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Abstract

A large body of research suggests arm extension and arm flexion to be indicators of automatically generated withdrawal and approach motivation, respectively. However, such a view has not remained unchallenged. Recent research suggests that the motivational significance of arm movements may be largely context dependent. The aim of this research was to demonstrate that an essential facilitating context factor for arm movements relies on the desirability of their expected outcomes. Participants viewed negative and positive stimulus material (pictures and words) and were asked to concurrently perform either an arm extension or an arm flexion. Arm movements were embedded in a meaningful context, leading to a stimulus size decrease or increase; and thus giving the visual illusion of withdrawing from the stimulus or approaching it. Results show that the significance of arm movements is indeed influenced by the desirability of their respective effects.

Keywords

action tendencies, appraisal, arm movements, emotion, motivation

Résumé

Un vaste ensemble de recherches suggère que l'extension et la flexion des bras sont des indicateurs de motivation, respectivement de repli et d'approche, générés automatiquement. Cependant, une telle vision n'est pas incontestée. Des recherches récentes suggèrent que la signification en termes de motivation des mouvements des bras peut être largement dépendante du contexte. Le but de la présente recherche est de démontrer qu'un facteur contextuel essentiel facilitant les mouvements des bras consiste en la désirabilité des résultats attendus. Les participants à l'étude ont

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visionné du matériel (images et mots) à valence négative ou positive et ont été invités à effectuer simultanément soit une extension soit une flexion du bras. Les mouvements de bras étaient intégrés dans un contexte significatif, conduisant à une diminution ou une augmentation de la taille du stimulus; donnant ainsi l'illusion visuelle du repli ou de l'approche par rapport au stimulus. Les résultats montrent que la signification des mouvements de bras est assurément influencée par la désirabilité de leurs effets respectifs.

Mots-clés

émotion, évaluation, motivation, mouvements de bras, tendances d'actions

Different attempts have been made to assess emotion-generated action tendencies such as approach and withdrawal. Studies carried out by appraisal theorists, for instance, generally used self-report measures to assess action tendencies (e.g. Frijda, 1987). These measures may be problematic not only with respect to recall or social desirability but also because they are largely subject to conscious processes. One might question whether automatically generated action tendencies, which are not necessarily conscious, can be assessed by a questionnaire. Other potential, and perhaps less subjective, candidates for the assessment of action tendencies are postures (Neumann et al., 2003), facial expressions (Frijda & Tcherkassof, 1997), and (neuro)physiological responses (e.g. Davidson, 1992).

Another frequently used method consists of the assessment of arm movements (e.g. Chen & Bargh, 1999; Duckworth et al., 2002; Solarz, 1960). Authors in this tradition have long postulated that the cognitive evaluation of stimulus valence is directly reflected in arm movements. Arm extension has been supposed to indicate withdrawal from negative stimuli because it would give the impression of increasing distance toward a stimulus (Solarz, 1960).¹ Arm flexion, in contrast, would signal approach motivation toward positive stimuli because it would give the impression of decreasing distance toward an object. Whether this suggested link between stimulus evaluation and arm movements should result from the activation of innate motor programs or be a product of learning processes remains unclear.

Participants in Solarz's (1960) study displayed slower reaction times (RTs) when they had to perform an arm extension in response to positive words and an arm flexion in response to negative words than for the reverse combinations of stimulus valence and arm movement. Results thus appear to support the idea of a fixed link between appraisals of stimulus valence, on the one hand, and arm movements as supposed indicators of motivational states, on the other (cf. Chen & Bargh, 1999). Similar results have been obtained with pictorial stimuli (Duckworth et al., 2002). Moreover, Cacioppo et al. (1993) presented results that suggest that the association proposed by Solarz (1960) may be bidirectional. In the studies by Cacioppo et al., neutral stimuli seen during extensor tension were rated as less positive than those seen during flexor tension. In line with these results, Neumann and Strack (2000) found faster categorization of positive words as compared with negative words during arm flexion and the reverse pattern for arm extension.

