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Left-Hemispheric Activation and Self-Infiltration: Testing a Neuropsychological Model of Internalization

Nicola Baumann,[1,2] **Julius Kuhl,**[1] **and Miguel Kazén**[1]

Two studies examined self-infiltration (as indexed by a tendency toward false self-ascription of assigned tasks) and its relationship to the activation of the two hemispheres of the human brain. Unilateral muscle contractions of each hand were performed by participants to activate the contralateral hemisphere and influence self-infiltration (confusing assigned tasks as self-selected in memory). In both studies, self-infiltration was observed after right-hand muscle contractions (left-hemispheric activation) and was absent after left-hand muscle contractions (right-hemispheric activation). In addition, Study 2 replicated the relationship between self-infiltration and left-hemispheric activation using a line drawing task to estimate participants' relative hemispheric dominance.

KEY WORDS: hemispheric activation; lateralization; self-access; internalization; introjection; self-infiltration; state-orientation; PSI theory.

Internalization is the process through which an individual transforms a formerly externally prescribed regulation, value, or goal into an internal one. Trying to "take on" regulations, values, and goals as one's own is important for motivated action and psychological functioning as evidenced in religious orientation (Ryan, Rigby, & King, 1993), political decision making (Losier, Perreault, Koestner, & Vallerand, 2001), health behavior (Fuhrmann & Kuhl, 1998), resistance to temptation (Baumann & Kuhl, 2005), goal attainment (Sheldon & Elliot, 1998), and free-choice behavior (Kuhl & Kazén, 1994; Ryan, Koestner, & Deci, 1991).

[1]University of Osnabrück, Osnabrück, Germany.
[2]Address all correspondence to Nicola Baumann, Faculty of Human Sciences, Area of Psychology, University of Osnabrück, Seminarstrasse 20, EW 49069 Osnabrück, Germany; e-mail: nbaumann@uos.de, mikazen@uos.de, or kuhl@uos.de.

Theories of internalization typically acknowledge that there are varied degrees or types of internalization (Adroer, 1998; Deci & Ryan, 2000; Koestner & Losier, 2002; Kuhl & Kazén, 1994). Examples of two very different types of internalization are *self-integration* and *self-infiltration*. Whereas the former involves congruence of socially transmitted values and goals with one's core sense of self, the latter does not. In self-infiltration, external values or goals are taken on although they are, in fact, not compatible with own preferences and implicit self-representations. The present article is concerned with the neuropsychological basis of this particular type of internalization: What is the relationship between self-infiltration and the activation of the two hemispheres of the human brain?

In the following paragraphs, we (a) elaborate on theory, assessment, and findings of self-infiltration, (b) discuss differences between right- and left-hemispheric processing that are relevant for self-infiltration, and (c) select an experimental manipulation of hemispheric activation. After this, we state our hypotheses and present two experimental studies aimed to test them.

Self-Infiltration

Self-infiltration is defined as a type of internalization in which a person assumes self-compatibility of a task or goal on a conscious level when, in fact, it has not been self-selected and is not compatible with own preferences and implicit self-representations.[3] The phenomenon is of substantial interest to motivation psychologists because it indicates a very conflict-laden type of internalization. Self-infiltration involves a conflict between conscious beliefs of self-compatibility and (unconscious) negative affect associated with objectively self-alien goals. This conflict can elicit an automatic attentional orienting which may be subjectively experienced as intrusive rumination (Baumann & Kuhl, 2003). Moreover, self-infiltration (or introjection) is often accompanied by feelings of shame, pressure, compulsion, and alienation (Kazén, Baumann, & Kuhl, 2003; Sheldon & Elliot, 1998). It is associated with stronger engagement in externally controlled activities (Fuhrmann & Kuhl, 1998; Kuhl & Kazén, 1994) and vulnerability to persuasion (Kazén et al., 2003; Koestner & Losier, 2002). Furthermore, a low self-integration of goals is associated with reduced subjective well-being and increased symptom formation (Baumann, Kaschel, & Kuhl, in press; Deci & Ryan, 2000; Sheldon & Kasser, 1995). To conclude, the detrimental effects of self-infiltration on psychological functioning underline the importance of understanding the mechanisms involved in this type of internalization.

[3]In previous research dealing with internalization (Kuhl & Kazén, 1994), self-infiltration has been labeled "*misinformed introjection*" because one fails to identify that a particular goal originated in another person. In contrast, the term "*informed introjection*" has been used when one is consciously aware of the self-alien status of a particular goal. In the present paper, we are interested in misinformed introjection and use the terms introjection and self-infiltration interchangeably.

Assessment

Because of the phenomenological self-congruency of self-infiltration, simply asking a person whether he or she has introjected a particular goal from other people does not suffice. Therefore, we applied the nonreactive method developed by Kuhl and Kazén (1994) that allows to experimentally vary the objective self-other status of goals. In a simulated office workday, their participants took the role of a secretary and selected nine activities from a given list of 27 (e.g., "*sharpening pencils*," "*sorting letters*") to carry out later. The experimenter took the role of a boss and assigned additional nine activities to them. The remaining nine activities were used as control because they were neither self-selected nor externally assigned. There was an unexpected memory test for the initial *source* of the goals, that is, participants were asked to classify each activity as previously self-selected, assigned by the boss, or remaining. A tendency to falsely ascribe more originally externally assigned than remaining activities as self-selected was interpreted as self-infiltration.

