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Research Article

Shopping to and fro: Ideomotor compatibility of arm posture and product choice

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Abstract

Consumption often requires flexing arms toward the body and merely inducing such activities has been shown to influence consumption. In three studies we show that the consumption effects from lateral arm movements arise from the fit between cognitions and motor activity. When a shopping situation conceptualizes product acquisition as movement away from the body the effects from priming arm flexion and extension are reversed. The findings prefer an ideomotor compatibility account rather than suggesting hardwired and unmalleable association between arm posture and consumption. The implications of these results for ideomotor research and management practice are discussed.

Keywords: Consumer behavior; Purchase quantities; Approach and avoidance motivation; Embodiment; Persuasion; Shopping

Body posture influences many behaviors, including consumption. Perhaps the most widely studied and easily manipulated body posture is arm extension or flexion. *Arm extension* occurs when the hand is extended away from the body (elbow ≈ 180°), whereas *arm flexion* occurs when the hand is retracted toward the body (elbow ≈ 90°). To illustrate, arm extension tends to facilitate responding to negative stimuli, whereas arm flexion facilitates responding to positive stimuli (for review see Eder & Hommel, 2013). Analogously, based on the association between arm flexion and positive evaluation, participants consume more when an arm is flexed than when it is extended (Förster, 2003). However, we will argue that posture effects on consumption are modulated by their compatibility with cognitions (Barsalou, Niedenthal, Barbey, & Ruppert, 2003; Körner, Topolinski, & Strack, 2015). In addition to providing a critical theoretical test of three models described below, this research also contributes practically by clarifying how shopping environments can be managed to optimize consumers' experiences.

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Theoretical framework

Arm postures both reveal and influence attitudes. Arm extension is typically faster when judging negative stimuli, whereas arm flexion is faster with positive stimuli (Chen & Bargh, 1999; Solarz, 1960). Rather than measuring arm flexion and extension, Cacioppo, Priester, and Berntson (1993) manipulated it. They had participants press their palms either downward on the topside of a table (arm extension) or upward against the bottom side of the table (arm flexion) while viewing a series of neutral Chinese ideographs. The ideographs were evaluated more positively when paired with arm flexion than with extension. Förster (2003) first applied this phenomenon to consumer behavior by manipulating arm flexion or extension (as in Cacioppo et al., 1993) while participants watched a TV program. Critically, while they watched the program, a bowl of cookies was placed nearby. Participants with flexed arms ate more cookies than those with extended arms. Researchers initially explained these posture-attitude associations via *evaluative conditioning*. That is, because negative stimuli are often pushed away from the body, and positive stimuli are typically pulled

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toward the body, arm extension and flexion respectively became associated with negative and positive evaluations of stimuli. And eventually, due to a lifetime's experience, those arm movements themselves come to signify negativity and positivity. Thus, arm extension induces a negative affective state, which elicits systematic processing that decreases consumption by critically highlighting negative attributes of products. In contrast, arm flexion induces positive affect and heuristic processing, which increases consumption by focusing on the positive attributes of products (i.e., feelings-as-information; Schwarz, 2002).

Although there is much evidence for evaluative conditioning as a general behavioral mechanism (Hofmann, De Houwer, Perugini, Baeyens, & Crombez, 2010), more recent evidence suggests that evaluative conditioning may not explain the effect of arm posture on attitudes. In particular, the effect appears to be moderated by the desirability of the product. For example, Förster (2003) had participants watch a documentary film with their arm in a flexion, extension, or neutral position, and with a glass of either orange juice or mineral water to drink. Importantly, the orange juice was shown in pre-testing to be extremely tasty, whereas the mineral water was judged to be of neutral taste. Participants drank more orange juice with flexed arms and less orange juice with extended arms, relative to the neutral posture. However, arm posture did not affect consumption of the neutral product, mineral water. Similarly, Förster (2004) showed a series of desirable foods and drinks (e.g., Snickers) and undesirable foods and drinks (e.g., beef lung) to participants whose arms were either flexed, extended, or relaxed in a neutral position. Participants judged the desirable products more favorably with flexed arms, and judged the undesirable products less favorably with extended arms. Van den Bergh, Schmitt, and Warlop (2011) also showed that product-type (i.e., vice or virtue) moderates the influence of arm posture on product choice. In a field study, they examined purchases by shoppers who carried a basket (which may involve arm flexion) or pushed a cart (which typically entails arm extension). They found that basket shoppers purchased more chocolate bars, candy, and chewing gum than cart shoppers. In a follow-up lab study, they had participants either extend or flex their arms while choosing between a vice or virtue product (i.e., forced choice between a fruit and a chocolate bar). Participants in the flexion group chose more vice products than participants in the extension group. Thus, arm flexion selectively increased the choice of vice over virtue products.

Evaluative conditioning does not explain this selective effect of arm posture on product choice, because if arm flexion simply induced positive attitudes, then it should increase choices of vice and virtue products equally, as well as desirable, neutral, and undesirable products. Instead, Van den Bergh et al. (2011) supported a *motivation* theory, whereby arm flexion induces a drive for immediate gratification (i.e., reward-seeking behavior) due to the association between arm flexion and approach motivation (Van den Bergh, Dewitte, & Warlop, 2008). Stated alternatively, arm flexion induces positive affect and heuristic processing, which increases choice of vice products by focusing on their short-term benefits. And arm extension induces negative affect and systematic processing, which increases choice of virtues by focusing on their long-term benefits (i.e., cognitive tuning; Schwarz, 2002). So in the choice between an apple (which has the delayed gratification of long-term health) and a chocolate (which has the immediate gratification of short-term satisfaction), arm flexion motivates choice of the immediately gratifying chocolate. And similarly in Förster's (2003) study, arm flexion increased consumption of immediately rewarding products (e.g., orange juice, cookies) but not of neutral products (e.g., mineral water). Thus, at present, this motivation account provides the most complete and viable explanation of the effect of arm posture on consumer choice.

Both of these accounts of arm posture effects assume that consumer behavior is *embodied*, in the broad sense that cognition and behavior are constrained by one's body (Barsalou, 2008; Casasanto, 2011; Krishna, 2012; Krishna & Schwarz, 2014). In this case, consumers' preferences, choices, and actual consumption are influenced by the posture of the arm. An equally important – but less studied – assumption of embodiment is that cognition is also *situated*, in the broad sense that cognitions occur in various situations that may impose different constraints and hence elicit different behaviors (Barsalou, 2009; Robbins & Aydede, 2009). For instance, people prefer products when the handle is oriented toward their dominant hand, so that they could easily imagine grasping it (Elder & Krishna, 2012). But if the dominant hand is occupied (e.g., by holding something else), then people prefer the product when the handle is oriented toward the nondominant hand, again presumably because it facilitates the mental simulation of grasping the product (Eelen, Dewitte, & Warlop, 2013). Thus, when the situation constrained the available bodily response, the embodied effect was reversed. Situation effects such as these demonstrate that the *ideomotor compatibility* between a mental simulation of an action (e.g., imagining grasping a cup with handle pointed leftwards) and the enactment of a compatible motion (i.e., pressing a button with the left hand) affects preferences and behaviors (Barsalou et al., 2003; Eelen et al., 2013; Ping, Dhillon, & Beilock, 2009).