Together, the results of the studies reported so far could suggest the existence of hard-wired links between arm extension and withdrawal motivation associated with negative stimulus evaluation, on the one hand, and between arm flexion and approach motivation associated with positive stimulus evaluation, on the other. However, arguing against the assumption of a rigid automatic mechanism, Rotteveel and Phaf (2004) showed that the link between stimulus evaluation and arm movements, as reported by Solarz (1960), Chen and Bargh (1999), and by Duckworth et al. (2002), might depend on the conscious processing of stimulus valence. What is more, Chen and Bargh conclude in their 1999 article that the relationship between attitudes (i.e. stimulus evaluations) and arm movements could have been different in a different context, 'as long as the laws within the psychological situation remain intact' (Chen & Bargh, 1999: 222). Such a view is in accordance with postulates from another group of researchers (e.g. Clore & Ortony, 2000) stating that the motivational significance of arm movements should be dependent on so-called situated meanings. Clore and Ortony write, for instance:

Interestingly, there is evidence that the connection is between appraisal and motivation rather than between appraisal and behavior because variations on this procedure produce the opposite results [than reported by Solarz and by Chen and Bargh] when arm flexion can be interpreted as withdrawing one's hand from an object (rather than as pulling an object toward oneself), and when arm extension can be interpreted as reaching for the object (rather than as pushing an object away) (M. Brendl, personal communication, 20 October 1997). Hence, it is the situated meaning of flexion and extension that is critical; the affective appraisals are manifested in the motivational realm as the desired end states of approaching or avoiding stimuli, rather than simply as triggers for distance-modulating behaviors (muscular flexion or extension). (2000: 51)

Indeed, recent research suggests that the above-reported relationship between arm movements and stimulus evaluations or action tendencies (e.g. Chen & Bargh, 1999; Solarz, 1960) can be reversed by manipulating the experimental setting (e.g. Wentura et al., 2000). An attempt to reconcile these ostensibly inconsistent findings has been made by Seibt and colleagues (2008). The authors were able to show that changing reference points can influence the observed association between arm movements and action tendencies. They predicted, that, if participants consider themselves as a stable and spatially fixed point of reference for the executed arm movements, extension could be interpreted as pushing something further away (withdrawal action) and flexion could be interpreted as pulling something toward oneself (approach action). However, if the object (in their case, a word presented on a computer screen) is taken as a stable and spatially fixed point of reference, flexion should be experienced as a withdrawal action from the object, whereas extension should constitute the approach action. Consistent with these hypotheses, in their study, arm flexion was facilitated during the presentation of positive words and arm extension during the presentation of negative words in the self-reference point condition only. The opposite was observed for the object-reference point condition. Based on these results, Seibt et al. concluded that participants in the Solarz and in the Chen and Bargh studies must have adopted a self-reference point, whereas participants in the Wentura et al. study had taken up an object-reference point.

Further evidence for contextual influences on the arm movement–action tendency link has been reported by Puca et al. (2006). These researchers manipulated the location of a sound source (in front of vs behind the participants) and showed that individuals with high avoidance motives more rapidly performed an extension when a sound stimulus was located behind them than when it was located in front of them. The reverse was observed for arm flexion. From these observations, Puca et al. concluded that ‘...it is not the physical direction (forward or backward) but rather the movement’s effect of distance reduction (approach) or distance increase (avoidance) in regard to the stimulus that defines a movement as an approach or an avoidance movement’ (Puca et al., 2006: 980).

What is more, an earlier experiment by Markman and Brendl (2005) demonstrated that the effect may not depend on an individual’s physical location but rather on the individual’s representation of his or her self in space. Participants in this study viewed their names (representation of their selves) presented on a screen. Positive and negative words appeared either in front of or behind their names. Regardless of type of arm movement, shorter RTs were displayed for the movements that brought positive words closer to the representation of participants’ selves and deflected negative words from this representation.

Finally, Eder and Rothermund (2008) showed that the instructed affective significance of arm movements was able to influence their facilitation in response to affectively laden stimuli. The authors argued that verbal instructions labeling arm flexion or arm extension as ‘up’, ‘down’, ‘away’, or ‘toward’ applied affective codes to the respective arm movements. Depending on their attributed affective codes, the performance of arm flexion and arm extension was then facilitated by either positive or negative stimulus material. Moreover, the facilitation effect extended to sideward movements, thus suggesting that it is not specific to distance reduction of an individual’s body with respect to the presented stimulus material.

