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RUNNING HEAD: MOTION AS INPUT

Motion as input: A functional explanation of movement effects on cognitive processes

Markus Raab

Center for Adaptive Behavior and Cognition

Max Planck Institute for Human Development, Berlin

Institute for Movement Sciences and Sport

University of Flensburg

Nikos Green

University of Osnabrueck, Cognitive Science Program,

Osnabrueck, Germany

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Correspondence should be addressed to Markus Raab, mail (raab@uni-flensburg.de)

Motion as input:

A functional explanation of movement effects on cognitive processes

Summary. – Motion is often thought of as the result of perceptual and higher cognitive processes. Although this idea has been investigated in myriad ways, the understanding of how movements tune cognitive processes is still in its infancy. The present study examined the nonaffective tuning of movements (arm extension and arm flexion) on heuristic and systematic processes. In a departure from recent cognitive tuning models, a model was derived that defines the tuning effect based on the movement goal and not on the movement position. In the experiment, participants moved toward an extension or flexion position with a movement goal that connected the movement with either an avoidance or an approach function. The results indicate that cognitive tuning is a product of the movement goal rather than the movement position. Implications for models of motor control as well as for cognitive tuning models are presented.

Movements are often understood as the result of cognitive or emotional processes. For instance, if a couple is observed in a dispute and one partner is in tears with a hanging head, it can be inferred that what the person heard was sad, and that this attribution resulted in the observed posture of the body.

Recent evidence from many fields has shown that movements are not controlled via a generalized movement program (Schmidt, 1975), defined as a set of parameters such as activations of homogeneous muscle groups, but rather are triggered by perceptual and motor goals. For instance, Gergely, Bekkering, and Kiraly (2002) showed that babies imitate an adult's movements with the motivation of achieving the same goal rather than simply copying the movement, if the goal is advantageous. In adults, bimanual experiments demonstrated that motor control is triggered by perceptual goals and not activations of homogeneous muscle groups (Mechsner, Kerzel, Knoblich, & Prinz, 2001). Kertesz and Ferro (1984) showed that patients with a movement disorder (ataxia) were unable to reach to a specific spatial position, but they were able to use movements to complete a goal-triggered task, such as taking a book from a shelf. In addition, in monkeys, Koski, Wohlschlager, Bekkering, Woods, Dubeau, Mazziotta, and Iacoboni (2002) demonstrated that movement production in imitation of others is also triggered by the functional goal of the movement rather than the movement itself (e.g., position, temporal-spatial pattern). These findings in children and adults, and in other species, led to the conclusion that it is important to understand the connection between movements and the perceived goals of the movement to understand how the cognitive system produces movements.

However, for as long as psychology itself has been a scientific discipline, it has been thought that movements can increase emotions or tune—that is, make (slight) adjustments to —cognitive processes, a concept known as cognitive tuning (described below). William James (1890) was one of the first to suggest this line. He proposed a hedonic hypothesis, which states that flexion and extension of effectors is associated with pleasant or unpleasant emotions, as opposed to the idea that movements are not connected to the emotional system.

The association between movements and emotions is evolutionary and therefore is the same for all people. Some forms of motor stimuli or the sensory consequences of movements can subtly influence a person's mental attitude, such that the attitude would have been different had the motor component been present or absent. More recently, Cacioppo, Priester, and Berntson (1993) discovered that the somatic activities of arm flexion and arm extension have differential effects on attitudes toward novel, unrelated stimuli that are the target of evaluative processing. This study focused on the direct effect of distal (perceptual) or proximal (motor) cognitive tuning in conditions in which mood has not been affected. Here we develop and test an alternative cognitive tuning model that assumes that movement goals and not movement positions are the important cues for the cognitive system. It is assumed that the unconscious evaluation of movement goals is the default mechanism that influences the cognitive system and therefore can override information of the movement positions.

Cognitive Tuning

The concept 'cognitive tuning' describes that affective states inform individuals as to whether their current situations are safe or problematic (Friedman & Förster, 2000, p. 478). This internal evaluation leads to unconscious deliberation and decision concerning the processing of data and may influence the performance of various cognitive tasks. Cognitive tuning is defined as the influence (tuning) of the present affective state, such as the self-evaluation in the current situation. It entails an unconscious decision on the activation of different cognitive processes. For instance, Friedman and Förster (2002) concluded from evaluating previous research that different arm positions motivate different hedonic states and activate different processing styles (systematic vs. heuristic). Their cognitive tuning model (Friedman and Förster, 2000, 2002) assumes that cues, for example, bodily cues such as the position of an arm, are associated with positive or negative hedonic states that themselves activate systematic or heuristic information processing.