We propose that arm posture affects shopping behavior via the ideomotor compatibility between the arm posture and the simulated movement required by the shopping situation. Given that arm flexion enacts movement toward the body, whereas arm extension enacts movement away from the body, arm flexion and extension are naturally compatible with mental simulations of moving objects toward and away from the body, respectively (cf. Glenberg & Kaschak, 2002). And critically, product choice and consumption are typically enacted by motion toward the body: Shopping typically entails moving products from shelves into one's basket, and ingestion entails bringing food or liquid toward the mouth. Consequently, consumption typically is mentally simulated by movement toward the body. So by default, arm flexion is compatible with mental simulations of consumption, and hence arm flexion should increase consumption and choice, especially of desirable products (Förster, 2003, 2004; Van den Bergh et al., 2011).

This account attributes the standard arm posture effect to a different mechanism than either evaluative conditioning or motivation. By both of those accounts, it is the long-term behavioral association between arm flexion and positive affect or reward that causes arm flexion to increase product evaluations. In other words, the two previous accounts treat arm posture effects as an ideomotor *reflex*: From a lifetime of experience, arm flexion becomes strongly associated with acquisition and consumption of desirable objects, and hence merely flexing an arm reflexively increases consumption of desirable objects. By the ideomotor *compatibility* account, in contrast, this effect is due to the compatibility of the arm posture with a simulated product acquisition: Arm flexion and object acquisition are both typically enacted with the same direction of motion toward the body. Thus, product choice typically is mentally simulated via motion toward the body, and it is this ideomotor compatibility that causes arm flexion to increase consumption. That is, the effect is contingent upon the mental simulation of product acquisition, rather than a hardwired and unmalleable association between arm posture and consumption.

Critically then, according to this ideomotor compatibility account, a different shopping situation could attenuate or even reverse this effect. For example, if the mental simulation of product acquisition entailed moving chosen products away from the self, that would be compatible with arm extension (i.e., movement away) rather than arm flexion (i.e., movement toward). Thus, contrary to the typical situation in which object acquisition is mentally simulated by motion toward the body, this situation in which product acquisition is simulated away from the body should increase product choice with arm extension rather than arm flexion. This ideomotor compatibility account therefore makes a different prediction from the evaluative conditioning and motivation accounts, both of which generally claim that arm flexion increases choice of desired products.

Indirect support for this ideomotor compatibility account of shopping behavior comes from research on affective evaluation. People are generally faster to classify negative stimuli by pushing a lever (or joystick) away from the body, but are faster to classify positive stimuli by pulling the lever toward the body (Chen & Bargh, 1999; Solarz, 1960). Across a series of experiments, however, Eder and Rothermund (2008) showed that simple manipulations of the task conceptualization completely reversed the standard effect of stimulus valence on response direction (see also Lavender & Hommel, 2007; Markman & Brendl, 2005; Rotteveel & Phaf, 2004). Although such situation effects provide general support for our ideomotor compatibility account, it must also be noted that those prior studies assume that responding toward and away from the self are associated with positive and negative valence (see also Barsalou et al., 2003; Förster, 2004). Our account, in contrast, makes no assumptions about emotional valence and instead attributes arm posture effects to the compatibility between the simulated product acquisition (i.e., the "idea") and the actual arm posture (i.e., the "motor").

In sum, we have identified three potential explanations of arm posture effects on consumer behavior, with mutually exclusive predictions. The evaluative conditioning model (Cacioppo et al., 1993) predicts increased consumption from arm flexion (relative to arm extension), regardless of product-type (e.g., vices and virtues). The motivation model (Van den Bergh et al., 2011) would predict that arm flexion selectively increases choice of vice but not virtue products, whereas arm extension selectively increases choice of virtue but not vice products. The ideomotor compatibility model predicts that, depending on the particular shopping situation, either arm flexion or extension can increase product choice independent of product-type. The following studies systematically test all three models. Importantly, because the ideomotor compatibility explanation of arm posture effects is novel, these studies provide the first direct tests of all three models.

Study 1

Study 1 examined hypothetical purchases of vice and virtue products under conditions of arm flexion or extension in a simulated shopping scenario. Participants moved a shopping cart, with arms either flexed or extended, to tables with products arranged on them. Because all participants used a cart, we controlled for personal and situational differences between basket and cart shoppers while manipulating arm posture. If arm posture effects are due to motivation, with flexion motivating immediate satisfaction and extension motivating delayed gratification, then arm flexion should induce more vice purchases, whereas arm extension should elicit more virtue purchases (Van den Bergh et al., 2011; see also Förster, 2003, 2004). In contrast, both the ideomotor compatibility and the evaluative conditioning models (Cacioppo et al., 1993) predict that flexion will increase hypothetical purchases of both vice and virtue products.

Method

Participants

101 students (mean age: 23 years; 49% female) were recruited in the lobby of the main building at a typical Austrian university. Although they participated voluntarily, at the completion of the study they were thanked with a gift (candy). An additional 23 students participated in a stimulus pre-test.

Products

Products were selected from a pre-test in which students (N = 23) listed vice and virtue brands that they frequently buy at the supermarket (see Methodological Appendix for detail). We selected Snickers, M&Ms, Kelly potato chips, NicNac's peanuts, Stiegl beer, Ottakringer beer and Servus white wine as vice products (M = €1.10) and Pril dish soap, Palmolive dish soap, Colgate toothpaste, OdolMed 3 toothpaste, Alufix trash bags and Zewa paper towels (M = €1.67) as virtue products.

Shopping cart

To disguise the purpose of the study, participants were recruited to participate in a physiological study on shopping behavior. We modified a shopping cart by attaching two small electrical impulse pads either on top of the handlebar's end points (extension group) or underneath it (flexion group). The pads were conspicuously wired to an ostensible recording device that was located in the cart (cf. Förster, 2003). Throughout the study the experimenter visually monitored participants' hands to ensure that they contacted both impulse pads, and verbal reminders were given when necessary.

Procedure

Participants were instructed to move a shopping cart to two display tables, where they would see several products, and their task was to indicate how many of each product they would like to buy at the given price. Participants were randomly assigned to either the extension or the flexion group. Participants in the extension group moved the shopping cart by placing their hands on the topside of the handlebar with arms extended, whereas those in the flexion group moved the cart by bending their arms and placing their hands on the underside of the handlebar. The extension and flexion groups were otherwise identical.