While it is observed that contextual factors are able to influence the stimulus evaluation–arm movement link, to date it is not clear which concrete contextual factors are influential. In this regard, it has been hypothesized that the outcome of an arm movement plays an important role (cf. Clore & Ortony, 2000). In real life, arm movements usually have some adaptive effect, provoking changes in the environment. The experiments conducted so far have uncoupled the arm movements from specific consequences (e.g. Chen & Bargh, 1999; Puca et al., 2006; Solarz, 1960) or have not independently varied the arm movements and the resultant effects on the presented stimuli (e.g. Wentura et al., 2000: extension always yielded an increase of word size, flexion always yielded a decrease of word size; for comparable paradigms with respect to this issue concerning pictorial stimulus material, see Heuer et al., 2007, as well as Rinck & Becker, 2007). Consequently, an independent contribution of outcome desirability on the facilitation of arm movements could not be determined, yet. Therefore, in the current study, the performance of a specific arm movement was not restricted to a single outcome.

In addition, instructions in the current study differed substantially with respect to earlier studies. Neither did we attach explicit labels to arm flexion or arm extension by varying instructions (cf. Eder & Rothermund, 2008; Seibt et al., 2008), nor was it the explicit goal of the participants to approach or withdraw from positively and negatively

valenced stimuli in the experimental task (e.g. Krieglmeier et al., 2011; Markman & Brendl, 2005). Instead, participants in our study had the explicit goal to display rapid RTs in response to displayed symbols in order to gain a monetary reward. Furthermore, our participants did not know in advance whether they needed to perform an arm extension or an arm flexion; in contrast to the majority of earlier studies, movement direction was varied within rather than across experimental blocks, thus reducing the degree of conscious processing of experimental aims. Lastly, another distinctive aspect of the current work is that we investigated whether words and pictures were characterized by similar or different facilitation effects.

Inspired by the studies of Heuer et al. (2007), Rinck and Becker (2007), and Wentura et al. (2000), we employed a zooming function in the visual domain and varied this zooming function orthogonally to arm flexion and arm extension. In accordance with earlier research in the field, we assumed that positive stimuli could be considered as rewarding and should provoke approach tendencies (cf. Lang et al., 1990; Solarz, 1960). Consequently, increasing the size of positive stimuli should be experienced as desirable or goal conducive (goal = maximization of positive stimulation). Decreasing the size of positive stimuli, in contrast, can be assumed to be undesirable or goal obstructive. Negative stimuli may be supposed to provoke withdrawal tendencies. Decreasing the size should provide relief and be desirable or goal conducive; increasing the size should be threatening and undesirable or goal obstructive (goal = protection from potential harm). We argue that a given movement should be facilitated only if it can be expected to lead to a desired outcome. According to this standpoint, either arm flexion *or* arm extension can be facilitated during the presentation of a positive stimulus, that is, when it decreases the distance between ourselves and the desired object (e.g. a positive image).

Participants in our study viewed affectively laden pictures and words (negative and positive) while performing the arm movements. For half of the participants (Group Ext-), the stimuli increased in size after the performance of arm flexion and decreased in size after the performance of arm extension. For the other half (Group Ext+), the reverse occurred. By including two groups, with reversed outcomes for extension and flexion, context or outcome effects could be separated from the performance of specific arm movements. We postulated faster responses for arm movements that led to a desired effect (decrease of negative stimuli and increase of positive stimuli) than for those that led to an undesired effect (increase of negative stimuli and decrease of positive stimuli).

Method

Participants

Forty-two female University of Geneva undergraduates, aged between 18 and 29 years ($M = 22.3$; $SD = 3.04$), participated in this study. They were either paid 15 CHF for their participation (30 participants), or took part in the context of an introductory psychology course (12 participants). The 4 best performers (rapid response times with no or few errors) obtained an additional 50 CHF each. All participants had normal or corrected-to-normal vision.

Experimental design

The experimental design was a $2 \times 2 \times 2 \times 2$ mixed-factorial design with one between-subjects factor and three within-subjects factors.

1 Between-subjects factor. (a) Visual effect following an arm movement = Group (two levels; Group Ext–: extension-small/flexion-large vs Group Ext+: extension-large/flexion-small). For half of the participants (Group Ext–), the image/word size became smaller when they pushed the joystick and larger when they pulled the joystick; for the other half (Group Ext+) the reverse was true. This way, the arm movements were embedded in a meaningful context. Visually, arm flexion in Group Ext– gave the impression of approach, whereas extension gave the impression of withdrawal (and the reverse for Group Ext+).

