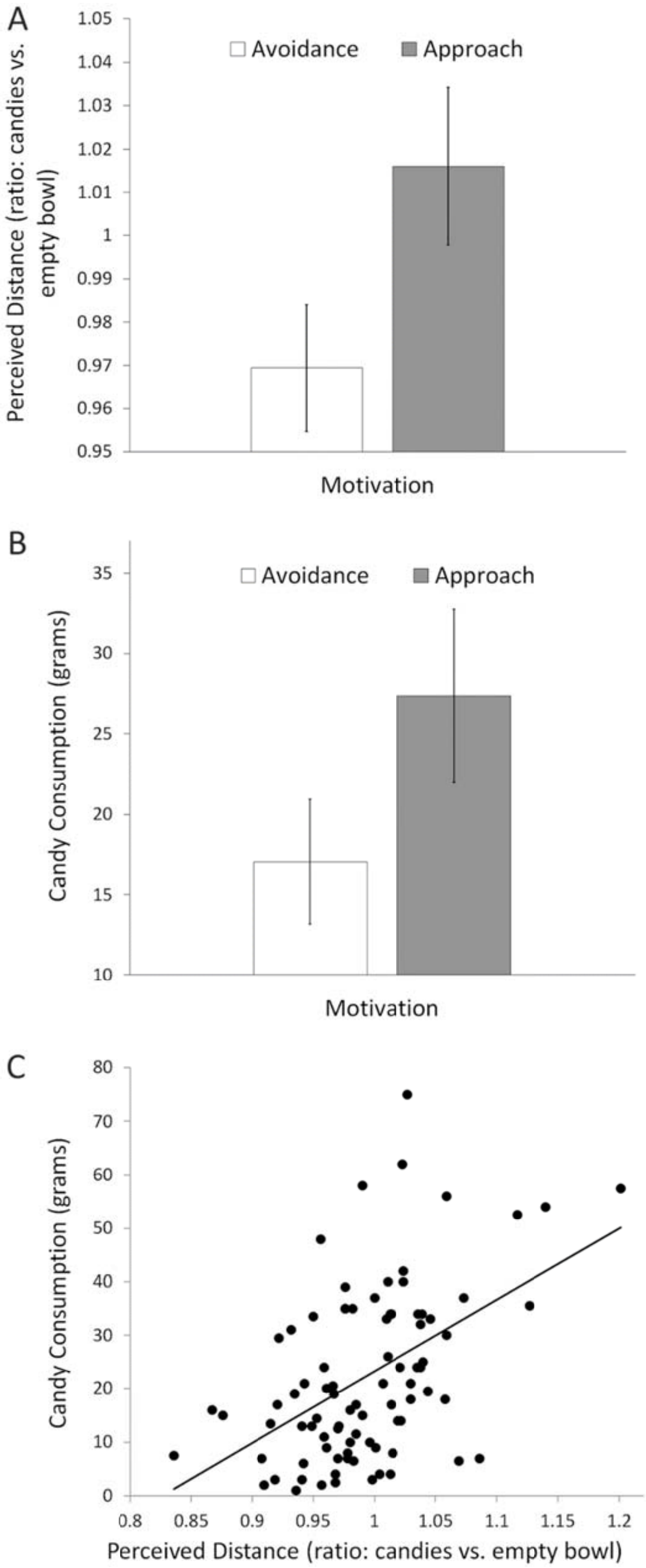

Fig. 1. Summary of the findings of Experiment 1. Panel A depicts the influence of non-affective approach versus avoidance motivation on perceived distance to Smarties, expressed as a ratio of distance estimates to the bowl with candies versus the empty bowl. Panel B shows the influence of non-affective approach versus avoidance on the amount of candies consumed in grams. Panel C illustrates the correlation between perceived distance to Smarties and their consumption. Error bars correspond to the 95% Confidence Intervals.