Two methodological precautions have to be observed to make sure that false self-ascriptions (*FSA*s) do indeed reflect a tendency toward self-infiltration. First, to avoid a confounding with a general memory deficit concerning the source of the activities, the number of FSAs of assigned activities is corrected for a baseline of general memory performance (i.e., the number of FSAs of remaining activities). Second, to avoid a confounding with self-integration one might ask participants to rate the attractiveness of all activities at the beginning of the experiment and then look at the results of low- and high-attractive activities separately. If the FSA effect occurs with *high*-attractive items, the assumption that self-infiltration took place remains uncertain because FSAs could reflect identification with something that, although externally assigned, was rated by them as attractive. Because of their higher intrinsic value, highly attractive options may not represent much of an imposition. On the other hand, if the FSA effect occurs with *low*-attractive items, one can assume that self-infiltration took place (cf. Baumann & Kuhl, 2003; Kazén et al., 2003). For the sake of clarity, we consider as evidence of self-infiltration a significantly higher FSA rate of assigned compared to remaining *low-attractive* activities.

Poor Self-Compatibility Checking

The FSA effect is presumed to occur because of poor self-compatibility checking during encoding and/or retrieval of goal choices (cf. Kazén et al., 2003, pp. 161–162). The formation of self-compatible goals is proposed to involve two steps (a) access to a valid model of one's emotional preferences and (b) tagging activities with a *commitment marker*. Such a marker indexes the fact that one has committed oneself to perform a particular future activity among many possible. It is assumed to be implicitly stored with the episodic memory trace of

the prospective activity and changes the subjective status of the activity from a wish into an intention (Heckhausen & Kuhl, 1985; Kuhl & Kazén-Saad, 1988; cf. also Gollwitzer, 1996, pp. 288–294). Personal commitment is especially important when activities are unattractive, because positive affect facilitating their automatic enactment is lacking. The decision process concerning previous goal formation is proposed to involve the same two steps mentioned above (a) examination of one's emotional preferences and (b) activation of a memory trace including information of a commitment marker. Any factor impairing processing of these steps during encoding and/or retrieval is expected to reduce the quality of self-compatibility checking and to increase the tendency toward self-infiltration.

Personality Differences in Self-Infiltration

The self-infiltration effect is moderated by self-regulatory ability and mood (Baumann & Kuhl, 2003; Kazén et al., 2003). Individuals who have an impaired ability to cope with negative affect (*state-oriented* individuals) show self-infiltration when negative affect or some other kind of stressor is present (e.g., external pressure, meaningless tasks, negative mood induction). In contrast, individuals who can reduce their negative affect (*action-oriented* individuals) are not "infiltrated" by self-alien goals even in negative emotionality conditions.

These personality differences in affect regulation can be explained by the Personality Systems Interactions (PSI) theory (Kuhl, 2000, 2001). According to the negative affect modulation assumption of PSI theory, negative affect inhibits a system providing implicit representations of extended semantic networks ("*extension memory*"). This system is necessary to have an overview of extended semantic fields (Rotenberg, 1993), relevant episodes experienced (Wheeler, Stuss, & Tulving, 1997), and integrated self-representations (Kuhl, 2000). Access to extension memory makes a great number of preferences and action alternatives simultaneously available so that a person can easily feel priorities and choose goals that satisfy multiple constraints. The self-related implicit representations are called the "self" or "self-system." According to PSI theory, state-oriented participants' higher tendency toward self-infiltration can be attributed to their persevering negative affect, which impairs access to extension memory and the self. Without self-access state-oriented persons can neither check the self-compatibility of intended activities nor truly integrate goals into the self. Action-oriented persons, in contrast, are able to reduce negative affect under threat and thus retain access to self-related functions of extension memory (Koole & Jostmann, 2004). Accordingly, they can perform a thorough self-compatibility checking and are therefore less vulnerable to take on self-alien goals.

If goals are not integrated into the implicit self they have to be based on representations on a level outside the self. Presumably, self-alien goals are based

on explicit representations of goals in a verbal or analytical format. According to PSI theory, explicit representations of intended actions are supported by a system called "*intention memory*" (Kazén & Kuhl, 2005; Kuhl & Kazén, 1999). It is specialized in analytical-sequential processing of verbal information and explicitly formulated goals. Activation of this system may help to maintain the cognitive representation of intentions (Goschke & Kuhl, 1993; Knight & Grabowecky, 1995) but it may not necessarily help to check the self-compatibility of goals. Therefore, explicitly-represented goals may dissociate from implicit goal preferences and take over executive control without being supported by the implicit self. According to this hypothesis, self-infiltration can be conceived of as a dissociation between implicit and explicit self-representations.