2 Within-subjects factors. (a) Material (two levels: pictures vs words). The experiment included two different blocks (counterbalanced presentation), which differed with respect to the included stimuli only (60 pictures versus 60 words). Pictures were chosen from Lang et al.'s (1999) International Affective Picture System and an own-picture evaluation study. Words were chosen from a list published by Bonin et al. (2003).

(b) Valence (two levels: negative [vs neutral] vs positive). Pictures and words differed with respect to their valence. Negative and positive pictures were matched for subjective arousal and complexity (Appendix Table 1). Negative and positive words were controlled for concreteness, imageability, subjective frequency and word length (Appendix Table 2). Neutral stimuli were inserted as filler items.

(c) Arm movement (two levels: extension vs flexion). The apparition of two different symbols superimposed on the stimuli approximately 500 ms after stimuli onset indicated whether the participants had to push or to pull a joystick. The push symbol (triangle pointing upward) and the pull symbol (triangle pointing downward) were projected onto 15 images/words each. Participants had to push the joystick five times and to pull it another five times within each valence level. There was no fixed combination of picture and push or pull symbol.

Setting and apparatus

Participants were seated comfortably in a reclining position, facing a computer screen (Sony CPD-E400E) at a distance of approximately 1.4m (picture size 16cm \times 24cm) in a sound-attenuated room (3.5m \times 4m). Participants performed the arm movements with a Logitech Extreme 3D Pro Twist Handle Joystick (Fremont, CA, USA) fixed at their right side. The joystick was blocked to prevent lateral displacements, so only extension and flexion movements were possible. The joystick automatically returned to the central position after every response. Participants were able to comfortably position their arm on an armrest while giving their responses.

Experimental control (i.e. stimulus presentation, registration of RTs and direction of joystick movements) was performed by DirectRT v2004 (Empirisoft Corporation, New York, USA), running on the presentation computer (HP Compact d530 CMT).

Procedure

Participants were informed that they were taking part in an experiment on sensorimotor coordination with the registration of bodily reactions, and that the four best performers would receive 50 CHF each. The participants, having signed a consent form on arrival at the laboratory, then had electrodes attached to register their physiological responses (psychophysiological data from this study are presented in Aue & Scherer, 2011).

The task consisted of viewing pictures/words presented on a computer screen (picture size: 256×192 pixels, word size: 24 [medium]) and reacting as rapidly as possible to two symbols superimposed on these pictures/words approximately 500 ms after picture/word onset. For one group of participants, the image/word size increased (pictures: 640×480 pixels, covering the whole screen; words: size 72 [extremely large]) in response to arm flexion, and decreased (pictures: 100×75 pixels, details no longer identifiable; words: size 8 [very small]) in response to arm extension. Another group of participants experienced the reverse responses. After the execution of an arm movement,² the picture/word in its new size was presented for 4s and then followed by a black screen (on average 2s).³ Each performance block was preceded by a training period of six trials. A neutral picture/word was shown as the first stimulus in each performance block to ensure that reactions to the first relevant stimulus were not simply an effect of surprise.

Finally, in a post-interview, participants were asked about their hypotheses concerning the aim of the study, their involvement, and their physical and psychological well-being. No participant indicated physical or psychological disturbance or that she had guessed the real aim of the study. Involvement was stated as having been sufficiently high ($M = 2.3$, $SD = 1.08$) on a scale ranging from 0 (*not at all*) to 4 (*extremely*). Before leaving the laboratory, participants were debriefed.

Dependent variable

Reaction times (RTs). A particular RT describes the latency between the apparition of the push or the pull symbol on a picture/word and the moment when the joystick traversed the point describing 50% of the maximum possible deflection in either the extension or the flexion direction. RT was measured in milliseconds.

Data analysis

Outlier detection and exclusion of participants. RTs deviating more than three standard deviations from an individual's mean RT in a given experimental block (pictures vs words) were treated as outliers and set to missing (1.2% of all valid responses; another 3% were excluded because a response had been given too late, taking more than 1000 ms [extreme outliers], or was wrong [flexion in response to the push symbol or extension in response to the pull symbol]). Participants were excluded from RT analyses when more than 10% of their responses in a given block were errors or outliers. This was the case for two participants in the picture block. RTs of a single participant were eliminated from both experimental blocks because of RT registration problems. For the remaining participants ($n = 39$), RTs related to errors or outliers were discarded.