The shopping scenario was arranged as an equilateral triangle, with a starting point and two shopping display tables all 10 m apart (see Fig. 1). After moving the shopping cart from the starting point to the first display, participants viewed the given products and read an order form that included prices for the products. To promote hypothetical purchasing, we assigned prices that were comparable to regional discounters. Next to each price on the order form was an empty box, and participants indicated their purchase intentions by entering in each box the number of that given item that they would like to buy (e.g., Ottakringer beer, €0.69 each, quantity: 2). After indicating their purchase intentions at the first display, participants placed their order form in the shopping cart, re-engaged the handlebar in the assigned posture (extension or flexion), and then moved the cart

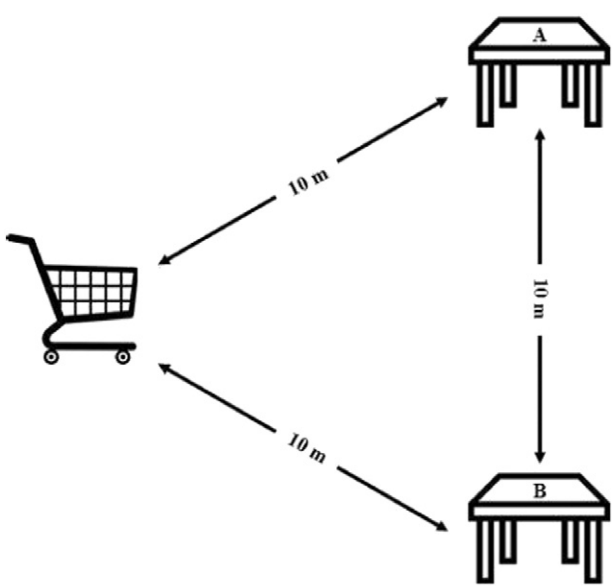

Fig. 1. Schematic illustration of the shopping environment in Study 1. Vice and virtue products were placed on separate tables, with their location counterbalanced across Tables A and B. Participants moved the shopping cart to either Table A or Table B (order counterbalanced) with arms either extended or flexed (between-participants) and indicated their purchase intentions by filling out an order form that listed prices for each item. Using the same arm posture, they then moved the cart to the other table and completed the order form. Finally they moved the cart back to the initial position, where they completed a follow-up questionnaire.

to the second display table, where the same procedure was followed. Participants then re-engaged the handlebar in the assigned posture and moved the shopping cart back to the starting point, where they indicated their mood and rated the ergonomics of the shopping cart (see Table 1 for items and reliability). Finally, participants were debriefed for hypothesis guessing and were thanked with a candy bar.

Results

Controls

No participant guessed the true purpose of the experiment. However, two participants whose purchase quantities were extreme outliers (Tukey, 1977) were excluded from further analysis. Mood did not differ between the two groups ($p > .7$), but the flexion group rated the shopping cart ergonomics worse ($M = 3.94$) than the extension group ($M = 5.67$), $t(97) = 4.38$, $p < .01$. This may be unsurprising, given that arm extension allows resting one's arms on the handlebar, whereas arm flexion does not. Nonetheless, because these ergonomics scores were unrelated to purchase quantities ($r = -.03$; $p > .7$), this difference in ergonomics could not explain any observed difference in purchase intentions.

Purchase quantities

Indicated purchases were summed to create a *quantity index* for each participant. Gender (1 = male; 2 = female) correlated significantly with purchase quantities ($r = .38$; $p < .01$), but mood and age did not. Gender thus was included as covariate in a mixed ANCOVA on purchase quantities with posture (extension, flexion) and product (vice, virtue) respectively as independent and repeated measures. Inclusion or exclusion of the covariate had no effect on the pattern of significant results. The gender covariate was significant, $F(1,96) = 17.83$, $p < .01$, and a significant main effect of product indicated more intended purchases of vice items ($M = 11.69$) than virtue items ($M = 6.33$), $F(1, 96) = 30.92$, $p < .01$. Moreover, a significant main effect of posture indicated more intended purchases when participants' arms were flexed ($M_{\text{vice}} = 12.94$; $M_{\text{virtue}} = 7.20$) than when extended ($M_{\text{vice}} = 10.35$; $M_{\text{virtue}} = 5.42$), $F(1, 96) = 5.42$, $p < .05$. Critically, the posture and product factors did not interact ($p > .5$).

Spending

To facilitate interpretation, we additionally created a *spending index* in EUR currency, and we replicated the preceding analyses. The less informative main effect of product-type was no longer significant ($p > .2$), but as illustrated in Fig. 2, the flexion group hypothetically spent more money than the extension group, $F(1, 96) = 4.67$, $p < .05$. Importantly, the interaction failed to approach significance ($p > .6$).

Discussion

Participants who moved the cart with arms flexed hypothetically purchased more and spent more than participants who moved the cart with arms extended. Critically, arm flexion significantly increased purchases of both vice and virtue products.

Table 1
Control measures used in Studies 1–3.

Study	Measure	Items
1	Mood	How do you feel at the moment? 1 = very bad, 9 = very good
	Ergonomics $r = .68$***	How strenuous was it to push the cart? 1 = very, 9 = not at all How comfortable was holding the handle bar? 1 = very uncomfortable, 9 = very comfortable
2	Decision ease $r = .46$**	How fast were you able to form your decisions? 1 = very slow, 9 = very fast How easy was it to make your decisions? 1 = very hard, 9 = very easy
	Stock buying	I always buy just as much as I immediately need. 1 = disagree very much, 9 = agree very much (reverse scored)
	Ergonomics $r = .46$**	How strenuous was the posture of your dominant arm? 1 = very, 9 = not at all How comfortable was the posture of your dominant arm? 1 = very uncomfortable, 9 = very comfortable
	Mood α = .86	How do you feel currently? 1 = very bad, 9 = very good What is your current mood? 1 = bad mood, 9 = good mood
3	Ergonomics $r = .50$**	How stressed to you feel? 1 = very, 9 = not at all How difficult or easy was the physical activity? 1 = very difficult, 9 = very easy The activity of the left and right arms matched. 1 = disagree very much, 9 = agree very much
	Mood	Same as in Study 2. (α = .76)

*** $p < .001$.
** $p < .01$.

This result is consistent with both the evaluative conditioning and the ideomotor compatibility models because both accounts predict a main effect of arm manipulation in this shopping scenario, independent of product-types. In contrast, Study 1 provided no support for the motivation account, which predicts that flexion would increase purchases of vices (which are immediately satisfying) but not virtues (which require delayed gratification).