Systematic processing involves active, intentional, and conscious processing and is cognitively demanding. In contrast, heuristic processing involves the use of simple rules, focuses on features of the environmental cues rather than on the content of the cues, and is less cognitively demanding (Chen & Chaiken, 1999). Testing the amount of heuristic and systematic processing that is used can be achieved by using tasks that allow for different processing speeds (fast: heuristic processing; slow: systematic processing) and different types of information (small amount, salient, or abstract: heuristic; large amount, content-dependent, or detailed: systematic). In an overview, Fiedler (1988) provided a table of empirical evidence of how the cognitive processes can be changed by mood manipulations or instructions. For instance, heuristic processing is increased by a positive mood in tasks such as creative problem solving and results in increased originality of associations generated (Isen, Johnson, Mertz, & Robinson, 1985; see also Bolte, Goschke, & Kuhl, 2003, for further evidence). Heuristic processing is assumed to be applied in a generation task, such as generating names of birds, if only a small number of birds is generated and participants stop their generation early in the task. Systematic processing is more involved if participants in these tasks take more time and generate more names of birds (Hirt, McDonald, & Melton, 1996). In addition to these quantitative differences, there are also qualitative differences, such that using heuristic processing results in changes of association strength compared to systematic processing (e.g., Isen et al., 1985).

One explanation of how movements might tune cognitive processes comes from an evolutionary perspective: this states that flexion of an arm activates a concept of acceptance (approach), whereas extension of an arm activates avoidance (Cacioppo et al., 1993). Approach focuses people on internal, subjective data, cuing the use of heuristic processing, and avoidance focuses people on external, objective data, cuing systematic processing, according to this theory (Cacioppo et al., 1993). Which focus is used mainly depends on information already in memory, as shown in Friedman and Förster's Experiment 4 (2002) in which participants completing word fragments were influenced in their use of systematic or heuristic processing by previously presented complete words that have a semantic meaning.

Nonaffective and distal cues activate cognitive tuning

Information from the environment, which we define as distal cues (e.g., a happy face or valenced colors), can tune cognitive processing. Ottati, Terkildsen, and Hubbard (1997) required participants to make verbal statements (impression formation task) about videotapes of a political candidate producing happy, neutral, or angry faces during an interview in a stereotyping experiment. In the condition where the political candidate produced more happy faces participants processed his verbal statements heuristically such that they globally judged his ideology. When the candidate produced neutral and angry faces participants judged systematically on the basis of his specific issue positions. Soldat, Sinclair, and Mark (1997) showed that positive or neutral affect can be conveyed by color: red for positive affect and either blue or white for neutral affect. Participants (introductory psychology students) completed 15 problem-solving tasks from the Graduate Record Examination (GRE) test in either the positive (red paper) or the neutral (white or blue paper) affect condition. On average, participants used more systematic processing of the information in the condition when white or blue paper was given and more heuristic processing of the information when red paper was given, indicated by the amount of time spent and the number of correct solutions.

These two experiments have in common that valenced information (in this case with positive valence) elicited heuristic processing without causing changes in mood as measured by the Present Mood State Inventory (Sinclair & Mark, 1995). In conclusion, distal cues from the environment that are not related to the task seem to influence cognitive processing styles.

Nonaffective and proximal cues activate cognitive tuning

Information from a person's internal sources, such as muscular sensation, which we define as proximal cues, can influence evaluations of environmental information. For instance, Strack, Martin, and Stepper (1988) found that participants rated cartoons funnier when holding a pen between their teeth (same muscular action as smiling) than when holding the pen between their lips. A number of follow-up studies have shown that muscular sensations influence judgments in various tasks, such as GRE problem-solving tasks and creative thinking tasks such as a verbal analogy task (Förster, 1998; Förster & Stepper, 2000; Neumann & Strack, 2000). Taken together, it seems that the generation of valenced information is moderated by the influence of proximal motor cues.