Statistical analysis. An analysis of variance (ANOVA) with the between-subject factor *Group* (two levels: Ext–, Ext+) and the within-subject factors *Stimulus material* (two levels: pictures, words), *Valence* (two levels: negative, positive) and *Arm movement* (two levels: extension, flexion) was calculated.

Results

RTs for pictures were longer than RTs for words; main effect for Stimulus material, $F(1, 37) = 79.76, p < .000001, \eta^2 = .68$ ($M_s = 536$ and 484 ms, respectively). Arm movements were performed more rapidly for positive as compared with negative stimulus material; main effect for Valence, $F(1, 37) = 5.42, p < .05, \eta^2 = .13$ ($M_s = 507$ and 513 ms, respectively). The significant interaction Stimulus material \times Valence, $F(1, 37) = 7.10, p < .05, \eta^2 = .16$ revealed a significant difference in RTs between positive and negative pictures but not between positive and negative words (all Tukey pairwise comparisons: $p < .005$, except positive words versus negative words: $p = 1.00$).

More importantly, in accordance with our expectations, the interaction Valence \times Arm movement failed to reach significance, $F(1, 37) = 0.01, ns, \eta^2 = .00$, demonstrating that facilitative effects on arm movements do not rely on a fix valence–arm movement link. Instead, in accordance with our predictions, goal-conductive arm movements were generally executed more rapidly than were goal-obstructive arm movements (Figure 1), as reflected in the significant interaction Group \times Valence \times Arm movement, $F(1, 37) = 6.36, p < .05, \eta^2 = .15$. Moreover, the effect was visible in both groups of participants,

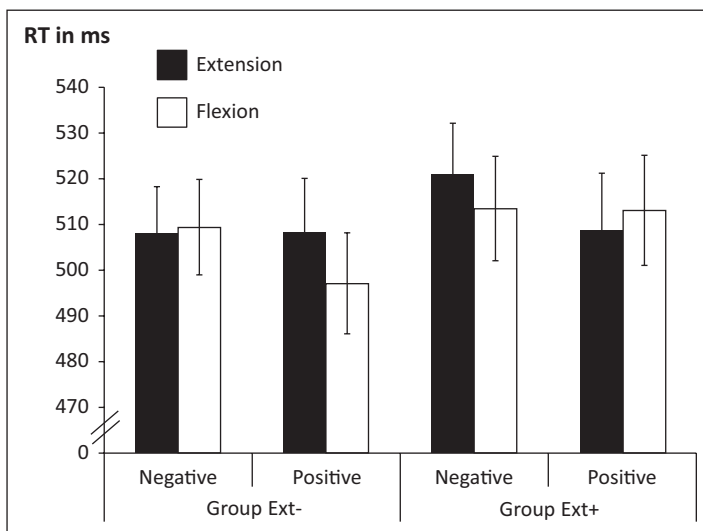


Figure 1. Reaction times (RTs) as a function of Valence, Arm movement and Group: Group Ext–: extension = decreasing stimulus size, flexion = increasing stimulus size; Group Ext+: extension = increasing stimulus size, flexion = decreasing stimulus size. Error bars depict standard errors. $N = 39$.

$t(37) = 1.66$ and 1.91 , p s = $.05$ and $< .05$ (one-tailed).⁴ Thus, it seems that the motivational context strongly determines the psychological significance of arm movements. Interestingly, the differences between positive and negative images are much more pronounced in the increasing stimulus size conditions (flexion in Group Ext– and extension in Group Ext+) than in the decreasing size conditions (extension in Group Ext– and flexion in Group Ext+). Finally, the four-way interaction Group \times Stimulus material \times Valence \times Arm movement was not significant, $F(1, 37) = 0.80$, ns , $\eta^2 = .02$, suggesting that the above-reported facilitation effects hold for pictures as well as for words.

Discussion

The current experiment is, to our knowledge, the first to independently vary arm movements and their resulting visual effects. We did this by manipulating the context in which arm movements were performed, establishing either an approach (stimulus size increase) or a withdrawal context (stimulus size decrease). In line with results from other studies (Markman & Brendl, 2005; Puca et al., 2006; Seibt et al., 2008), our results show once more that flexion does not unequivocally represent an approach movement, and extension does not unequivocally represent a withdrawal movement. Rather, RTs in our experiment strengthen the idea of a situated or context-dependent meaning of arm movements. We were able to show that the desirability of an effect of an arm movement on a given stimulus determines its facilitation or inhibition. Participants simply preferred the movements that initiated the decrease of negative and the increase of positive images and words.