Right- and Left-Hemispheric Processing

The right hemisphere is specialized in parallel-holistic (Rumelhart & McClelland, 1986; Springer & Deutsch, 1998) and polysemantic information processing (Beeman & Bowden, 2000; Beeman, Friedman, Grafman, Perez, Diamond, & Lindsay, 1994; Rotenberg, 1993; Rotenberg & Weinberg, 1999). For example, in their experiments on "summation priming" Beeman et al. (1994) found the activation of extended semantic networks to be supported more by the right than by the left hemisphere. Direct priming, on the other hand, produced a left-hemispheric advantage in target processing. The automatic activation of extended associative networks may be regarded as the functional basis of intuitive judgments (Baumann & Kuhl, 2002; Beeman et al., 1994; Smith & Shapiro, 1989). Another example of polysemantic information processing is the simultaneous availability of various meanings of polysemous word (e.g., to sit on a bank and to deposit money in the bank; cf. Marcel, 1983). Parallel-distributed processors are capable of handling vast amounts of complex information at speeds that greatly exceed the capacity of the conscious mind (Rumelhart & McClelland, 1986). In a series of computer simulations, Nowak, Vallacher, Tesser, and Borkowski (2000) demonstrated how the application of parallel-processing principles can transform simple processing elements into an integrated, dynamic system that reflects the properties of the self.

The parallel-holistic, polysemantic, and integrative processing characteristics make the right hemisphere especially suited for processing integrated self-aspects (self-images). Weinberg (2000) has proposed that a deficit in right-hemispheric functioning, producing a shift to left-hemispheric functioning, is involved in the pathology of suicidal persons, which includes disintegration of self- representations, overly general nature of personal memories, and alienated and negative perception of the body. Studies using positron emission tomography (PET) or event-related potentials (ERP) support the assumed neuroanatomical foundation of the implicit self by showing a specific activation in the right prefrontal lobe when the task is self-relevant and involves self-related judgements (Craik, Moroz,

Moscovitch, Stuss, Winocur, Tulving, & Kapur, 1999; Keenan, Nelson, O'Connor, & Pascual-Leone, 2001; Ranganath & Paller, 1999).

For example, Keenan et al. (2001) presented normal participants with pictures showing a morph composed of a famous face and either their own or a familiar face. Right-hemispheric activation (as indicated by amplitude of the resulting motor-evoked potentials induced by transcranial magnetic stimulation) was significantly greater than left-hemispheric activation while participants viewed pictures containing elements of their own face. Right-hemispheric activation was also significantly greater in the self-famous compared to the familiar-famous morph condition. In a further study with five patients undergoing the Wada test involving anesthetization of one cerebral hemisphere at a time, Keenan et al. (2001) presented morphs made of the patient's own face and a famous face. Under left-hemispheric anesthesia (i.e., right hemisphere remained active) all patients selected their own face on a forced-choice recognition test of the pictures presented. Under right-hemispheric anesthesia (i.e., left hemispheric remained active) four out of five patients selected the famous face as being shown. These results can be interpreted as showing right hemispheric involvement for self-recognition and left hemispheric involvement in processing information of other (famous) persons, for most participants of the study.

The left hemisphere, in contrast, is specialized in analytical, sequential, and "monosemantic" (i.e., unambiguous) information processing (Beeman et al., 1994; Rotenberg, 2004; Springer & Deutsch, 1998). The reduction of extended polysemantic networks of associations to monosemantic information may be useful, for example, in preparation of approach behavior presumably associated with the left hemisphere (Harmon-Jones, 2003; Murphy, Nimmo-Smith, Lawrence, 2003): In order to make progress on a planned (i.e., explicitly intended) action cognitive processing has to be reduced to information that is relevant for the imminent action. Furthermore, the left hemisphere is specialized in analytical-sequential processing of verbal information (Springer & Deutsch, 1998).

How do these hemispheric differences in information processing relate to self-infiltration? Which hemisphere would be most important for solving the self-discrimination task? If valid self-compatibility checking necessitates access to the self including its implicit representations of emotional preferences and personal commitments, right hemispheric activation should facilitate its access and enable participants to perform a thorough self-compatibility checking of prospective activities. In contrast, activation of the analytical, monosemantic processing format of the left hemispheric should impair access to extended networks of emotional preferences and integrated self-aspects of the right hemisphere so that external assignments cannot be validly checked for self-compatibility during encoding and/or retrieval. Consequently, unattractive tasks originally assigned by the experimenter will be more likely to be falsely attributed as self-selected under left-hemispheric activation.

Experimental Induction of Hemispheric Activation

A more direct test of the hypothesis that self-infiltration is caused by an asymmetric activation of left-hemispheric processing whereas self-integration is supported by right-hemispheric processing can be expected from an experimental manipulation of left- versus right-hemispheric activation. In kinesiology, cross-lateral body movements are used to improve the integration of the two hemispheres. A similar principle is adopted in eye-movement desensitization and reprocessing in the treatment of posttraumatic stress disorder (Shepherd, Stein, & Milne, 2000). There is convincing experimental evidence that unilateral muscle contractions are able to activate the contralateral cerebral hemispheres and the functions associated with them (Martin & Shrira, 2001; Schiff, Guirguis, Kenwood, & Herman, 1998; Schiff, & Lamon, 1994; see also Bassel & Schiff, 2001, for analogous effects on emotional biases on cognition after unilateral *vibrotactile stimulation*, especially of the right side of the body). For example, Schiff et al. (1998) found that persistence in attempting to solve insoluble problems is greater after left-hemispheric activation induced by unilateral muscle contractions in the right hand (i.e., squeezing a soft ball) or in the right side of the face. The authors interpret the above findings as consistent with the assumption that persistence is stimulated by approach behavior associated with left-hemispheric activation (Sutton & Davidson, 1997; for a review, see Harmon-Jones, 2003). Ball-squeezing in one hand as a means to induce unilateral muscle contractions and to activate the contralateral hemisphere has also been successfully used by Martin and Shrira (2001) in the context of ego-depletion, thought rebound following suppression, and mortality salience.