More relevant for the purpose of the present study, Förster and Strack (1997, 1998) found that flexed or extended arm positions had different effects on the categorization of celebrities into groups of ‘like’, ‘dislike’, and ‘neutral’. Participants generated more names of persons that they disliked under arm extension and more names that they liked under arm flexion. As Sinclair and Mark (1995) showed with distal cues, proximal cues (e.g., muscular sensation) also have no effect on the mood of the person, measured by mood scales before and after presenting information (Förster & Strack, 1997). Friedman and Förster (2000) further examined the effect of the nature of motor actions (approach/flexion or avoidance/extension) on heuristic and systematic processing strategies in creative insight problems and analytical reasoning tasks. For instance, they assumed that the physical feedback produced by the arm position triggers heuristic processes if the arm is held in a flexed position and systematic processes if the arm is held in an extended position. This nonaffective physical feedback produced by arm flexion and extension informs individuals about the processing requirements of the situation, leading to the adoption of different processing styles and thereby influencing cognitive processing. This effect was found even when the mood of participants did not change over the course of the experiment, and mood was not different between conditions of arm flexion and arm extension. Therefore, Friedman and Förster (2002) concluded that the position of the arm itself directly influences cognitive processing without the moderating effect of mood. This finding is robust in a number of experiments using different tasks and settings (see Friedman & Förster, 2002, for an overview).

While the reported behavior is an interesting phenomenon, there have not been many attempts to explain how movements affect cognition. A possible framework comes from Cacioppo et al. (1993), who pointed out that most movements with an extended arm are done, and were done from an evolutionary perspective, to hold off others and therefore are connected with negative emotions, whereas pulling someone or something toward oneself is connected with positive emotions. Whether or not this is a plausible and generalizable explanation (e.g., it does not work with flexion and extension of the feet; see Cacioppo et al., 1993), it seems likely that the anticipated consequences of all goal-oriented movements and emotional states can be associated.

It has been suggested by Mechsner et al. (2001) that the *movement goal* determines which decision-making process is activated. The proprioceptive information (e.g., activation of muscles) is enriched by the goal-oriented information. Both inputs activate a cognitive component that influences the evaluation of the situation and the engagement of appropriate processing strategies according to the above-mentioned principles. Until now, there have been no hypotheses about this empirical evidence of proprioceptive information cuing. Förster and Strack (1998) stated in a footnote that, in some situations, the valence of the arm *positions* could be reversed. However, it is proposed that the *function* of an arm movement and not the *position* of an arm defines whether the signal implies approach (heuristic processing) or avoidance (systematic processing) content. For instance, a person may want to bring something toward himself but has to extend his arm, or has to pull a trigger to move something away. In these situations, the arm position itself seems less important for tuning cognitive processes than the goals of the intended movements, which, when fulfilled, lead to a neutral evaluation outcome, because a constraint has been satisfied. If the same position is used (flexion of the arm) but different functions (approach vs. avoidance) are served, then one could expect different processing strategies for approach and avoidance functions of the movement. The strongest hypothesis states that the avoidance function should trigger systematic processing, even when this requires pulling the arm in a flexion position, whereas the approach function should trigger heuristic processing independent of the arm position. A second, weaker, hypothesis is that both movement position and movement goal serve as cues that tune cognitive processes. The stronger hypothesis will be tested in the following experiment.

Method

Participants

Forty self-reported right-handed female students (between 22 and 28 years old, M = 22.9, SD = 2.65) from the Free University of Berlin were asked to participate. All participants were paid 10 euros for participation and they provided informed consent prior to the study. Only right-handed female students were used as subjects to allow easier manipulation of the power of the movement and the apparatus used (see Apparatus). They were randomly assigned to one of four arm-holding conditions, ‘flexion/avoidance goal’, ‘flexion/approach goal’, ‘extension/avoidance goal’, and ‘extension/approach goal’.

Apparatus

The apparatus consisted of a lever that was connected to a spring system, which produced equal resistance while pulling or pushing the lever. Pulling or pushing the lever allowed participants to perform the extension or flexion function by moving the elbow to a 90° or 0° position. This position could then be held, as indicated by the arrows in Figure 1. Therefore, the objective power required of each participant and in each condition was constant, because the same power was required to bring the lever to each arrow. In a pilot study, participants with different levels of strength were asked to evaluate the amount of effort needed to push or pull the lever. The average position that was evaluated by the participants as most pleasant was used to fix arrow marks for the experiment. A chair for participants could be adjusted in height such that every participant had a position that enabled her to sit straight, comfortably laying the left arm on a keyboard and moving the right arm toward the arrow, with the right elbow close to her body.