On the whole, our data do not support the notion of an automatic, hard-wired link between arm movements and stimulus appraisals or action tendencies. Specifically, a particular outcome of the valence appraisal did not consistently facilitate or inhibit a specific arm movement. Thus, stimulus valence did not appear to have a unique or prepotent influence on the facilitation of a specific arm movement. This result is not surprising because the simple fact that something negative or positive is presented at a certain ‘psychological distance’ (which is the case with words or pictures) does not require a specific type of action preparation. Rather, the potential outcomes of available actions in relation to personal goals should determine which behavior is finally facilitated and shown.

Importantly, in contrast to earlier research, neither did our observed effects arise in an experimental environment that made use of instructions to apply motivational meanings to arm extension and arm flexion (Eder & Rothermund, 2008; Seibt et al., 2008), nor was it the explicit goal of our participants to approach or withdraw from the presented stimulus material (Krieglmeyer et al., 2011; Markman & Brendl, 2005).

In our specific case, the significance of arm movements was evidently shaped by the desirability of the visual outcomes. Thus, we were able to demonstrate that the significance of arm movements easily adapts to the context – without the need for specific task instructions. Our results suggest as well that individuals do not need to consciously process the meaning of an arm movement for facilitation effects to occur.

The RT differences we found between conducive and obstructive arm movements were relatively small. One reason for this may be that, due to the inclusion of physiological measures (serving the investigation of non-related hypotheses, see Aue & Scherer, 2011),

we were restricted to a limited number of trials and could not have rapid stimuli presentation. Also, the rather long intervals between subsequent onsets of stimuli (~ 6.5s) and the time elapsed between stimulus onset and requested response (~ 500ms) may have reduced the impact of the stimuli on the facilitation of arm movements and augmented the strength of alternative influences on RT. It is possible that the extended stimulus presentation times led to changing states of attention, thus blurring RT differences between conducive and obstructive arm movements. However, we also cannot clearly determine if the influence of the visual outcomes on the facilitation of arm movements on valence would occur in studies investigating only early stages of stimulus processing.

An important point to consider is whether our pictorial stimulus material was really unambiguous with respect to valence. It can be speculated that negative images are frequently experienced as ambiguous. On the one hand, they can be thought to evoke withdrawal tendencies. On the other hand, it is also very important to pay attention to and orient toward potentially threatening situations. Some participants in our study may have been curious to figure out what was being depicted in a given negative image. In extreme cases, there can even be an effect of sensation seeking (Zuckerman, 1979). Human beings often have a tendency to enjoy the confrontation with negative information and stimulus material. A typical example of this is the pleasure that at least some of us take in watching horror films. Evidence for simultaneous activation of approach and withdrawal motivation comes from several studies (e.g. Larsen et al., 2004; Miller, 1961).

Conclusion and future perspectives

It seems unjustified to interpret the relative ease of arm flexion and arm extension as reliable indicators of the relative strength of approach and withdrawal motivation (e.g. Förster et al., 1998; Heuer et al., 2007; Rinck & Becker, 2007), at least when considered independently from contextual factors. Only when contextual factors allow an unambiguous interpretation of the motivational significance of the arm movements can these be taken as indicators for motivational states. Our study shows that visual consequences of arm extension and arm flexion can shape the motivational significance of these arm movements. Such visual outcomes could also affect whether, in the long run, a self-reference point (Group Ext-) or an object reference point (Group Ext+) is adopted.

Although our results suggest the motivational significance of arm movements to be context dependent, this does not at all imply that the study of arm movements is worthless or without interest. Rather, it will be useful to identify more exhaustively which additional contextual factors (other than visual consequences) moderate the link between arm movements and stimulus evaluations. Krieglmeyer et al. (2011) demonstrated that ultimate rather than immediate distance change with respect to a desired end state played a major role in the facilitation of arm movements. Participants in this study made a manikin on a computer screen approach or withdraw from affectively laden words. In some experimental trials, the participants needed to initiate a detour that first put the manikin at an even greater distance from a desired end state but ultimately enabled the accomplishment of that desired end state. In these same trials, immediate distance reduction would have complicated the attainment of the desired

end state. Participants more rapidly performed the arm movements that yielded an ultimate rather than immediate distance reduction with respect to the desired end state. It would be interesting to embed this experimental paradigm into a more naturalistic setting, for example by employing a virtual-reality environment that makes use of visual zooming.