In addition to studies on functional neuroanatomy emphasizing regional differences within each hemisphere (cf. Gazzaniga, 2000), there is evidence for an interaction between systems and widely spreading activation effects (Keenan et al., 2001; Lee, Siebner, Rowe, Rizzo, Rothwell, Frackowiak, & Friston, 2003; Wittling, 1990). For example, Lee et al. (2003) showed that freely selected finger movements are associated with increased activation in prefrontal regions. Furthermore, Wittling (1990) showed that asymmetries in autonomic responses during lateralized presentation of an emotionally laden film (i.e., increased blood pressure during right- compared to left-hemispheric viewing) were significantly enhanced when combined with lateralized stimulus-related responses. Thus, the additional contralateral motor activity caused a significant increase in unilateral processing. Finally, using morphed faces (i.e., composites of a picture of self and a famous person) Keenan et al. (2001) in the previously reported study showed a clear-cut relationship between motor-evoked potentials in the right hemisphere and self-recognition suggesting that motor activity may well stimulate right-hemispheric functions necessary for self-integration.

In the present studies, participants squeezed a soft ball with either the right or left hand prior to a goal selection phase (i.e., self-selection and external assignment

of goals), producing in that way unilateral muscle contractions. Right-hand ball-squeezing is expected to activate the left hemisphere and hence make participants vulnerable to self-infiltration. Left-hand ball-squeezing is expected to activate the right hemisphere and hence facilitate self-integration. The ball-squeezing task does not allow any regional specification of hemispheric activation. Nevertheless, the findings of widely spreading activation and interaction among systems cited above suggest that this simple manipulation may well stimulate hemispheric processing asymmetries involved in internalization. Notice that ball-squeezing is not expected to be accompanied by any conscious affect that would trigger coping activity in action-oriented participants. Therefore, the experimental induction is expected to work for all participants and circumvent personality differences in the ability to reduce asymmetries in hemispheric activation on the basis of self-regulation of affect (action-oriented coping).

Hypotheses

To summarize: (a) Unilateral muscle contractions of the right hand (i.e., left-hemispheric activation) are expected to increase self-infiltration as indicated by significantly higher rates of false self-ascriptions (FSAs) of low-attractive tasks that were originally assigned by the experimenter as compared to low-attractive control tasks. (b) Unilateral muscle contractions of the left hand (i.e., right-hemispheric activation) are expected to facilitate self-integration of goals and to produce no significant increase in FSA rates of assigned low-attractive tasks.

STUDY 1

Study 1 was designed to investigate the relationship between hemispheric activation and self-infiltration. Hemispheric activation was induced by ball- squeezing in the contralateral hand for 1 min prior to the self-selection and assignment of goals. Self-infiltration was assessed by the number of attribution errors in retrospective memory concerning the source of goal selections. To gain information whether FSAs were more of an encoding or retrieval phenomenon, ball-squeezing was repeated for 1 min prior to the memory test (balanced across hands).

Method

Participants

Thirty-two right-handed participants (24 women and 8 men) were recruited through flyers at the University of Osnabrück and paid DM 15 for their participation. Their mean age was 23 years (range 18–37 years). All participants

were right-handed as assessed by a German adaptation of the 10-item Edinburgh Inventory of Handedness (Oldfield, 1971). Their mean laterality quotient was +82 (range +60 to +100).

Materials

The program *PANTER* ("Process-Analytic Neuroticism Test for Adults")[4] was used to assess self-infiltration, that is, FSA rates of assigned compared to remaining activities (Baumann & Kuhl, 2003; Kazén et al., 2003). The Action Control Scale (*ACS-90*; Kuhl, 1994) was administered to assess state and action orientation. An example item from the failure-related scale is: "When I am told that my work has been completely unsatisfactory: (a) I don't let it bother me for too long, or (b) I feel paralyzed." In this example item option "*a*" reflects the action-oriented and option "*b*" the state-oriented response alternative. The scale ranges from 0 to 12 with higher scores indicating lower state orientation (*preoccupation*) and higher action orientation (*disengagement*). Cronbach's α is =70 for this scale. The German adaptation of the NEO-Five-Factor Inventory (Borkenau & Ostendorf, 1993) was used as a filler activity.

Procedure

Participants were tested individually. At the beginning of the experiment, participants were asked to fill out the ACS-90. Similar to Kuhl and Kazén (1994), the cover story of the experiment dealt with the simulation of a working day of a secretary. The general procedure was closely related to those used in Baumann and Kuhl (2003) and Kazén et al. (2003). Participants were told that the aim of the study was to investigate how people organize their work schedules. They were introduced to the PANTER program and asked to rate the attractiveness of 48 office activities (e.g., "sealing letters," "sharpening pencils," or "looking up a telephone number") on a 19-point scale, ranging from –9 (*very unattractive*) to +9 (*very attractive*). The PANTER program automatically split items according to the median of these ratings into high- and low-attractive items, representing the within-participants factor "*Item Attractiveness*."