Movement task

Using the apparatus described above, the task was to hold the arm in the position indicated by an arrow and then to perform an association task. There were four conditions. In Condition 1, the flexion position with the goal 'approach', the chair was set toward the middle of the arrows so that when pulling the grip to the degree of the right arrow (Figure 1) the participant ended with a 90° elbow position of the arm. In Condition 2, the flexion position with the goal 'avoidance', the chair was set more to the right, such that the participant had to push the arm to reach a 90° arm position. In Condition 3, the extension position with the goal 'approach', the chair was set even more to the right, such that the participant had to lean forward, holding the grip with the extended arm, and then lean back and sit straight again. In Condition 4, the extension position with the goal 'avoidance', the chair was set such that the participant had to hold the grip with an extended arm and push the arm forward to sit straight. Starting from different leaning positions was used to manipulate unconsciously the approach and avoidance goals of the movement before the final position of the arm was reached. The final position of the arm was exactly the same as in the other experiments reported in the Introduction. The difference lies in that the movement goal as another proximal cue was introduced before the task, by the leaning position, as in most cases in real environments the movement goal precedes the movement execution.

Insert Figure 1 about here

Association Tasks

Generation tasks such as association tasks allow us to distinguish between heuristic and systematic processing, as argued in the Introduction. The association tasks that were used in this study were based on the Hager word norms for German words (Hager & Hasselhorn, 1994). The Hager word norms list average strengths of associations and valences by German participants ascribed to target words. Ten target words, all of neutral valence, were taken from the Hager word norms from the middle of the distribution of association strengths in the list of words. These association cues varied from 0.6 to 5.93 on a valence scale of –20 to +20 (target words: stone, grass, pipe, star, piano, potato, ship, letter, mountain, alley). Target words with neutral valence were used to avoid changing mood through the presentation of words of positive or negative valence. The strengths of associations by participants were scored according to Hager and Hasselhorn's (1994) tables. In these tables for each target word used in this study a list of words generated by a German population was ranked in order of how often a specific word was associated first with the target word and then given a score. For instance, if the first association a participant named for the target 'stone' was 'hard,' then this association received a score of 28.7 compared to the association 'mountain' which received a score of 2.5 or 'throw' which received a score of 1.2 based on the word norms for each association in the Hager word norm list.

In the first association task (counter-balanced over participants), a red fixation point of 3 cm was displayed in the middle of a computer screen and a warning tone sounded, followed by a random time interval between 1000 ms and 3000 ms before a target word was presented visually in the middle of the screen. Participants were instructed to press the space bar and immediately name the association verbally as soon as they built an association in their mind.

The time between presentation of the target word and pressing the space bar was used to estimate the time taken to produce the association. The participants controlled the time interval between naming the first association and the next trial. To continue, participants pressed the space bar, a ready signal sounded, and a cross appeared in the middle of the screen for a short random-length period until the new target word was presented.

The second association task displayed the same target words as in the first association task, however target words were presented in random order, each word displayed as long as the participant continued to make additional associations to it. The participant could view the next word by pressing the start button (the Enter key on the keyboard). A word, for example, ‘grass’, would appear and the participant was required to generate as many associations as needed to complete a semantic profile of the target word (e.g., Martin, Ward, Achee & Weyer, 1993, for a similar instruction). After processing each target word (generating associations), the participant could press the space bar to view the next target word. Generation period was measured as the time between onset of a target word and the pressing of the space bar.

<u>Mood control</u>

To measure any changes in participants’ mood, a questionnaire on actual feeling states (EMO 16; Schmidt-Atzert & Hüppe, 1996) was used. The questionnaire consists of eight questions measuring the current mood state of the task performer before and after the experiment (e.g., ‘rate your current self-consciousness’; ‘rate your current state of activation’). Age, occupation, and visual abilities were assessed at the beginning of the experiment. The questions on actual mood states were placed between other questions such as: ‘Are you feeling ill?’, ‘Does your right arm regularly cause you pain?’, ‘Did you have a hard day?’, and ‘Do you regularly have headaches?’, rated on a scale of 1 to 7 (no to very likely).