2.3. Discussion

Experiment 1 showed that inducing approach (vs. avoidance) motivation via arm movements (Cacioppo et al., 1993) influenced participants to perceive candies as farther, in line with Krpan and Schnall (2014a). Moreover, approach made participants consume more candies compared to avoidance, as expected given previous research and theorizing on motivation (Förster, 2003; Strack & Deutsch, 2004). Finally, distance estimates were positively related to candy consumption—those who saw the stimuli as more distant also ate more, thus revealing that perception was linked to behavioral patterns indicative of approach motivation. This finding is in line with Krpan and Schnall (2017). Given that in the current experiment arm flexion and extension did not impact participants' feelings, it is plausible that the present effects were accounted for by non-affective approach and avoidance motivations (Friedman & Förster, 2005a).

Overall, Experiment 1 provided a synthesis of previous work on non-affective motivation, perception, and behavior. We extended previous findings of Krpan and Schnall (2014a) by not only probing how evoking approach versus avoidance via motor movements influenced perception to rewarding stimuli, but also including the behavioral component. Furthermore, in contrast to Krpan and Schnall (2017) who enhanced the impulsive system via ego-depletion and then measured motivation via self-reports, we experimentally manipulated motivation to test the relationship between distance estimates and eating. In the next experiment, we explored whether the interplay between approach and avoidance, perception, and eating behavior would change when affect is introduced into the equation.

3. Experiment 2

The present experiment tested the link between affective motivation, perceived distance to candies, and their consumption. The research design was similar to Experiment 1, with one exception: To manipulate affective motivation, we asked participants to complete both the arm flexion versus extension task (Cacioppo et al., 1993) and a maze task (Friedman and Förster, 2005a) that evokes mood states associated with approach and avoidance. This task required participants to adopt the perspective of a mouse trapped inside a paper-and-pencil maze (see *Materials* section for specifics). In the approach condition, they were asked to imagine and write down how it feels getting out of the maze to reach a slice of cheese and eat it (approach behavior). In the avoidance condition, they were asked to imagine how it feels getting out of the maze to escape from an owl chasing them (avoidance behavior).

Considering that the maze task is a manipulation of affective approach and avoidance, it is necessary to further elaborate why we paired it with the arm flexion and extension task rather than used on its own. In brief, the maze task may not be sufficient to impact candy consumption. As previously indicated, approach and avoidance motivations are fundamental components of the impulsive system (Strack & Deutsch, 2004). Thus, to influence behavior, they either need to be sufficiently strong to override the reflective system, or otherwise the reflective system needs to be weakened via depletion of people's self-regulatory resources (see Förster, 2003; Hofmann, Friese, & Strack, 2009; Krpan & Schnall, 2014a, 2017). The main weakness of the maze task in this regard is that it is administered prior to the eating task and its strength may therefore wear off with time. Indeed, previous research showed that affective states do not consistently impact food intake (Hofmann, Friese, & Strack, 2009;

Macht, 2008). By supplementing the maze task with the arm procedure known to reliably influence eating we created a robust experimental manipulation that both induced emotional approach versus avoidance and affected candy consumption.

We made several predictions. In contrast to Experiment 1, we expected that approach (vs. avoidance) would make the candies appear as closer rather than as farther, in line with theorizing by Balcetis (2016). Moreover, as in Experiment 1, we expected approach (vs. avoidance) would lead to increased candy consumption (Strack & Deutsch, 2004). Finally, if a decrease in perceived distance indeed reflects affective approach (vs. avoidance) motivation, then people who see the candies as closer should eat more of them. Besides these main hypotheses, Experiment 2 also tested whether affective approach manipulation evokes more positive self-reported affect relative to avoidance, as demonstrated by Friedman and Förster (2005a), and whether affect in turn correlates with perceived distance to candies.

3.1. Method

3.1.1. Participants and Design

One hundred and twelve participants (83 female; $M_{\text{age}} = 22.286$ years, $SD = 2.945$) were recruited from a participant pool consisting mostly of students of the London School of Economics and Political Science and some staff members. Data from one participant were excluded because of failing to comply with experimental instructions during the distance estimation task (continuously changing reference points from which the distance was estimated). All manipulations and measures are reported. This was the only experiment conducted to test the hypothesis (i.e. we did not conduct other studies that were unsuccessful). The design involved *Affective Motivation* (approach vs. avoidance) as a between-subjects factor.

3.1.2. Power Analyses

Given that the design of the present experiment was highly similar to Experiment 1, sample size for Experiment 2 was determined based on the same power analysis with the aim to test between 40-55 participants per condition. One hundred and twenty-one participants initially signed up for the experiment, but nine of them failed to show up.