Although this result may initially appear inconsistent with that of Van den Bergh et al. (2011), we do not believe it is. In their first study, Van den Bergh et al. compared vice purchases by basket shoppers and cart shoppers. Our study differed importantly in that we had no basket shoppers. Given this fundamental difference in study designs, the results are not directly comparable. In fact, we believe this design is a strength of our study: By controlling the shopping apparatus (i.e., all participants moved a shopping cart), we were able to manipulate arm posture while eliminating other potential physical and cognitive confounds (e.g., the physical weight and cognitive mindset of carrying a basket). In their second study, Van den Bergh et al. introduced self-control dilemmas in which basket and cart shoppers had to choose between a chocolate (vice) and a fruit (virtue). They showed that basket shoppers (with flexed arms) chose more vices than cart shoppers (with extended arms). In fact, this result is directly consistent with our finding that arm flexion increased vice purchases. But what cannot be determined from Van den Bergh et al.'s forced choice paradigm is whether basket shoppers might also have wanted more of the virtue products; that is, because participants had to choose, we learn nothing about the unchosen product. Our study instead provided shopping measures of both vice and virtue products separately, and indeed we showed that arm flexion increased hypothetical purchases of both product-types. Thus, we believe that Van den Bergh et al. discovered an interesting and important difference between basket shopping and cart shopping. Our study instead shows that, independent of the shopping apparatus, arm flexion generally increases purchasing behaviors relative to arm extension.

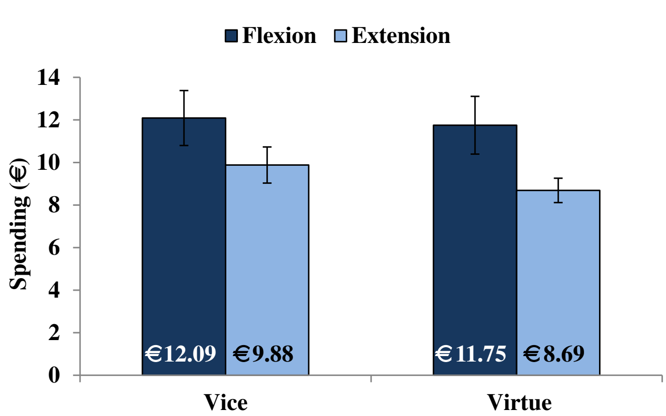

Fig. 2. Spending ($M \pm SE$) on vice and virtue products by participants who moved a shopping cart with arms flexed or extended, Study 1.

Study 2

In Study 1, we manipulated arm posture by having participants move a shopping cart with arms either flexed or extended. Although relatively high in ecological validity, this manipulation differed from most other studies of arm posture, which typically have participants press their palm either upward on the underside of a table (flexion) or downward on the topside of a table (extension; Cacioppo et al., 1993; Förster, 2003, 2004). For more direct comparison with prior studies, in Study 2 we therefore used this traditional manipulation of arm posture. We also implemented two other changes aimed at increasing generalizability: Study 2 used a broader set of vice and virtue products than any prior study on arm posture, and it used an online shopping scenario in which participants browsed a set of products on a computer and indicated their purchase intentions by entering purchase quantities into an order box.

Another important theoretical question, unaddressed by Study 1, is whether arm flexion increases purchasing and/or arm extension decreases purchasing. That is, because Study 1 lacked a neutral control condition, it does not discriminate between theoretical explanations based on facilitation and inhibition of consumption. Study 2 therefore included not only flexion and extension groups, but also a control group who neither flexed nor extended their arms (as in Förster, 2004). The evaluative conditioning model predicts that arm flexion and extension respectively increase and decrease consumption, relative to a neutral arm posture. Several studies have shown that positive conditioning (i.e., pairing a target with a positive stimulus) increases product evaluations, whereas negative conditioning decreases evaluations (e.g., Schemer, Matthes, Wirth, & Textor, 2008; Walther & Grigoriadis, 2004). Moreover, neutral stimuli that are conditioned with movement toward or away from the body are later perceived to be more positive or negative, respectively (Woud, Becker, & Rinck, 2008). So if arm flexion induces positive affect and arm extension induces negative affect (Cacioppo et al., 1993), then flexion and extension should respectively increase and decrease consumption.

The ideomotor compatibility model predicts only increases, not decreases, of consumption. There are two reasons for this prediction. First, goal-relevant information captures more attentional resources than goal-irrelevant information (Dijksterhuis & Aarts, 2010), so arm postures that are compatible with a simulated purchase may be attended to more than postures that are incompatible with the purchasing act. Second, when an ideomotor incompatibility is attended to, it can lead to correction strategies in behavior (Förster, 2004; Strack, 1992). Together these findings suggest that ideomotor incompatibilities tend to be ignored, and when they are noticed, people tend to correct for them behaviorally. Thus, ideomotor compatibility should increase consumption, whereas ideomotor incompatibility should have little or no effect. That is, the ideomotor compatibility account predicts that arm flexion would increase purchases relative to both control and extension groups, but that the extension and control groups would not differ from one another.

Method

Participants

150 students (M = 24 years; 53% female) were recruited and rewarded in the same way as Study 1. An additional 56 students (M = 26 years; 55% female) participated in a stimulus pre-test.

Products

Products were selected from a pre-test in which 56 students evaluated 31 products in terms of their vice (=1) or virtue (=9) status (for details see the Methodological Appendix). We selected the 12 items with lowest ratings as vice products (M = 2.68, SD = .37; mean price = €0.92) and the 12 items with highest ratings as virtue products (M = 7.05, SD = .38; mean price = €1.52). The selected items are shown in Table 2.

Table 2
Products used in study 2.

Vice products	Virtue products
Candy	Toothpaste
M&M	Elmex
Mars	Odol Med 3
Snickers	Household
Bounty	Pril dish soap
KitKat	Palmolive dish soap
Corny	Zewa paper towels
Sugary drinks	Lovely toilet paper
Cola-Cola	Alu Fix baking paper
Fanta	Office products
Sprite	Stabilo text marker
Red Bull	PC printer paper
Ice T	Student notepads
Frozen food	Post-It notes
Dr. Oetker pizza	Other
	Vöslauer mineral water

Procedure

Participants were recruited for a study investigating whether physical coordination influences the perceived ease of decision-making. The procedure simulated an online shopping experience. Participants were seated in front of a computer screen on a desk, where the experiment was presented via online survey software. Participants were asked to view products from a hypothetical campus shop, and to indicate how many of each product they would like to buy at the given prices. The 24 products were grouped into product categories (e.g., beverages), with each category being presented on a separate webpage. Each product was presented on a separate row of the webpage with a picture, a verbal label, and a price, and with an empty box on the right for entering the desired quantity of the product. The order of the webpages (i.e., product categories) and the order of the products on each page were randomized. Participants indicated their purchase intentions by entering a number (i.e., purchase quantity) into the box next to any item they wanted to buy.