Procedure

Three phases of the experiment were conducted. First, a questionnaire was used to collect personal data, introduce the cover story, and present the questions on actual feeling states. The cover story informed the participants that they were doing a hemisphere activation experiment identical with that used by Friedman and Förster (2000) to eliminate self-perception effects on performance. Questions concerning the experiment could be posed after the cover story and before the task was started. Next, instructions were given. The instructions on using the apparatus (dependent on condition) were followed by a practice trial to ensure that the participants could hold the grip. Regarding the association task, participants were told that a fixation point would be displayed on a computer screen and following a random time interval, a warning tone would sound, followed by a word appearing in the middle of the screen. Participants were instructed to have their left hand on the space bar on the keyboard in front of them and to press it when they had built the first association (first-association task) or additional associations (second-association task) that came to mind after the presentation of the target word. They were asked to speak the words out loud, so that the experimenter could write the answers down. After the 10 target words in the first-association task and a short break, participants were presented with the same list again and asked to produce, while holding the grip in the same position, as many additional associations in the second-association task as they thought were required to represent a complete semantic profile of the target word, as usually instructed in association tasks (Martin et al., 1993). Third, after finishing the two association tasks, participants were asked to complete another list of questions regarding the arm movement and the association tasks. Again questions on actual mood states were hidden among questions regarding the cover story. Finally, participants answered questions regarding the pleasantness of the flexion and extension task, were paid (10 euros), and debriefed.

Analysis

To test the hypothesis, a 2 (arm position: flexion, extension) x 2 (arm function: approach, avoidance) between-subjects design was used. Planned contrasts for the same position and same goal groups were performed. The dependent variable for separating heuristic and systematic processes in an association task was the association strength. This variable needed to be controlled by other potentially moderating variables, such as time taken for generating associations, number of generated associations, valence of associations, and emotional state or changes in mood.

Results

The significance criterion was established for all reported tests at $p = 0.05$. Prior to testing the main hypothesis, moderating effects of mood and pleasantness, decision time, and valence of generated associations were checked. There were no statistically significant unwanted influences by these factors. An analysis of variance (ANOVA) revealed no significant differences on the mood scale between pretest ($M = 4.83$, $SD = .13$) and posttest ($M = 4.61$, $SD = .15$) collapsed over all groups ($F_{1, 36} = 3.39$, $p > .05$). More importantly, there were no statistically significant differences between groups in mood ($F_{3, 36} = .06$, $p > .05$). Answers about the pleasantness of the arm position showed that neither extension nor flexion groups found the arm position different with respect to pleasantness. A one-way ANOVA with four groups ($F_{3, 36} = 1.38$, $p > .05$) with most answers in the middle of the scale collapsed over all groups ($M = 2.68$, $SD = 1.27$) confirmed no differences between groups in answers about pleasantness. Another manipulation check was the time spent on the association task. A one-way ANOVA between treatment groups demonstrated that there was a significant difference produced by the significantly slower decisions of the arm flexion/approach group compared to the two arm extension groups with either approach or avoidance functions for the first association decision time (Scheffé, $p < .05$; $F_{3, 36} = 4.42$, $p <$

.05). However, there were no differences for the time spent on the second-association task ($F_{3, 36} = 1.10$, $p > .05$). Slightly longer times spent for additional associations for the arm flexion/approach group compared to the remaining groups did not change the valence of the generated associations, nor did the treatment of any of the four groups result in more or fewer valenced associations (ANOVA, $F_{3, 36} = 2.76$, $p > .05$). The results, averaged over all groups, showed a small positive valence value of 7.86, with the range for target words roughly 0 to 6 (scale –20 to +20).

If the position of the arm influences an association's strength, then one would expect a main effect of position independent of the goal of the movement. However, it was hypothesized that a main effect of approach/avoidance would be found, independent of whether the arm was in an extension or flexion position. As predicted, the main effect for the goal of the movement was evident in the results of the first-association task (see Table 1).

Insert Table 1 about here

Two ANOVAs revealed a main effect of movement goal ($F_{1, 39} = 6.43$, $p < .05$) but not for the position of the arm ($F_{1, 39} = .34$, $p > .05$) on association strength for first associations. No significant interaction was found. In addition, no differences could be found in the second association task.

The additional associations in the second task, however, revealed a tendency for the approach conditions to have a higher association strength. To evaluate if the average higher association strength could be explained simply by fewer words being generated, an ANOVA was run. It showed that, on average, no difference existed between groups in the number of generated associations ($F_{3, 36} = .75$, $p > .05$). Including the number of generated second associations as a covariate also did not change the nonsignificant result of the association strength between the groups.

Discussion

Instead of a general approach and avoidance motivation system triggered by arm position, it may be that the goals of movements themselves are linked to emotions and cognitive processes. The present model assumes that the movement goals are signals on the proximal sensory level that tune the internal evaluation processes in a situation. The explanation of the position effect based on evolutionary arguments is enriched by the results of this study. The evaluation system, thought of as a subsystem of higher-order decision making mechanisms, leads to a decision on the processing mode according to the available environmental information: flexion biases the evaluation positively and thereby triggers the heuristic processing mode, whereas extension biases the evaluation negatively and leads to a systematic processing mode.