3.1.3. Materials

3.1.3.1. Affective approach versus avoidance manipulation

Affective approach and avoidance were induced in a two-step procedure involving the maze task (Friedman & Förster, 2005a) and arm flexion versus extension (Cacioppo et al., 1993). For the maze task, participants in the approach condition were shown an image in which a mouse was trapped inside a paper-and-pencil maze and had to attain a cheese outside of the maze (Friedman & Förster, 2005a). In the avoidance condition, they saw a similar image, but this time the mouse had to exit the maze to escape from an owl flying above the maze. In both conditions, participants were asked to "write a vivid story from the perspective of the mouse" (Friedman & Förster, 2005a, p. 269). For approach participants, the story was entitled "The Happiest Day in the Life of the Mouse", and they had to imagine the mouse's perspective and describe how it feels approaching the cheese, getting closer to it, and eventually eating it. For avoidance participants, the story was entitled "The Terrible Death of the Mouse", and they described how it feels trying to escape from the owl but eventually getting caught and killed. Then participants in the approach (vs. avoidance) condition flexed (vs. extended) their arm and maintained this position throughout the distance estimation and the taste evaluation tasks, as in Experiment 1.

3.1.3.2. Other Materials

Stimuli, taste evaluation questionnaire, manipulation check (affect), and items assessing potential confounds—self-reported attitudes regarding Smarties ($\alpha = .929$), effort and pleasantness of arm positions, frequency of eating candies, gender, and hunger—were identical to Experiment 1.

3.1.4. Procedure

Except for few alterations, the experimental procedure was as in Experiment 1. Participants completed either the approach or avoidance maze task, answered the manipulation check and then they made the distance estimates. The only difference was that trials with the empty and filled bowls were mixed randomly rather than the former trials appearing before the latter. The reason behind this change was that the duration of affective states induced by the maze task was uncertain and we therefore wanted to rule out that the differences in perceptual estimates occurred because mood had worn off. To stop participants from realizing that we were comparing perceptual estimates to the empty bowl versus the bowl with candies, as a cover story they were told that the memory for earlier distance estimates regarding candies can affect later distance estimates regarding the stimuli, and hence the empty bowl was employed to cancel out these potential confounding effects of memory.

Then participants completed the taste evaluation task. At the end they answered the manipulation check once again to probe whether the affect induced by the maze task persisted throughout the experiment. Finally, participants filled in a questionnaire assessing the potential confounds, and they also indicated whether they maintained the arm position throughout the taste evaluation task. Three participants admitted that they failed to do so, and their data were excluded from analyses. At the end, participants were debriefed and probed for suspicion. Nobody reported any insights.

3.2. Results

3.2.1. Main Analyses

3.2.1.1. Manipulation check: The impact of approach and avoidance on affect

To probe whether approach and avoidance motivations influenced self-reported affect, we performed two independent t-tests (two-tailed). Approach indeed led to greater self-reported positive affect scores immediately after the maze task compared to avoidance, $t(106) = 5.413$, $p < .001$, $d = 1.043$ (Figure 2, Panel A), and this effect was still apparent at the end of the experiment, $t(106) = 3.719$, $p < .001$, $d = 0.716$ (Figure 2, Panel A). Thus, the manipulation evoked affective motivations.

3.2.1.2. The relationship between affect and perceived distance

To test whether affect was linked to distance estimates we computed correlations between the two variables. The first correlation showed that affect measured immediately after the maze task was a significant predictor of distance estimates to candies, $r = -.446$, $p < .001$ (Figure 2, Panel B). Indeed, those who experienced more positive affect subsequently perceived candies as closer. A similar, but slightly weaker relationship was obtained when affect was measured at the end of the experiment, $r = -.342$, $p < .001$ (Figure 2, Panel C).

3.2.1.3. The influence of approach versus avoidance on distance estimates and candy consumption

To investigate the hypothesis regarding the influence of approach versus avoidance on perceived distance to candies and their consumption we performed two independent t-tests (two-tailed). As predicted, compared to avoidance, inducing approach made participants see the bowl of candies as closer, $t(106) = -7.173$, $p < .001$, $d = -1.381$, and eat more candies, $t(106) = 4.180$, $p < .001$, $d = 0.805$ (Figure 2, Panels D & E). A correlation analysis further showed that perceived distance predicted candy consumption in line with expectations, $r = -.441$, $p < .001$: The closer participants saw the candies, the more they subsequently ate (Figure 2, Panel F).