As a *first experimental induction* of contralateral hemispheric activation through unilateral muscle contractions, participants were asked to squeeze a soft ball for 1 min. On a random basis, 16 participants were asked to do the ball-squeezing using their left hand (i.e., right-hemispheric activation) and 16 participants were asked to do the ball-squeezing using their right hand (i.e., left-hemispheric activation). The alleged reason for ball-squeezing was to investigate

[4] The label of the PANTER program is based on the idea that self-infiltration is a central factor associated with neuroticism. The German word for adults is "*Erwachsene*." German and English versions of the PANTER program are available from the authors.

the effects of simple motor activity on subsequent task accomplishment. They were informed by the experimenter when the 1 min was over.

The subsequent selection phase consisted of two parts: A preliminary self-selection of office activities and the assignment of office activities by the "boss" (experimenter). (a) *Self-selection*: Participants were asked to select activities they would be willing to carry out at the end of the experiment. Items were grouped into lists of six activities. Participants were asked to always select half of the activities of each list for later enactment. Even if none of the activities in a list was specially attractive they were asked to choose half of them anyway, since "office secretaries have to select these at some point as well." (b) *External assignment*: Participants were informed that part of a secretary's job was to enact the assignments of the boss. As to the cover story, the experimenter (the boss) had previously selected half of the activities that he/she wanted them to do. All items were presented sequentially on the screen. The 24 external assignments were indicated by an asterisk (*). In order to equate salience of external assignment and self-selection, participants were asked to carefully read each item and press a key corresponding to the assignment status ("assigned by the boss" versus "not assigned by the boss"). The order of self-selection and external assignment was balanced across participants. The combination of self-selection and external assignment resulted in four categories indicating the actual source of items: (1) *Both*, self-selected by participants and assigned by experimenter, (2) *self*, only self-selected by participants, (3) *other*, only assigned by experimenter, and (4) *remaining*, neither self-selected nor assigned. Through presentation of homogeneous item lists for self-selection and built-in algorithms for external assignment, PANTER completely balanced the three factors of self-selection, external assignment, and item attractiveness within participants. Thus, there were six subjectively high-attractive and six subjectively low-attractive activities in each of the above-listed four categories.

Participants filled out the Oldfield Handedness Inventory and the NEO-FFI. This intervening activity had the purpose of weakening the memory for the original source of items. As a *second experimental induction* of hemispheric activation, participants were asked to squeeze the soft ball for 1 min, again. One half of the sample was asked to do the ball squeezing using the same hand as before and the other half was asked to do the ball squeezing using the opposite hand. Afterwards, participants were introduced to unexpected memory tasks regarding the source of the activities. In a "self-classification task" participants were asked to decide whether or not they had previously self-selected the activities for later enactment. In a separate "other-classification task" they were asked whether or not they had been assigned to do the activities by the experimenter. The classification tasks were performed with the same hand as used for the second ball-squeezing. For each task, PANTER sequentially presented the 48 items in a new random order. The order of presentation of the classification tasks was balanced across participants.

Finally, participants were paid and debriefed concerning the purpose of the study. The experimental session lasted about 60 min.

Results

Descriptives

Action orientation scores ranged from 0 to 11. Applying the norms of the failure-related dimension (Kuhl, 1994), 19 participants were classified as state-oriented because their score was below the median of the norms (i.e., lower than 5, indicating a stronger disposition to preoccupy, $M = 2.42$, $SD = 1.57$) and 13 participants as action-oriented since their score was above the median of the norms (i.e., a score of 5 or higher; $M = 6.62$, $SD = 1.56$).

Manipulation Check of Item Attractiveness

To control for differences in initial item attractiveness between experimental induction conditions, attractiveness ratings were analyzed using a First Hemispheric Activation (left vs. right) × Second Hemispheric Activation (left vs. right) × Item Attractiveness (low vs. high) mixed analysis of variance (ANOVA), with the last one as within-participant factor. As expected for a median-split variable, there was a highly significant main effect of Item Attractiveness, $F(1, 28) = 342.37$, $p < .001$. This finding confirms the expectations that PANTER successfully selected two sets of items that differed with regard to participants' own rated attractiveness: One set of items was rated by participants as low-attractive ($M = -2.76$, $SD = 2.12$) and another set as high-attractive ($M = 4.16$, $SD = 1.66$). There were no significant interactions with experimental induction conditions. Participants did not systematically differ in their initial attractiveness ratings of office activities between conditions. In addition, a Personality (state versus action orientation) × Item Attractiveness (low vs. high) ANOVA was calculated. There were no significant main or interaction effects for Personality. State- and action-oriented participants did not differ in their initial ratings of office activities.