To emphasize our cover story about physical coordination, we had participants operate the mouse and keyboard with their non-dominant hand throughout the shopping task. This allowed us to manipulate arm posture in the dominant hand, which exhibits stronger effects than the non-dominant hand (Van den Bergh et al., 2011). While hypothetically shopping online, participants' dominant hand was placed either palm-down against the top of the desk (extension group), palm-up against the bottom of the desk (flexion group), or in a resting position in the lap (as in Förster, 2004). Participants were randomly assigned to groups. After shopping, participants completed four control measures: Decision ease, stock buying, posture ergonomics, and mood (see Table 1). As in Förster (2003), posture ergonomics was measured in the two treatment groups only (i.e., the control group was excluded).

Results

Controls

At debriefing, no participant guessed the purpose of manipulating arm posture. One participant whose purchase quantity was an extreme outlier (Tukey, 1977) was removed from all further analyses. No group differences were observed in decision ease ($p = .62$), posture ergonomics ($p > .24$), or mood ($p = .41$). Surprisingly however, stock buying behavior differed across groups, $F(2, 143) = 3.99$, $p < .05$. More specifically, Tukey post hoc tests indicated that the extension group reported significantly more stock buying ($M = 4.55$) than the flexion ($M = 3.43$) and control groups ($M = 3.46$).

Purchase quantities

Preliminary analyses revealed that neither gender (1 = male; 2 = female) nor ergonomics correlated with purchase quantity (both $r < .1$; $p > .3$). However, purchase quantity significantly correlated with mood ($r = .17$; $p < .05$), age ($r = -.20$; $p < .05$) and stock buying ($r = .31$; $p < .01$). Mood, age, and stock buying thus were included as covariates in a mixed ANCOVA on purchase quantities with posture (extension, flexion, control) and product (vice, virtue) respectively as independent and repeated measures. The covariates mood ($F(1, 140) = 8.44$, $p < .01$), age ($F(1, 140) = 8.49$, $p < .01$) and stock buying ($F(1, 140) = 21.60$, $p < .01$) remained significant. More importantly, the main effect of posture was significant, $F(2, 140) = 5.12$, $p < .01$. Planned contrasts revealed that the flexion group purchased significantly more items ($M_{\text{vice}} = 12.31$; $M_{\text{virtue}} = 14.80$) than both the extension group ($M_{\text{vice}} = 8.35$; $M_{\text{virtue}} = 11.59$; $p < .01$) and the control group ($M_{\text{vice}} = 7.90$; $M_{\text{virtue}} = 13.2$; $p = .03$), which did not differ from one another ($p = .39$). The less informative main effect of product was marginally significant ($p = .06$), with more purchases of virtues ($M = 13.20$) than of vices ($M = 9.53$), but there was no interaction with arm posture ($p = .29$). When the three covariates were not included, the main effect of posture on purchase quantities was marginally significant, $F(2, 146) = 2.91$, $p = .06$, as was the planned contrast between the flexion and extension groups, $p = .06$, both two-tailed.

Spending

Results of hypothetical spending, illustrated in Fig. 3, were the same as for purchase quantities. The main effect of posture was significant, $F(2, 140) = 5.64$, $p < .01$. The flexion group hypothetically spent significantly more money than both the extension group ($p < .01$) and the control group ($p = .01$), which did not differ from one another ($p = .53$). The main effect of product was significant ($p = .04$), with more spent on virtues (M = €16.72) than on vices (M = €9.10), but its interaction with posture again failed to approach significance ($p = .78$). When the three covariates were not included, both the main effect of posture and the planned contrast between the flexion and extension groups remained significant.

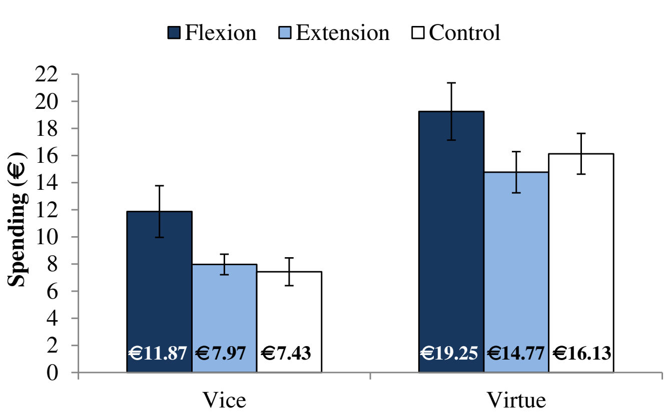

Fig. 3. Spending ($M \pm SE$) on vice and virtue products with the dominant arm in a flexion, extension, or neutral control posture, Study 2.

Discussion

As in Study 1, shoppers with a flexed arm hypothetically purchased more and spent more than shoppers with an extended arm, and again this occurred for both vice and virtue products. Moreover, the results generalize the finding of Study 1 to an online shopping environment here in Study 2, and to a broader set of vice and virtue products than any prior study on arm posture. Study 2 additionally showed that arm flexion increased purchases, whereas arm extension had no effect on purchases, relative to a neutral arm posture. Thus, our results indicate that arm postures have a facilitative but not inhibitory effect on consumption. Because goal-irrelevant information tends to be ignored (Dijksterhuis & Aarts, 2010) or corrected for (Förster, 2004; Strack, 1992), and product acquisition tends to be enacted by arm flexion rather than extension, arm extension had no effect on hypothetical purchasing. This result is at odds with the evaluative conditioning model because prior research has demonstrated that negative conditioning decreases consumers' evaluations of otherwise neutral products (Walther & Grigoriadis, 2004). If arm extension is hardwired with negativity, then arm extension should have decreased consumption relative to a neutral group that received no arm manipulation. Studies 1 and 2 also failed to support the motivation account of arm posture effects, which predicts that arm flexion should increase purchasing of vice products but not virtue products (Van den Bergh et al., 2011). That is, flexion induces an approach motivation, which is associated with the immediate reward of a vice product. And because virtue products are not immediately rewarding, flexion should not increase virtue consumption. The absence of a posture × product-type interaction in both experiments increases confidence that the motivation model does not explain our results. Thus, the obtained results failed to support either the motivation or evaluative conditioning models, and instead supported the ideomotor compatibility model. By default, shopping is conceptualized via movement toward the body, so given that arm flexion enacts movement toward the body, those compatible movements generally increase product choices. On the other hand, neither of these first two studies directly tested the novel prediction of the ideomotor compatibility model: If product choice is conceptualized via movement away from the body, that would be compatible with arm extension rather than flexion, and hence arm extension should increase product choice.