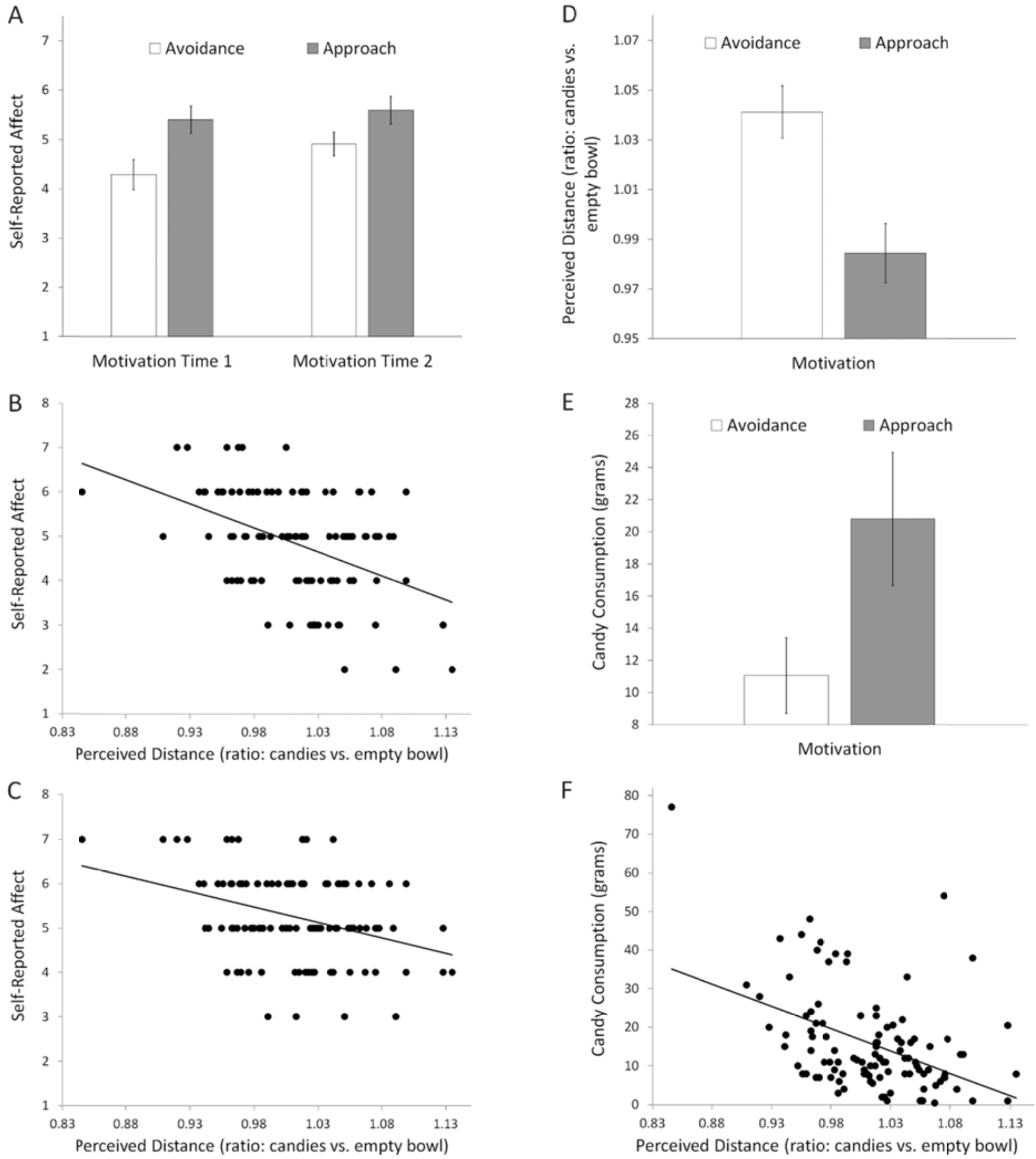

Fig. 2. Summary of the findings of Experiment 2. The first three panels (A-C) concern affect scores. Panel A depicts the influence of affective approach versus avoidance motivation on self-reported affect immediately after the maze task (Time 1) as well as at the end of the experiment (Time 2). Panel B corresponds to the relationship between perceived distance to Smarties and affect at Time 1, whereas Panel C depicts this relationship at Time 2. The last three panels (D-F) outline the dynamics between motivation, perception, and action. Panel D illustrates the influence of affective approach versus avoidance on perceived distance to