There are potential sources that could have influenced the results. For instance, the nonpreferred arm was extended to lay on the space bar of the keyboard to enable the measurement of association time.[1] It is possible that the extension of this arm added additional information to the system. However, and this was consistent across conditions, the significant differences between the different goal manipulations were still present in the association strength.

More importantly, the two independent variables flexion/extension and approach/avoidance may have been confounded because both variables have motor components and one motor program may just overrule the other, and thus no cognitive tuning mechanism needs to be assumed to explain the current findings. Although this possibility cannot be excluded it seems unlikely if the times of motor activations are considered. Usually it is the case that the goal is introduced before the movement. Because the first goal-orientated leaning took place in less than a second and the arm position task was carried out later and for

[1] As suggested by an anonymous reviewer.

a longer time, it seems unlikely that the first, briefly activated motor program overruled the position effect. Controlling for this in further research and finding another means of unconscious goal manipulation is warranted[2]. However, introducing the goal unconsciously to enable cognitive tuning, such that the internal evaluation of the present state in the current situation activates different cognitive processes, seems less likely to be achieved by explicit manipulations of the instruction.

Yet, further potential moderators could be eliminated. The main results showed no moderating effects of mood, pleasantness, or time spent on the task. Seven of eight previously reported studies also showed no moderating effects. Only in one experiment was extension of the arm more pleasant than flexion. In that experiment (Förster & Strack, 1998), participants had to generate the names of people and evaluate their attitudes toward each. The variables mood, pleasantness, and task rating were tested after the generation task. Nonetheless, the results showed that these covariates had no influence on the task, neither for generation nor evaluation. In all other previous experiments, no differences between arm positions were found for pleasantness. Regarding mood, only in Förster and Stepper (2000) did mood have a possible effect on cognition, which may have mediated the performance for the two groups; again, in all other experiments including the present study, no group differences or changes of mood from pre- to posttest were observed.

The new twist in this study is the evaluation of the arm-position effect reported in a number of earlier studies (see Friedman & Förster, 2000, for an overview) from a new perspective. Previous findings were challenged by the introduction of a variable that is very well known in motor control theories (Mechsner et al., 2001) as an anticipated consequence of intended movements. Here, the functional goal of the performed or to-be-performed movement is connected with cognitive states rather than the arm position itself. The theoretical challenge is twofold. First, the conceptualization of arm position as a major

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[2] As suggested by an anonymous reviewer.

cognitive tuning system should be reconsidered. Arm position may be one source, on average, that activates more heuristic processes in the flexion position compared to more systematic cognitive processes in the extension position. It is possible that humans have learned or evolved (see Cacioppo et al., 1993), on average, a stronger association of flexion movements or postures with positive feeling (James, 1890). The flexion movement might also be more strongly associated with an approach motivation to movements that result in an extended arm position. The experimental results show that the goal of the movement associated with an approach or avoidance motivation is a stronger cognitive tuning device than the position of the arm. Second, although this is just one study of the influence of movement on cognition, the results challenge existing explanations of cognitive tuning mechanisms by introducing other important sources that were missing in previous models. Further experiments and model simulations are needed to increase our understanding.

The cognitive tuning model presented here does not neglect other sources within and outside the sensorimotor system. However, it is assumed that movement goals are more strongly connected with other cognitive subsystems and therefore have stronger influence than proprioceptive sources, be they learned or evolved. The model still lacks acknowledgment of other sources. For instance, it is not known how much relative influence each cue had on the effects that were demonstrated, because visual and proprioceptive stimuli were not separated. This remains an open and empirical question.

A possible effect on cognitive tuning that needs to be studied more is the interaction of intrinsic and extrinsic information. For instance, perceptual fallacies influence the perceived consequences of a movement and therefore could tune the recognition of the desired goal. Different sources may be tested with respect to their potential interactions. For instance, imagine pushing a lever to receive something you like. One would expect that in conditions of incongruent perceptual and motor information the influence on the cognitive system is reduced. However, because of what is known about the strong effects of perceptual and motor illusions (Franz, 2001), it might also be expected that there would be a tendency to be more heavily weighted toward the perceptual information. Congruent conditions, such as extension of the arm with an avoidance goal, and perceptual feedback would produce stronger cognitive tuning for systematic processes.