Study 3

The purpose of Study 3 was to provide a strong test of our ideomotor compatibility model. We asked participants to indicate their purchase intentions by moving products (i.e., cans of Red Bull energy drink) into a hypothetical purchasing area, while maintaining a flexion or extension arm posture with the other arm (cf. Förster, 2003). Critically however, we manipulated the location of the purchasing area, so that participants indicated their purchase intentions by moving the products either toward or away from themselves. The motor compatibility model predicts an interaction of arm posture and purchase direction: Arm flexion should increase purchasing toward the body, whereas arm extension should increase purchasing away from the body. That is, because arm extension enacts movements away from the body, it is compatible with simulating product choices away from the body, and hence arm extension should increase purchases that are enacted by moving the products away. In contrast, the evaluative conditioning model predicts a main effect, such that only arm flexion can increase purchases. Because arm extension is associated with rejecting or repelling objects, arm extension should never increase purchasing.

Method

Participants

178 students (M = 22 years; 43% female) were recruited and rewarded in the same way as Study 1.

Stimuli

Stimuli were 12 Red Bull cans (.25-l) presented at a discount price (€0.99/can). This brand is well known and regularly consumed by Austrian students.

Procedure

As in Study 2, participants were recruited for a study investigating whether physical coordination influences the perceived ease of decision-making. Participants were seated at a table that held (a) the 12 Red Bull cans and (b) a shopping cart symbol printed on a standard A4 sheet. In the *toward* condition, the cans were placed 40 cm away and the shopping cart symbol was placed directly in front of participants. In the *away* condition, the location of the cans and shopping cart was reversed. Participants were instructed to move into the shopping cart area, using their non-dominant hand, as many of the Red Bull cans as they would like to purchase at the given price (€0.99). Thus, to indicate their purchase intentions, participants had to move the desired number of cans either away from themselves (*away* group) or toward themselves (*toward* group). Throughout this purchasing task, participants placed their dominant hand (see Van den Bergh et al., 2011) either palm-down on the table (*extension* group) or palm-up against the bottom of the table (*flexion* group). Participants were randomly assigned to one condition of this 2 (direction: toward, away) × 2 (posture: extension, flexion) between-participants design. Finally, we also measured task ergonomics and mood (see Table 1).

Results

Controls

At debriefing, no participant guessed the true purpose of the experiment. However, three participants whose purchase quantities were extreme outliers (Tukey, 1977) were removed from all further analyses. A 2 (direction) × 2 (posture) between-participants ANOVA on task ergonomics revealed only a significant main effect of direction, $F(1170) = 10.93$, $p < .01$. Participants rated the task more ergonomic when they moved the cans toward themselves ($M = 6.79$) than away ($M = 5.85$). An analogous ANOVA on mood revealed no significant effects (all $p > .8$).

Purchase quantities

Purchase quantities did not correlate significantly with mood ($r = .01$; $p > .94$) or task ergonomics ($r = .08$; $p > .2$). However, gender (1 = male; 2 = female) correlated significantly with purchase quantities ($r = -.17$; $p < .05$), such that males intended to purchase more Red Bull than females. Purchase quantities also correlated marginally with age ($r = -.13$; $p > .08$). We therefore included both gender and age as covariates in a 2 (direction) × 2 (posture) ANCOVA on Red Bull purchase quantities. Both covariates were significant ($p < .05$), but inclusion or exclusion of the covariates had no effect on the pattern of significant results. Most importantly, neither main effect approached significance (all $p > .7$), but the interaction was significant, $F(1, 169) = 9.09$, $p < .01$. Simple effects analyses confirmed that, when indicating their desired purchases by moving them toward themselves, participants hypothetically purchased more Red Bull if they flexed the dominant arm ($M = 2.34$) than if they extended it ($M = 1.57$), $F(1, 169) = 4.95$, $p < .05$. This essentially replicates the result of Study 2. In contrast, if participants indicated their desired purchases by moving them away from themselves, they chose more Red Bull ($M = 2.48$) when extending their dominant arm than when flexing it ($M = 1.59$), $F(1, 169) = 4.17$, $p < .05$.

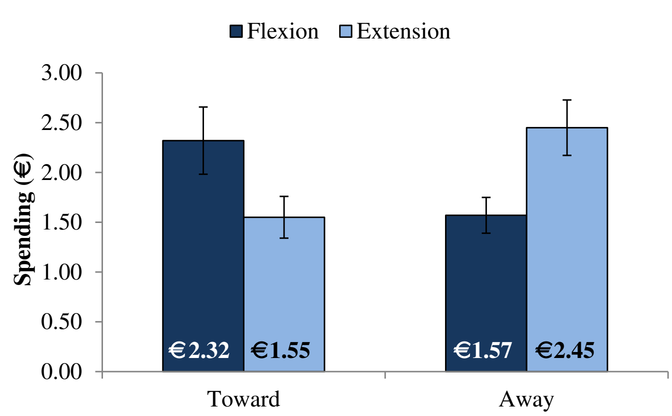

Fig. 4. Spending ($M \pm SE$) by participants who moved selected products toward or away from the body with the non-dominant arm while maintaining the dominant arm in a flexed or extended posture, Study 3.

Spending

In terms of amount hypothetically spent, participants with their dominant arm extended spent more when moving the Red Bull cans away from themselves, whereas participants with arms flexed spent more when moving the Red Bull cans toward themselves (see Fig. 4). Because only a single product was available at a constant price, statistical results of the spending amount were identical to the purchase quantities reported above.

Discussion

In contrast to Studies 1 and 2, Study 3 showed that shoppers with a flexed arm hypothetically purchased more and spent more only when product choice was framed as movement toward the body. When product choices were conceptualized via movement away from the body, arm extension increased purchases. To our knowledge, this is first demonstration that arm extension can increase consumption, in this case hypothetical purchasing. Moreover, the effect was unrelated to mood and task ergonomics, so the effect cannot be attributed to motor priming whereby exerting a specific arm posture facilitated the physical movement of products in one or the other direction. Rather, the absence of an ergonomics effect instead supports our claim that it is the *ideomotor* compatibility between motor enactment and the direction in which product choice is mentally represented. By default, product choice and consumption appear to be compatible with arm flexion (e.g., Cacioppo et al., 1993): Given that arm flexion enacts movement toward the body, it is compatible with simulating product choice, and hence in our Studies 1 and 2 arm flexion increased hypothetical purchasing and spending. But rather than being hardwired from a lifetime of consumption experiences, Study 3 reveals that the conceptualization of product acquisition and consumption is situated: Given that arm extension enacts movement away from the body, it is compatible with moving chosen products away from the body, and hence in the 'away' condition participants hypothetically purchased and spent more with an extended arm. So arm flexion and extension are differentially compatible with situated conceptualizations of product choice, thereby producing an arm posture × purchase direction interaction. This observed interaction is at odds with the evaluative conditioning model and the motivation model, both of which predict the same main effect of arm posture regardless of whether choice is framed as movement in one or the other direction. Thus, this novel effect critically discriminates between models. Arm flexion is associated with consumption, but that association is overturned by a simple and transient reconceptualization of the shopping situation.