False Self-Ascriptions (FSAs)

FSA rates were calculated as percentages of the total number of activities per cell. FSA rates were analyzed using a First Hemispheric Activation (left vs. right) × Second Hemispheric Activation (left vs. right) × Item Attractiveness (low vs. high) × Source (assigned vs. remaining) ANOVA, with the last two as within-participant factors. Results yielded a significant main effect of

Item Attractiveness, $F(1, 28) = 43.65$, $p<.001$. Replicating previous findings (Baumann & Kuhl, 2003; Kazén et al., 2003; Kuhl & Kazén, 1994), high-attractive items were misperceived as self-selected more often than low-attractive items (high: $M = 39.81$, $SD= 20.29$; low: $M = 14.09$, $SD= 14.21$). More important, there was a significant First Hemispheric Activation × Item Attractiveness × Source interaction, $F(1, 28) = 4.92$, $p < .04$. To further explore the nature of the higher order interaction, separate First Hemispheric Activation × Source ANOVAs were carried out for FSA rates of low- and high-attractive items, respectively. The central self-infiltration hypothesis concerned *low-attractive* activities and no predictions were made for high-attractive activities because the latter may be internalized through identification. Consistent with expectations, the First Hemispheric Activation × Source interaction was significant for low-attractive

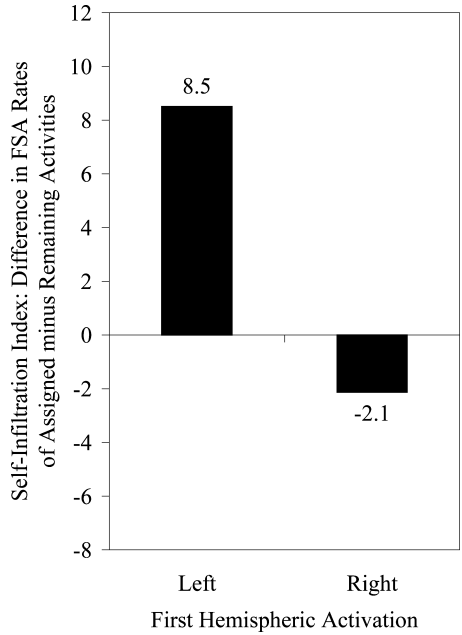

Fig. 1. Mean difference rates (%) of false self-ascription (FSA) of low-attractive office activities originally assigned by the experimenter minus remaining, as a function of experimentally induced hemispheric activation (i.e., ball-sequeezing in the contralateral hand before item selection phase) in Study 1. Positive values on the ordinate indicate higher FSA rates from assigned activities (i.e., self-infiltration), whereas negative values indicate higher FSA rates from remaining activities.

items, $F(1, 30) = 4.50$, $p < .05$.[5] As depicted in Fig. 1 using difference scores, participants had significantly higher FSA rates of assigned compared to remaining low-attractive activities after right-hand ball-squeezing (i.e., *left-hemispheric activation*) before the selection phase, $t(15) = 2.78$, $p < .02$. FSA rates were 17.88% for assigned items versus 9.38% for remaining items. In contrast, participants did not have a tendency to misperceive assigned low-attractive activities more often as self-selected than remaining low-attractive activities after left-hand ball-squeezing (i.e., right-hemispheric activation) before the selection phase. FSA rates were 13.50% for assigned versus 15.62% for remaining items. The analysis of high-attractive items yielded no significant main or interaction effects.

To test whether self-infiltration after left-hemispheric activation was different for state- and action-oriented participants, additional analyses were carried out with Personality (state vs. action orientation) as a between-participants factor. There were no significant main or interaction effects including Personality. The experimental induction of left-hemispheric activation before the item selection phase was effective for all participants: Both, state- and action-oriented participants had a tendency toward self-infiltration after right-hand ball-squeezing (i.e., left-hemispheric activation).

False Other-Ascriptions (FOAs)

To test whether participants had a tendency toward false externalization (i.e., falsely ascribe as assigned a self-selected compared to a remaining activity), FOA rates were analyzed using a First × Second Hemispheric Activation × Item Attractiveness × Source (self-selected vs. remaining) ANOVA, with the last two as within-participant factors. There were no significant main or interaction effects. An additional First Hemispheric Activation × Source (self-selected vs. remaining) ANOVA conducted on FOA rates of low-attractive items yielded no significant effects. Neither left-hemispheric activation (self-selected 59.4% vs. remaining 44.8%, $t(15) = 1.67$, $p > .12$) nor right hemispheric activation (self-selected 42.8% vs. remaining 43.6%, $t(15) = -.15$, $p > .85$) were associated with a tendency toward false externalization. In either experimental condition, FSA and FOA rates for low-attractive items were not correlated (left-hemispheric activation $r(16) = .01$, *ns*; right-hemispheric activation $r(16) = .05$, *ns*).

[5] Additional analyses including the factor Selection-Order (self-other vs. other-self) did not yield any significant effects of this factor in the present studies. The order of self-selection and external assignment did not moderate the self-infiltration effect. This finding contributes to the ecological validity of the self-infiltration effect because in natural settings either order is possible and a continuous alternation between self-selections and external assignments most likely.

Discrimination Index

To test an alternative hypothesis that left-hemispheric activation is associated with less elaborated information processing and global source monitoring deficits, we computed the signal detection measure of discriminability d'. The First $\times$ Second Hemispheric Activation ANOVA on d' yielded no significant effects. Source discriminability after left-hemispheric activation prior to the selection phase ($d' = .79$) was not significantly different from source discriminability after right-hemispheric activation ($d' = .69$), $t(30) = -.77$, $p > .45$.