Modeling the idea of movement goals also assumes there are critical thoughts about the power and space dimension in which the movement is performed. The plausibility of the presented model would be undermined if flexion and extension movement goals were performed through different positions yet led to the same results. Measuring the effort used by the participants to push or pull the lever could allow one to determine the effect such effort has on participants' mood and pleasantness ratings, which also could have an effect on the processing system, perhaps even overriding the movement goal or position factor through emotional influence. Only the behavioral level of a movement goal influencing cognitive processes has been described here. One should not forget about the motor signals that also manifest themselves on the sensory level. Therefore, possible future research topics will concern the physiological side of the present model. The motor and premotor areas have sensory input that may influence the process of evaluation at a higher, cognitive level. Also excluded from consideration are any effects of memory decay, as the participants had to perform the association task and the movement at the same time. How durable are cognitive tuning effects for the motor system? The answer to this question may help to differentiate results like the present one in which the effect occurs in the first association task but not in the second association task.

The work presented here is a first step toward a better understanding of how the human decision system works and what factors play roles. That movement goals, as opposed to movement position, serve as an important cue for evaluating one's current situation is an appealing alternative that can enrich cognitive tuning theories. Understanding the decision-making processes on different levels might also lead to a better understanding of human development and might enable us to design a technical world more adapted to human cognitive abilities. Finally, conclusions from further research in this area may lead to new methods in training, such as emotional regulation procedures in sport settings, and therapy, such as behavioral therapy in which movements may be used to tune cognitive or emotional processes.

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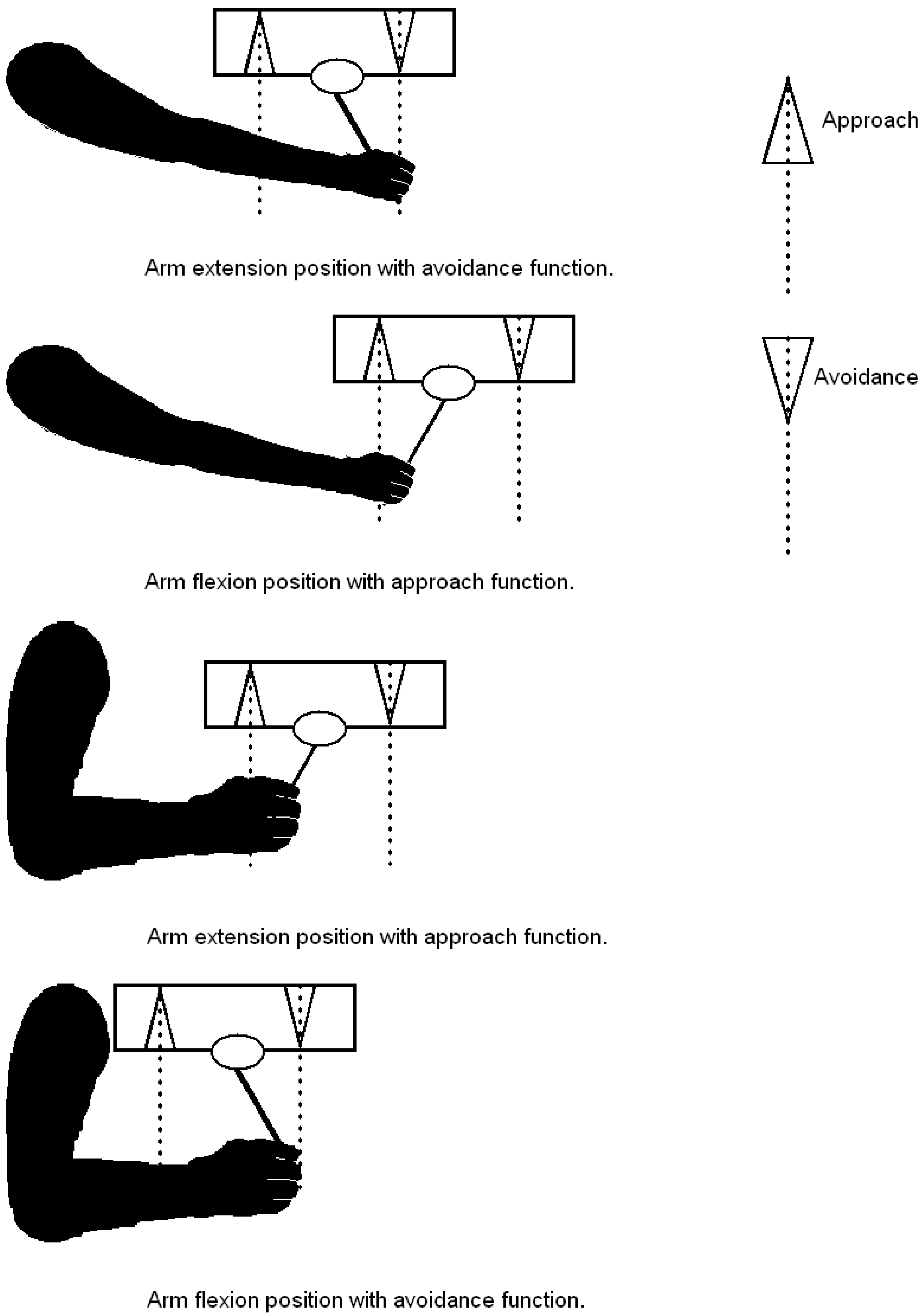
Table 1. Mean score of association strength (standard deviation in parentheses) of the four groups flexion position/approach goal, extension position/approach goal, flexion position/avoidance goal, extension position/avoidance goal.