General discussion

We conducted three studies on product choice with three different hypothetical shopping scenarios, while also using both traditional and novel manipulations of arm posture. Study 1 used a grocery shopping scenario in which participants moved a shopping cart with either flexed or extended arms, and Study 2 used an online shopping scenario in which participants browsed lists of products while either flexing, extending, or relaxing the other arm. In both of those studies, arm flexion increased purchases and spending for both vice and virtue products. Finally, Study 3 used a shopping scenario in which participants indicated their purchase quantities by moving the selected products (i.e., cans of Red Bull) into a purchasing area that was located either toward the body or away from the body, while also holding the other hand in either a flexed or extended posture. Whereas arm flexion increased purchases toward the body (as in Studies 1 and 2), arm extension increased purchases away from the body. Thus we demonstrated that when consumption is conceptualized as movement away from the body, arm extension induces more purchases than arm flexion. Collectively, these results support an ideomotor compatibility model of arm posture effects.

Theoretical implications

An *evaluative conditioning model* (Cacioppo et al., 1993) claims that, given a lifetime of experience moving appetitive stimuli toward the body via flexed arms, the mere act of flexing one's arms increases appetitive evaluations of target stimuli. In contrast, arm extension is typically used to expel or reject aversive stimuli, so arm extension becomes associated with decreased consumption. In fact, evaluative conditioning could explain the result of our Study 1, which demonstrated that arm flexion increased hypothetical purchases of both vice and virtue products. Critically however, evaluative conditioning cannot explain the results of our Study 2, where arm extension failed to decrease hypothetical purchases relative to a neutral control condition, nor can it explain the results of our Study 3, where arm extension *increased* hypothetical purchases directed away from the body. If flexion and extension respectively increase and decrease evaluations (Cacioppo et al., 1993), then arm extension should decrease consumption (in Study 2) and should never increase consumption (in Study 3).

The *motivation model* also posits that through a lifetime of consuming and acquiring things via arm flexion, that posture becomes associated with an approach motivation (Van den Bergh et al., 2011). Because an approach motivation induces reward-seeking behavior (Van den Bergh et al., 2008), arm flexion increases preference for immediately gratifying options like vice products over delayed gratification options like virtue products. However, our Studies 1 and 2 provided critical evidence against this motivation account. Both studies should have yielded a product-type × arm posture interaction, but instead arm flexion increased consumption of both vice and virtue products approximately equally. Moreover, our Study 3 demonstrated that when product acquisition was conceptualized as movement away from the body, then arm flexion actually decreased hypothetical purchasing of a vice product (i.e., Red Bull).

Nor can these results be explained by *feelings-as-information* or *cognitive tuning* (Schwarz, 2002), whereby the positive and negative feelings evoked by arm flexion and extension respectively signal a benign or problematic state for the perceiver (Schwarz & Clore, 2003). That is, arm flexion signals that the environment is benign, thus inducing heuristic processing and increased consumption. Arm extension signals that the environment is somehow problematic, inducing systematic processing and decreased consumption (Friedman & Förster, 2002). Furthermore, these somatic signals can be interpreted differently according to the situation (i.e., cognitively tuned), thus potentially accounting for the present results. Feelings-as-information and cognitive tuning both assume that arm flexion and extension respectively induce a positive or negative affective state, which then influences choice. However, in none of our three studies did the arm posture manipulation significantly affect participants' affective states.

Finally, these results are not attributable to *self-representations* either. Self-representations may sometimes appear to influence ideomotor compatibility (cf. Markman & Brendl, 2005; Proctor & Zhang, 2010) because motor actions are typically executed by the self, but it is the motor action rather than the self-representation that is hypothesized to cause body posture effects. The results of Study 3 support this hypothesis, in that when product acquisition was manipulated to occur away from the self, the arm posture effect was reversed. If the effect were due to self-representation, the effect should have remained constant.

The *ideomotor compatibility model*, by contrast, successfully accounts for the results of all three studies. This model focuses on the motor compatibility between a simulated product acquisition (the "idea") and the actual body posture (the "motor"). Because consumption behaviors (e.g., ingestion and object acquisition) typically entail motion toward the body via arm flexion, consumption is—by default—compatible with arm flexion. This explains why arm flexion increases product evaluations, choices, and consumption of desirable and immediately gratifying products (Förster, 2003, 2004; Van den Bergh et al., 2011). In Studies 1 and 2, arm flexion increased hypothetical purchasing of both vice and virtue products, presumably because product acquisition by default was conceptualized toward the body. Moreover, in Study 2, arm flexion increased purchasing whereas arm extension did not differ from a neutral control posture. Arm extension had no effect on purchasing (relative to the neutral control posture) because the mental simulation of product acquisition toward the body was incompatible with the arm posture that typically enacts movement away from the body. People tend to ignore information that is not goal-relevant (Dijksterhuis & Aarts, 2010), and when such ideomotor incompatibility is experienced, people tend to correct their behavior to reduce this processing disfluency (Barsalou et al., 2003; Förster, 2004; Strack, 1992). Consequently, ideomotor compatibility facilitates consumption, but ideomotor incompatibility has no effect on consumption (Förster, 2004). Study 3 provided the strictest test of the ideomotor compatibility model. A novel prediction of this model is that if consumption is conceptualized away from the body, this is compatible with arm extension (which enacts movement away from the body), and hence arm extension should increase consumption. In support of this hypothesis, when participants indicated their hypothetical purchases by moving products away from themselves, arm extension elicited more hypothetical purchases than did arm flexion. Importantly, this result was not attributable to task ergonomics, as participants generally found it easier to move the products toward themselves but nonetheless hypothetically purchased more products when moving them away from themselves.

These results demonstrate that arm posture effects can be overturned by a simple and transient reconceptualization of the situation, which is consistent with a larger literature on situated cognition in consumer behavior (Barsalou, 2009; Barsalou et al., 2003; Eelen et al., 2013; Krishna & Schwarz, 2014; Ping et al., 2009). This model differs critically from prior models, which have attributed embodiment effects (e.g., arm posture) to behavioral reflexes. For instance, although arm flexion generally increases choice of vice products (Van den Bergh et al., 2011), for people with dieting goals this effect reverses. Relative to non-dieters, dieters judge vices (e.g., calorie-rich food) significantly faster with motion away from the body, and judge virtues (e.g., working out) faster with motion toward themselves (Fishbach & Shah, 2006). Thus, extending the arm in a self-control dilemma should facilitate mentally distancing from a temptation (cf. Van den Bergh et al., 2011). Ideomotor compatibility therefore is contingent upon the mental simulation in a particular situation, rather than a hardwired and unmalleable association between bodily activity and mental states. Thus, the fundamental novelty of our ideomotor compatibility account is that it is a higher-level model that generalizes beyond paradigms and explains both current and prior findings. Product acquisition and consumption, like other motor behaviors, are cognitively simulated within a specific environmental context (Barsalou, 2009; Robbins & Aydede, 2009). When the simulated motor action is compatible with the body in the particular situation, the motor behavior is facilitated and other contingent behaviors (e.g., consumption) are also affected.