Smarties, whereas Panel E conveys how the two motivations impacted candy consumption. Finally, Panel F describes the correlation between perceived distance to Smarties and their consumption. Error bars correspond to the 95% Confidence Intervals.

3.2.2. Confound Tests

3.2.2.1. Manipulation check: The impact of approach and avoidance on affect

To show that hunger, self-reported attitudes regarding Smarties, frequency of eating the candies, gender, and effort and pleasantness associated with arm positions did not confound the influence of approach versus avoidance on affect, we performed one-way ANOVAs with Affective Motivation as a fixed factor while simultaneously including all potential confounds as covariates.[3] The effect of approach versus avoidance on affect measured both immediately after the maze task, $F(1, 93) = 25.662$, $p < .001$, $\eta_p^2 = .216$, and at the end of the experiment, $F(1, 93) = 14.331$, $p < .001$, $\eta_p^2 = .134$, remained significant, thus showing no confounding influences.

3.2.2.2. The relationship between affect and perceived distance

To demonstrate the robustness of the link between affect and perceived distance to candies, we performed partial correlations between the two variables while controlling for all potential confounds simultaneously. The analyses showed that distance estimates remained significantly correlated with both affect measured immediately after the maze task, $r = -.421$, $p < .001$, and affect measured at the end of the experiment, $r = -.367$, $p < .001$. Therefore, the present relationships could not be explained by potential confounds.

3.2.2.3. The influence of approach versus avoidance on perceived distance and candy consumption

[3] Eight participants failed to answer the questions regarding hunger and effort or pleasantness of arm positions. Therefore, their data were not used in confound testing.

To show that the influence of approach versus avoidance on either distance perception or candy consumption was robust, we performed one-way ANOVAs with Affective Motivation as a fixed factor while simultaneously including all potential confounds as covariates. The effect of approach versus avoidance on both perceived distance, $F(1, 93) = 43.082$, $p < .001$, $\eta_p^2 = .317$, and candy consumption, $F(1, 93) = 21.943$, $p < .001$, $\eta_p^2 = .191$, remained significant, thus showing no confounding influences.

3.2.2.4. Perceived distance and candy consumption

To demonstrate the robustness of the link between perceived distance and candy consumption, we computed a partial correlation between the two variables while simultaneously controlling for all potential confounds. This relationship remained significant, $r = -.455$, $p < .001$, thus revealing no influence of confounds.

3.3. Discussion

Overall, Experiment 2 showed that affective motivations impacted perceived distance to candies differently than the non-affective ones from Experiment 1. In line with theorizing by Balcetis (2016), approach made the stimuli appear as closer relative to avoidance. Moreover, as in Experiment 1 and Förster (2003), approach increased candy consumption. Therefore, distance estimates were negatively related to eating: Participants who saw the candies as closer subsequently ate more of them (see Balcetis, 2016). Next to testing the main hypotheses, we performed additional analyses to show that the motivations accounting for the present findings were indeed affective. This assumption was supported by two findings. First, unlike in Experiment 1, approach made participants feel more positive compared to avoidance when affect was measured either immediately after the maze task or at the end of the experiment. Second, participants' mood was positively related to distance estimates regarding candies: those who reported feeling more positive perceived candies to be closer.