Discussion

Results of Study 1 show that asymmetric activation of left-hemispheric processing through right-hand muscle contractions during goal selection increases the likelihood of being "invaded" by the expectations of other influential persons (like the "boss") without noticing it as indicated by an increased FSA rate of assigned activities. In contrast, activation of right-hemispheric processing through left-hand muscle contractions is consistent with its assumed facilitation of self-compatibility checking of external assignments which should protect individuals from making FSAs. Alternatively, it could be argued, that FSAs of assigned activities do not indicate self-infiltration (i.e., unconscious introjection of self-incongruent goals), but an identification with external assignments. As in previous studies, this alternative interpretation cannot explain why the FSA effect (higher FSA rates of assigned compared to remaining items) occurs with *low-attractive* activities only. If FSAs were indicative of identification one would expect the FSA effect to increase with an increase in item attractiveness, which is not the case (cf. Baumann & Kuhl, 2003; Kazén et al., 2003). Notice that overall there were higher FSA rates of high-attractive compared to low-attractive activities (assigned *and* remaining). This tendency indicates a "healthy" bias in our participants toward identification with positive goals and is consistent with organismic theories of personal growth (Sheldon, Arndt, & Houser-Marko, 2003). However, increased FSA rates of assigned compared to remaining items were found only for low-attractive activities.

Given that all of our participants were right-handed, it could be argued that contractions in the nondominant (left) hand may not only activate the right hemisphere, but may also be more unusual and challenging. Feelings of unfamiliarity or difficulty may have stimulated participants in the right-hemispheric activation condition to engage in more systematic processing of the information provided, including the source cues required for discrimination whether activities had previously been self-selected.[6] However, if participants engaged in more systematic processing of source cues they should have increased overall performance on

[6]We thank an anonymous reviewer for suggesting this possibility.

both memory tasks. Our results, however, found no evidence for increased source discriminability in the right-hemispheric condition.

Alternatively, it could be argued that left-hemispheric activation reduces working memory capacity (Luu, Tucker, & Derryberry, 1998), diminishes processing of source cues, and leads to source monitoring failures.[7] However, the signal detection measure of discriminability (d') was not significantly reduced in the left-hemispheric activation condition. Findings do not support the assumption of less systematic processing. Moreover, the FSA effect observed after left-hemispheric activation was not accompanied by an FOA effect. Findings suggest that left-hemispheric activation is associated specifically with self-infiltration and not with a global source monitoring deficit, which would also include a tendency toward externalization.

The self-infiltration effect after left-hemispheric activation was found in state- and action-oriented participants to the same extent. This finding is consistent with the expectation that the experimental manipulation successfully circumvented personality differences in self-regulation of negative affect. According to the modulation assumptions of PSI theory (Kuhl, 2000, 2001) and in accordance with empirical findings (Davidson, 1992), "affective fixations" (i.e., inability to change one's negative or positive affective state in a context-adequate way) are associated with asymmetries in hemispheric activation whereas affective changes are associated with cross-hemispheric exchange. Action orientation is conceived of as the ability to downregulate negative affect and to self-generate positive affect (cf. Koole & Jostmann, 2004; Kuhl & Beckmann, 1994) so that asymmetries in hemispheric activation due to affective fixations should be less likely to occur. According to this rationale, any method that could bring about a shift toward the left hemisphere without the induction of an affective change (e.g., sad mood) should be able to produce similar effects (i.e., independent of individual differences in affect regulation). Consistent with this reasoning, muscle contractions of the right hand presumably activating the contralateral left hemisphere asymmetrically in *all* participants produced the self-infiltration effect. Presumably, this manipulation did not induce any conscious change in affect that could have initiated self-regulatory processes (e.g., compensatory activation of extension memory after left-hemispheric activation).

To summarize, findings of Study 1 supported the assumed neuropsychological basis of one type of internalization: Left-hemispheric activation during self-selection and external assignment of goal options increased participants vulnerability for self-infiltration whereas right-hemispheric activation protected individuals from premature self-attribution of self-alien goals. An interesting question arising from these findings relates to the range of phenomena associated with left-hemispheric activation and internalization: Is the self-infiltration effect restricted to prospective activities or does it occur with preference judgements as well? Study 2 was designed to examine this question.

[7]The same anonymous reviewer also suggested this possibility.

STUDY 2

The aim of Study 2 was to replicate Study 1 findings with different item material obtained from the domain of preference judgements. Furthermore, an alternative measure of hemispheric activation was used (line bisection task) in addition to the experimental induction of hemispheric asymmetries.

Hemispheric Dominance

Neuropsychological findings show that lesions of the right hemisphere are associated with partial neglect of the left visual field as evidenced in line bisection tasks (e.g., Riddoch & Humphreys, 1983; Schenkenberg, Bradford, & Ajax, 1980): When asked to mark the midpoint of a given horizontal line, participants with right-hemispheric lesions show a shift to the right because they neglect the left end of the line. The line bisection task has also been used with healthy participants to estimate hemispheric dominance with longer left sections (i.e., stronger shifts to the right) indicating relative stronger left- compared to right-hemispheric activation (Friedman & Förster, 2005; Martin & Shrira, 2001; Martin, Shrira, & Startup, in press; Milner, Brechmann, & Pagliarini, 1992; Roig & Cicero, 1994). In the present study, we used a line drawing task to estimate the relative level of hemispheric activation: Participants are asked to draw a horizontal line through a given midpoint. Similar to the line bisection task, left-hemispheric dominance (i.e., relative lower right-hemispheric activation) should be associated with drawing longer left compared to right sections.