Managerial implications

Our results also have important practical implications for managers. Most fundamentally, consumers may conceptualize consumption behaviors either toward or away from themselves in different situations, and our results suggest that these different conceptualizations may differentially affect consumption. For instance, although shopping carts are nearly always pushed with extended arms, shopping baskets may be carried with either a flexed or an extended arm. In fact, a primary physical constraint on arm posture among basket shoppers is the weight of the basket and its contents. When handling a light basket with few or no products, one may easily hold the basket with a flexed arm, thereby creating ideomotor compatibility with moving products toward oneself and into the basket. However, as the basket becomes heavier, arm flexion becomes more difficult and arm extension becomes more likely. This gradual reversion to arm extension presumably creates an ideomotor incompatibility with moving products toward the self and into the basket. In other words, ideomotor compatibility predicts that people will tend to choose more products when the basket is light (and held with a flexed arm), and will begin to decrease product choices as the basket becomes heavier (and held with an extended arm). Thus, lighter baskets may encourage greater product choice, and retailers may do well to keep shoppers' baskets as light as possible for as long as possible into the shopping event. For instance, they may stock lightweight items (e.g., tissues) at the beginning of the shopping layout, and stock heavier items (e.g., bottled water) closer to the check-out area.

A second practical implication concerns impulse purchases. Product choices made at the aisles of a supermarket presumably are conceptualized toward oneself and are typically enacted by moving the chosen products into one's cart or basket. However, many impulse purchases made at the check-out area instead are enacted by moving the chosen products away from oneself, by either handing the product directly to a cashier or placing it onto a belt that moves away from oneself and toward the cashier. Our results suggest that such product choices made directly at the check-out area should be facilitated by arm extension, rather than arm flexion. Yet another direct implication concerns retail display designs. For example, refrigerator doors that slide open sideways are intrinsically less congruent with product acquisition and consumption than refrigerator doors that are opened by pulling them toward the body. However, if consumption is conceptualized as motion away from the body, then doors that open outward (i.e., toward the body) would be conceived as incompatible with product acquisition.

Limitations and future directions

Our study has several important limitations, which also provide avenues for future research. Regarding our experimental manipulations, it must be noted that moving a shopping cart with flexed arms (as participants in the "flexion" condition of our Study 1 did) is unusual and potentially uncomfortable. Indeed, participants in that Study 1 rated the cart to be less ergonomic when they moved it with flexed arms than with extended arms. However, ergonomics fails to explain the observed result, because the less ergonomic position of flexion actually elicited more hypothetical purchasing. But more generally, we hope that future research will document more directly the extent to which basket and cart shoppers actually use arm flexion and extension while shopping. Our approach was to eliminate this uncertainty in Study 1 by having all participants move a shopping cart, while varying only whether they moved it with flexed or extended arms. A less controlled aspect of our manipulation in Study 1 was that participants viewed the products while their arms were either flexed or extended, but they actually indicated their purchase intentions on a clipboard, which entailed releasing the assigned arm posture. Thus, the effect was observed across some unknown and variable amount of time after releasing the posture. This raises an interesting question about the duration of arm posture effects. Cognitive research indicates that short-term working memory is modality-specific (Vermeulen, Corneille, & Niedenthal, 2008). Presumably then, the bodily representation of arm flexion or extension remained active in short-term motor memory, thereby influencing the subsequent purchase decisions. Future research investigating the decay rate of arm posture effects would be both theoretically informative and practically important.

Manipulating arm posture by pressing upward or downward on a desk with the dominant hand may lack ecological validity. Nonetheless, we used this manipulation because it is the most widely used method for manipulating arm posture. Interestingly, the effects of arm posture tend to be stronger when manipulated via the dominant hand (Van den Bergh et al., 2011), as in our Studies 2 and 3. This could be due to the specialization of the dominant and nondominant arms for different motor acts. The nondominant arm tends to perform spatial orienting actions, such as holding a nail against a surface, whereas the dominant arm is more skilled at transforming an arm trajectory plan into precisely coordinated motor actions, such as hammering a nail (e.g., Sainburg, 2002). Consequently, the dominant arm exhibits less variance in visually guided reaching and other grasping actions (Salimpour & Shadmehr, 2014), which may partially explain why arm posture effects tend to be larger when the product choice is enacted by the nondominant hand. Moreover, our participants maintained the induced arm posture very consistently while making hypothetical purchases. In real shopping situations, arm postures presumably are less consistently maintained, and product choices are typically enacted with the dominant hand. Future studies therefore should investigate such effects in real shopping settings.

Another methodological limitation is that our participants faced no real cost of their product choices, nor any opportunity cost (i.e., choosing product A did not affect the opportunity to choose product B). Many psychological models assume that decisions are made in relation to other options at hand (Vlaev, Chater, Stewart, & Brown, 2011). Thus, it is possible that we found no motivation effects because our methods imposed no opportunity cost. Budget constraints, for instance, could instill a much more comparison-based decision process, which could give rise to motivational effects.

Finally, a remaining theoretical question is whether arm flexion and extension effects are equally strong. Like prior researchers (Cacioppo et al., 1993; Förster, 2003, 2004; Van den Bergh et al., 2011), we have assumed that the flexion–consumption association and the extension–rejection association are equally strong. However, food is nearly always consumed via flexion, but is rarely rejected by extending it away. Thus, the flexion–consumption association may well be stronger than the extension–rejection association. If so, that could potentially explain why our flexion group differed from the control group in Study 2, but the extension group did not (see Fig. 3). A relatively weak extension–rejection association might also partially explain the reversal of the effect in the 'away' condition of Study 3. If the extension effect were indeed weak, then it could be overturned by situational manipulations. We doubt this explanation, however, because in Study 3 the flexion and extension effects were extremely similar in effect size (see Fig. 4), and because we are not aware of any prior study that has found flexion and extension effects to differ substantially. Nonetheless, the possibility of asymmetric flexion and extension effects is theoretically important. So despite the theoretical contributions of the present studies, much remains to be learned about arm posture effects on consumption and other behaviors.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at http://dx.doi.org/10.1016/j.jcps.2015.12.001.

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