Finally, it is necessary to discuss the present effects in relation to how we manipulated affective approach and avoidance. A critic may argue that motivations in Experiment 2 (vs. Experiment 1) did not influence perception differently because of the change in affect, but because pairing two procedures (maze task and arm position) yielded overall stronger motivation. However, if this was the case, then the motivations in Experiment 2 should also produce a significantly stronger impact on candy consumption. We tested this possibility by computing the interaction between *motivation* (approach vs. avoidance) and *experiment number* (Experiment 2 vs. Experiment 1) using a two-way ANOVA. The interaction was insignificant, thus showing no evidence for alternative explanation $F(1, 190) = 0.022$, $p = .883$, $\eta_p^2 < .001$. However, *motivation* and *experiment number* interacted in influencing affect because approach (vs. avoidance) impacted participants' feelings only in Experiment 2 (see Sections 2.2.2.1. and 3.2.1.1. for specifics). The interaction effect was significant when the dependent variable comprised affect scores from Experiment 2 (time 1) and Experiment 1, $F(1, 190) = 17.745$, $p < .001$, $\eta_p^2 = .085$, or from Experiment 2 (time 2) and Experiment 1, $F(1, 190) = 8.774$, $p = .003$, $\eta_p^2 = .044$. Based on these analyses, it is improbable that the strength of motivation, rather than experienced feelings, reversed the perceptual effects.

4. General Discussion

Previous research on motivated perception has been marked by inconsistent findings and competing theoretical accounts. Whereas Balcetis and Dunning (2010) demonstrated that approach motivation makes everyday objects appear as closer relative to avoidance (see also Balcetis, 2016), Krpan and Schnall (2014a) obtained the opposing findings. Moreover, whereas Balcetis (2016) argued that people are more likely to act towards objects they perceive as closer, Krpan and Schnall (2017) found that people who perceived candies as farther actually ate more in a subsequent "consumer taste test".

The present research established that these inconsistencies can be explained by affective states. In Experiment 1, we evoked motivation using a non-affective procedure (Cacioppo et al., 1993) and obtained the same findings as Krpan and Schnall (2014a): Approach (vs. avoidance) made participants perceive a bowl of candies as farther. In contrast, in Experiment 2 we used an affective procedure and obtained the findings consistent with Balcetis and Dunning (2010): Approach (vs. avoidance) made participants perceive a bowl of candies as closer. Mood also changed the relationship between perceived distance and candy consumption. Under non-affective approach and avoidance, participants who saw candies as farther subsequently ate more, as previously found by Krpan and Schnall (2017). In contrast, when the two motivations were affective, seeing candies as closer predicted eating more, in line with Balcetis's (2016) reasoning. Overall, these findings show that previous inconsistencies in motivated perception literature occurred because researchers neglected affective states that accompany motivation.

4.1. Yes, but what is the mechanism?

Although the present research clarified the dynamics between motivation, perception, and action, a precise mechanism behind the effects remains to be determined. Balcetis (2016) argued that motivation decreases perceived distance because this bias is functional in translating motivation into behavior, a process that involves two stages. In the first stage approach recruits perceptual mechanisms to identify an appetitive object and render it closer. In the second stage perceived proximity itself impacts behavior by making the person energized and thus more likely to engage with it (for instance, consume appealing food). Instead, Krpan and Schnall (2014a) proposed that motivational states alter perception to resolve cognitive inconsistencies that occur when these states mismatch actions afforded by the surroundings (see Centerbar, Schnall, Clore, & Garvin, 2008). For example, if an avoidance-oriented person encounters candies, this should create a cognitive conflict given that avoidance is not a natural response to rewards (e.g. Kenrick & Shiota, 2008). Perception should then be mobilized via brain mechanisms involved in conflict detection to allow for effective conflict resolution (Krpan & Schnall, 2014). For example, seeing candies as closer may allow the organism to examine the stimuli in detail and determine the appropriate course of action.

The present research showed that Krpan and Schnall's (2014a) model accurately predicts the perceptual effects when motivation is not affective, whereas the model by Balcetis (2016) has predictive validity when it is. However, our findings also reveal that previous theories are limited because a general model that would account for all the findings is missing. One potential candidate for an overarching mechanism involves hemispheric asymmetry. Indeed, it is plausible that affective versus non-affective motivations produce different patterns of brain activation (Friedman & Förster, 2005a; Harmon-Jones & Gable, 2009; Heller, Koven, & Miller, 2003), which in turn give rise to distinct perceptual effects (Krupp, Robinson, & Elias, 2010). For example, Friedman and Förster (2005a) used a line bisection task as a behavioral measure of relative hemispheric activation. They showed that, without affect, approach (vs. avoidance) is characterized by a more dominant activation of the right hemisphere. In contrast, in the presence of conscious feelings, this motivational state involves a more dominant activation of the left hemisphere. Such a switch in cortical activity may in turn also change motivational effects on perception, given that the two hemispheres process visual information differently. For example, objects generally appear as spatially closer in the left (vs. right) hemisphere (Krupp et al., 2010). Therefore, if affective approach activates the left hemisphere more than avoidance (Friedman & Förster, 2005a), this may reduce perceived distance, whereas the opposite perceptual effect may occur in the absence of feelings, when approach enhances the right hemisphere.