In our experiment, we did not distinguish between the initiation and the execution time of the arm movements. Instead, we measured only the time elapsed between stimulus onset and halfway joystick displacement in either the extension or the flexion direction. Whether initiation or execution differences were responsible for the observed effects remains to be clarified. Results reported by Rotteveel and Phaf (2004) and by Solarz (1960) suggest that the effects originate in the initiation phase. However, the Puca et al. (2006) studies suggest execution time (or response force) to be the more important determinant. Subsequent studies should further investigate this point. It will be essential to find out whether our observed differences in RTs have their origin in differential time needed for decision-making and response preparation (both influencing initiation time) or in differences in motor execution time.

In future experiments, it will also be challenging to integrate different time intervals between the image/word onset and the apparition of the symbol demanding either an arm extension or an arm flexion. An interesting question is whether the impact of context influences changes with varying time intervals between picture/word onset and symbol apparition. On the one hand, with increasing time intervals, the probability of controlled processing is probably augmented and might enhance context influences on the facilitation of arm movements. On the other hand, affective responses may rapidly fade, and influences on response tendencies could therefore also be expected to be particularly strong in the early phase of stimulus presentation.

Finally, it has to be taken into consideration that our results cannot be generalized to the oppositely directed link, namely the one in which arm movements are not taken as indicators but as causal agents of stimulus appraisals. Whereas we do present data that question the idea of specific arm movements being facilitated by positive versus negative stimulus evaluations, we cannot infer that this also questions the idea of the execution of arm flexion/extension provoking appraisals of positive/negative valence (cf. Cacioppo et al., 1993; Neumann & Strack, 2000).

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Notes

1. It is important to note that Solarz, in his article, did not use the label *withdrawal* but *avoidance* when referring to arm extension. However, Schneirla (1959) emphasized the importance of making a clear distinction between avoidance and withdrawal, as only the latter implies increasing distance from a source of stimulation and thus constitutes the direct opposite of approach. For the sake of clarity, we make use of Schneirla's approach and withdrawal terminology throughout this article.
2. More precisely, after 50% of the maximum possible deflection in either the extension or the flexion direction had been performed.

3. In contrast to earlier studies employing a zoom effect (Heuer et al., 2007; Rinck & Becker, 2007; Wentura et al., 2000), we did not use intermediate steps of size changes but simply replaced the medium-sized images and words by the large or small images and words.
4. *t* values refer to the difference scores between goal-conducive and goal-obstructive events in each group and were tested against zero.

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Klaus Scherer is a Professor emeritus at the University of Geneva and directs the Centre Interfacultaire en Sciences Affectives and the Swiss Center for Affective Sciences. His research activities focus on emotion. Several research programs, financed by granting agencies and private foundations in the US, Germany, and Switzerland, are directed at the study of cognitive evaluations of emotion-eliciting events and on facial and vocal emotion expression. Scherer has reported this work in numerous publications in the form of monographs, contributed chapters, and papers in international journals. He has edited several collected volumes and handbooks and co-edits the ‘Affective Science Series’ for Oxford University Press. He is a founding co-editor of the journal *Emotion*.

Appendix

Table 1. Means for valence, arousal, and complexity ratings for pictures.