	Flexion position		Extension position		Marginal means
Approach goal	12.12	(0.52)	7.76	(0.32)	9.94
Avoidance goal	6.76	(0.41)	9.48	(0.49)	8.12
Marginal means	9.44		8.62		

Note. Score for association strength was calculated by the German Hager word norms that list how often a specific word is associated first with a target word.

Figure 1. Positioning task. Schema of the arm position and functions during the experiment.

Figure 1


Approach
Avoidance
Arm extension position with avoidance function.
Arm flexion position with approach function.
Arm extension position with approach function.
Arm flexion position with avoidance function.

1. Functional organization of a computer a) processes and stores large amount of data and solves problems of numerical computations; 2. Input b) circuits used in large-scale digital systems; 3. Memory c) method of interrelation of the main units of a computer 4. Control unit d) removing data from the de- vice to the outside world; 5. Output e) inserting information into.Â Đ"ĐĐ® ĐœĐĐžĐ"Đž Đ'ĐĐ›ĐžĐ'8 Write six questions asking for careers advice using thestructures in the Sentence Builder and the cues below.I'm interested in â€¦ a job as a wind farmer. Please pay attention to the following: 1. When you link a credit card to your Alipay account, we will verify the validity of your card by temporarily holding one cent in your card, but you will not actually be charged $0.01. This one cent will be released automatically within 24 hours. 2. Maestro and American Express card cannot be linked to your account.Â Note: you can follow your report status under your My AliExpress account: Go to My AliExpress > Manage Reports > My Reports. Do I have to pay for customs and import taxes? You may be charged customs duties and taxes for something you bought on AliExpress because: â€¢ Duties and taxes are typically not included in the price of the item, and might not be included in the overall shipping costs you pay to the seller. â€¢ by Stefanie Imagine you are writing a paper on a cutting-edge topic. A friend in the field passes along a manuscript on which she is working that is relevant to your work. Your advisor, on reading your draft, hands you...Â If this happens while your own article is in preparation and if your reference names the first journal or publisher to which the material was submitted, your reference is not only out of date but misleading. Castle, R. (2012). Shadowing a police officer: How to be unobtrusive.Â Thank you for your question! Cite these works in the text by author and date, as you would other references. If we take the two Castle references above as examples, the first would be cited in text as (Castle, 2012), and the second would be (Castle, in press). I hope this helps! This material may not be published, reproduced, broadcast, rewritten, or redistributed without permission. Use of this site constitutes acceptance of our terms and conditions of fair use. Reference List: Other Print Sources. Note: This page reflects the latest version of the APA Publication Manual (i.e., APA 7), which released in October 2019.Â Note: Provide the secondary source in the references list; in the text, name the original work, and give a citation for the secondary source. For example, if Deleuze and Guattariâ€™s work is cited in Nail and you did not read the original work, list the Nail reference in the References. In the text, use the following citationÂ Follow-Up, Thank You Letters Index. Follow-Up & Thank You Letter Overview. In this paper, we explore the landscape of transfer learning techniques for NLP by introducing a unified framework that converts all text-based language problems into a text-to-text format. Our systematic study compares pre-training objectives, architectures, unlabeled data sets, transfer approaches, and other factors on dozens of language understanding tasks. By combining the insights from our exploration with scale and our new ``Colossal Clean Crawled Corpus'', we achieve state-of-the-art results on many benchmarks covering summarization, question answering, text classifi...Â Final version as published in JMLR. Subjects: Machine Learning (cs.LG); Computation and Language (cs.CL); Machine Learning (stat.ML). Cite as: arXiv:1910.10683 [cs.LG].