Overall, beyond providing the first step towards a more unified understanding of motivated distance perception, the present research pointed out certain limitations in earlier theoretical assumptions. The main role of future research will therefore involve determining an overarching mechanism behind motivated distance perception, potentially by focusing on underlying brain activity.

4.2. Is It Really Visual Perception?

Apart from discussing the mechanism, it is necessary to tackle current debates involving top-down influences on visual processes. Researchers have been debating whether subjective states can change visual perception (Firestone & Scholl, 2016; Lupyan, 2015; Macpherson, 2012; Schnall, 2017a, 2017b; Witt, 2017). Pylyshyn (1999) divided visual processing into several distinct stages: early-vision, attention-allocation stage, and evaluation, selection, and inference stage. According to Pylyshyn (1999, p. 341), the function of early vision is “to provide a structured representation of the 3-D surfaces of objects sufficient to serve as an index into memory”; this visual stage cannot be impacted by subjective forces. However, he acknowledged that the visual experience of the world commonly referred to as visual perception (e.g. seeing things as closer) is not determined only by early vision but by other stages as well, and can thus be shaped by motives. In the present research, we indeed do not claim that motivation affected early vision regarding candies (although some theorists argue for this view as well; see Lupyan, 2015), but only that it changed the visual experience of the stimuli (distance perception). Therefore, the debate regarding cognitive-affective penetrability of perception (Lupyan, 2015; Macpherson, 2012; Pylyshyn, 1999) does not call our findings into question.

However, other critics have also argued that other non-perceptual processes, most notably demand characteristics (Orne, 1962), can account for the type of effects we have obtained (Durgin et al., 2009; Durgin, DeWald, Lechich, Li, & Ontiveros, 2011; Durgin, Klein, Spiegel, Strawser, & Williams, 2012; Firestone, 2013; Firestone & Scholl, 2014, 2016). For example, it was argued that the influence of a wooden rod that participants held across their chest on perceived width of an aperture (see Stefanucci & Geuss, 2009) can be explained by their understanding of experimental hypothesis (Firestone & Scholl, 2014). A similar criticism was directed at the seminal experiment by Bhalla and Proffitt (1999), which showed that wearing a heavy backpack makes people perceive challenging hills as steeper (Durgin et al., 2009; see also Durgin et al., 2012).

The issue of demand characteristics has been comprehensively addressed elsewhere (e.g. Schnall, 2017a, 2017b; Witt, 2017) by pointing to many findings that cannot be explained by such factors. Similarly, it is highly unlikely that demand characteristics played a role in the present research. At the end of each experiment, we probed participants for suspicion regarding the study objective, and not a single person showed awareness of the real purpose of the experimental manipulations or the hypotheses. This is in line with all the other experiments we conducted using the same methods as in the present research (e.g. Krpan & Schnall, 2014a), and with other research that used such procedures (e.g. Cacioppo et al., 1993; Förster, 2003; Friedman & Förster, 2005a). Indeed, in contrast to the previously criticized experimental manipulations that may be more intuitive to people (e.g. wearing a heavy backpack), participants generally struggle to grasp the role of pressing a desk in their perception and behavior. Understanding this may require comprehensive knowledge of theories of approach and avoidance and motivated perception (Krpan & Schnall, 2014a; Strack & Deutsch, 2004).

Moreover, in contrast to other research that has been criticized because of demand characteristics (see Durgin et al., 2009; Firestone & Scholl, 2014), our experiments were multilayered and contained various components. Therefore, in order for demand characteristics to guide participants' responses, they would need to understand a) what kind of mental states pressing and extending the arm or solving the maze task evoke; b) how these states should influence the way participants see candies and their eating behavior; and c) how exactly eating and perception should be correlated. We posit that it would be highly challenging for any participant to quickly grasp all this in a novel experimental situation they have not previously encountered and deliberately produce the effects we have predicted. Overall, for all these reasons, it is unlikely that the present findings could be explained by demand characteristics.