Valence	Picture (IAPS number)	Source	Valence	Arousal	Complexity
Negative	KKKI rally (9810)	IAPS	1.59	5.75	4.95
Negative	Beggar	Web	1.75	4.47	4.38
Negative	Vomit (9320)	IAPS	1.80		
Negative	Gun (6560)	IAPS	2.01		
Negative	Nuke	Web	2.09	5.57	4.70
Negative	Burial	Web	2.36	3.47	4.24
Negative	Car accident (9911)	IAPS	2.71		
Negative	Attacking dog	Web	2.86	5.54	3.35
Negative	Soldier (9421)	IAPS	2.93		
Negative	Dirty pig	Web	3.35	4.37	4.16
Neutral	Railtracks	Web	4.30	3.40	6.20
Neutral	Building 2	Web	4.77	2.95	3.21
Neutral	Boat	Web	4.98	2.51	2.92
Neutral	Motorcyclist (8260)	IAPS	5.17		
Neutral	Man on cliff (8160)	IAPS	5.29		
Neutral	Mist	Web	5.31	3.72	5.02
Neutral	Skyscraper	Web	5.44	2.64	4.00
Neutral	Conference	Web	5.63	2.34	5.50
Neutral	Roofer	Web	5.75	3.41	3.51
Neutral	Condom (4613)	IAPS	5.88		
Positive	Lion (1720)	IAPS	6.95		
Positive	Airplane flight	Web	7.05	5.45	4.62
Positive	Carousel	Web	7.32	5.10	4.84
Positive	Young koala	Web	7.71	3.01	3.27
Positive	Kittens (1463)	IAPS	7.74	4.15	3.69
Positive	Sandcastle	Web	7.90	3.52	6.27
Positive	Dolphins	Web	8.06	3.46	3.23
Positive	Skiers (8190)	IAPS	8.08		
Positive	Sunset (5830)	IAPS	8.09		
Positive	Old couple (2550)	IAPS	8.31		

Note: Thirty-eight participants in a picture-evaluation task rated the pictures on continuous scales. Average scores of all participants were transformed into values ranging from 1 (*not at all/very negative*) to 9 (*extremely/very positive*). Gray values were obtained in another experiment. Web = pictures found on the World Wide Web; IAPS = pictures taken from the International Affective Picture System.

Table 2. Means for concreteness, imageability, subjective frequency, and valence ratings for words selected from a French word list (Bonin et al., 2003).

Valence	French	English translation	Concreteness	Imageability	Subjective frequency	Valence	Number of characters
Negative	Fusil	Gun	4.82	4.68	2.36	1.12	5
Negative	Seringue	Syringe	4.91	4.64	2.36	1.20	8
Negative	Araignée	Spider	4.86	4.76	3.24	1.32	8
Negative	Tombe	Grave	4.18	4.04	2.68	1.32	5
Negative	Limace	Slug	4.77	4.46	2.20	1.52	6
Negative	Serpent	Snake	4.77	4.56	2.84	1.52	7
Negative	Sang	Blood	3.95	4.20	3.88	1.72	4
Negative	Ambulance	Ambulance	4.59	4.36	3.12	1.76	9
Negative	Soldat	Soldier	4.41	4.16	2.64	1.88	6
Negative	Diable	Devil	2.55	4.00	2.52	1.92	6
Neutral	Ceinture	Belt	4.82	4.36	3.68	2.84	8
Neutral	Statue	Statue	4.68	4.29	2.68	2.84	6
Neutral	Micro	Microphone	4.36	4.40	2.84	2.88	5
Neutral	Cadran	Dial	4.14	3.16	2.28	2.96	6
Neutral	Tronc	Trunk	4.64	4.40	2.92	2.96	5
Neutral	Cube	Cube	4.32	4.56	3.00	3.00	4
Neutral	Marmite	Cooking pot	4.77	4.44	2.40	3.00	7
Neutral	Chemisier	Shirt	4.77	4.28	3.36	3.04	9
Neutral	Horloge	Grandfather clock	4.82	4.68	3.40	3.08	7
Neutral	Haie	Hedge	4.55	3.92	2.76	3.12	4
Positive	Couffin	Carrycot	4.82	3.84	2.08	4.08	7
Positive	Mûre	Blackberry	4.73	4.72	2.84	4.08	4
Positive	Bague	Ring	4.91	4.84	3.96	4.20	5
Positive	Baignoire	Bath(tub)	4.86	4.64	3.96	4.20	9
Positive	Trèfle	Clover	4.36	4.72	2.52	4.20	6
Positive	Rose	Rose	4.91	4.76	3.44	4.40	4
Positive	Hamac	Hammock	4.86	4.36	2.08	4.44	5
Positive	Famille	Family	3.23	3.44	4.72	4.52	7
Positive	Dauphin	Dolphin	4.68	4.80	2.52	4.56	7
Positive	Etoile	Star	3.86	4.68	3.96	4.60	6

Note: Ratings were given on a 5-point scale from 1 (*very little concrete/evokes a mental image with difficulty, slowly, or no image at all/word name rarely used in spoken or written language/very unpleasant*) to 5 (*very concrete/evokes a mental image very easily, rapidly, and spontaneously/word name very frequently used in spoken or written language/very pleasant*).