4.3. The Big Picture

The final stage of conveying the contributions of the present findings is to reveal the bigger picture they form when placed alongside previous research. Table 1 contains a summary of all experiments conducted by Krpan and Schnall that used the same paradigm to probe how motivation changes perception, or how perception is related to eating under impulsive circumstances. The earliest finding that inspired the present research (Krpan & Schnall, 2014a, Experiment 4) demonstrated that non-affective approach (vs. avoidance) increased perceived distance to positive words.[4] Experiment 1 in the present paper showed that this effect is generalizable to three-dimensional objects by replicating it on appetitive stimuli with actual behavioral relevance—candies. Moreover, Experiment 2 obtained an effect of a similar size but different direction, thus showing how strikingly the impact of motivation on perception reversed when affect was involved.

When it comes to the link between perception and behavior, Krpan and Schnall (2017) found that an increase in perceived distance predicted eating when the impulsive system was boosted, either because participants were tired (Experiment 1) or depleted (Experiments 2 & 3). The present paper (Experiment 1) showed that this relationship replicates even when

[4] Krpan and Schnall (2014a) also contained three other experiments, but only Experiment 4 used a design that lends itself to straightforward comparisons with the present research. More specifically, in the experiments not included in Table 1, perceived distance to appetitive stimuli was not computed by using neutral stimuli as baseline, thus allowing no meaningful comparisons with the current work.

approach and avoidance as basic impulsive forces are directly manipulated. Finally, as indicated in Table 1, Experiment 2 in the present paper produced the effects that are similar in magnitude, but differ in direction. It was the only experiment that involved affective motivations, and presenting it alongside earlier findings illustrates how it expands on previous knowledge of motivated perception.

Importantly, the experiments presented in Table 1 are the only ones we conducted, and the effects they yielded are highly significant, thus comprising strong evidential value (Simonsohn, Nelson, & Simmons, 2014). The fact that most of the effect sizes are also large as specified by Cohen (1988) indicates that we established a powerful paradigm to study distance perception that relies on measuring multiple distance estimates regarding the same stimulus while using a neutral object as baseline (see Krpan & Schnall, 2014a, 2017). The importance of this paper is therefore not only in uncovering deeper insights into motivated perception, but also in providing other researchers with a reliable procedure they can employ to continue advancing scientific understanding of this phenomenon.

Table 1

Summary of previous and present research by Krpan and Schnall that investigated the impact of approach versus avoidance on perceived distance to appetitive stimuli, and the relationship between distance estimates and eating under conditions that foster the impulsive system.

Reference	The influence of approach (vs. avoidance) on perceived distance to appetitive stimuli		The relationship between distance estimates and eating	
Non-affective manipulations	M_{diff}	Cohen's *d*	Slope (*b*)	Slope (β)
Krpan and Schnall (2014a: Experiment 4)	0.058**	1.804**	n/a	n/a
Krpan and Schnall (2017, Experiment 1)	n/a	n/a	104.067*	0.346*
Krpan and Schnall (2017, Experiment 2)	n/a	n/a	131.969*	0.432*
Krpan and Schnall (2017, Experiment 3)	n/a	n/a	135.396**	0.377**

Present paper (Experiment 1)	0.047**	0.864**	133.907**	0.486**
Affective manipulations				
Present paper (Experiment 2)	−0.057**	−1.381**	−115.198**	−0.441**

Note: * $p \leq .01$, ** $p \leq .001$

Cohen's d was calculated in line with Lipsey and Wilson (2001). Positive (negative) effects indicate that approach led to increase (decrease) of perceived distance relative to avoidance, or that seeing candies as farther predicted increased (decreased) candy consumption.

Appetitive stimuli used in reported experiments were Smarties (Krpan & Schnall, 2017: Experiments 2 & 3; present paper: Experiments 1 & 2), M&Ms (Krpan & Schnall, 2017: Experiment 1) and positive words (Krpan & Schnall, 2014a: Experiment 1).

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