To summarize, right-hand muscle contractions (i.e., left-hemispheric activation) are expected to increase vulnerability for self-infiltration of preference judgements compared to left-hand muscle contractions (i.e., right-hemispheric activation). In addition, relative stronger left-hemispheric activation (as indexed by longer left compared to right sections in a line drawing task) is expected to be associated with self-infiltration.

Method

Participants

Participants were 28 right-handed undergraduate psychology students (21 women and 7 men) who received course credit for their participation. Their mean age was 23 years (range 19–41 years). All participants were right-handed according to the Edinburgh Inventory of Handedness (Oldfield, 1971). Their mean laterality quotient was +82 (range +50 to +100).

Materials

The same materials were used as in Study 1. In addition, a line drawing task was used consisting of 12 marks in the middle of a sheet with the instruction to draw horizontal lines of 8, 10, 12, and 14 cm length (about 3–6 in.) through the given midpoints. They were asked to cover the finished lines with a blank sheet before drawing the next line. Difference scores (left section length minus right section length) were calculated to estimate the hemispheric dominance with higher scores indicating relative stronger left-hemispheric activation. To control that participants did not randomly draw longer left or right sections, internal consistencies were calculated for the difference scores. In the present study, internal consistencies were $\alpha = .81$ for the 12 items of the baseline task and $\alpha = .95$ for the 36 items of the main line drawing task.

Procedure

The following changes in procedure were employed in Study 2 compared to Study 1: (a) The *cover story* of the experiment dealt with the development of a "Test of Everyday Life Intelligence." A variety of everyday skills were to be simulated by small activities (e.g., "solving crossword-puzzles," "paint a self-portrait," and "disentangle paper-clips"). Participants were requested to express their opinion about the suitability of these activities for measuring intelligence in everyday life. The aim of the study was to compare the opinion of lay-man with the opinion of experts. (b) Participants rated the attractiveness of 96 instead of 48 activities. The selection phase of the PANTER was continued with *low-attractive items only*. This was done to double the number of low attractive items in the critical cells. (c) Participants were informed about the *recommendations of experts* about the suitability of activities for measuring intelligence in everyday life. (d) Participants were asked to do the *ball-squeezing for a period of 3 min* instead of 1 min. (e) The line drawing task was assessed before (t_0) and after (t_1) the first ball-squeezing as well as before (t_2) and after (t_3) the second ball-squeezing. $T0$ was used as a baseline to check for individual differences in hemispheric dominance between ball-squeezing conditions. T_1 to t_3 were aggregated to estimate participants' relative level of hemispheric activation during the experiment.

RESULTS

Descriptives

Action orientation scores ranged from 0 to 12. Applying the norms of the failure-related dimension (Kuhl, 1994), 12 participants were classified as state-oriented because their score was below the median of the norms ($M = 2.17$,

$SD = 1.47$) and 16 participants as action-oriented since their score was above the median of the norms ($M = 8.00$, $SD = 2.34$).

Manipulation Check of Item Attractiveness

To control for differences in initial item attractiveness between experimental induction conditions, attractiveness ratings were analyzed using a First Hemispheric Activation (left vs. right) × Second Hemispheric Activation (left vs. right) × Item Attractiveness (low vs. high) ANOVA, with the last one as within-participant factor. As expected, there was a highly significant main effect of Item Attractiveness, $F(1, 24) = 380.06$, $p < .001$: PANTER successfully selected two sets of items, one set of items was rated by participants as low-attractive ($M = -2.20$, SD= 1.53) and another set as high-attractive ($M = 4.51$, $SD = 1.22$). There were no significant interactions with experimental induction conditions. Participants did not systematically differ in their initial attractiveness ratings of office activities between conditions. In addition, a Personality (state versus action orientation) × Item Attractiveness (low vs. high) ANOVA was calculated. There were no significant main or interaction effects for Personality. State- and action-oriented participants did not differ in their initial ratings of office activities.

Manipulation Check of Hemispheric Dominance

To control for initial differences in hemispheric activation between experimental conditions, the line drawing task at t_0 was analyzed using a First Hemispheric Activation (left vs. right) × Second Hemispheric Activation (left vs. right) ANOVA. There were no significant main or interaction effects. Participants did not differ in their initial hemispheric dominance between conditions.

False Self-Ascriptions (FSAs)

Experimental Induction. FSA rates of low-attractive items were analyzed using a First Hemispheric Activation (left vs. right) × Second Hemispheric Activation (left vs. right) × Source (recommended vs. remaining) ANOVA, with the last one as within-participant factor. Consistent with expectations, there was a significant First Hemispheric Activation × Source interaction, $F(1, 24) = 4.41$, $p < .05$. As depicted in Fig. 2 using difference scores and replicating previous findings, participants had significantly higher FSA rates of recommended compared to remaining low-attractive activities after right-hand ball-squeezing (i.e., left-hemispheric activation) before the selection phase, $t(13) = 2.56$, $p < .05$. FSA rates were 28.54% for recommended versus 19.14% for remaining items. In contrast, participants did not have a tendency toward self-infiltration after left-hand

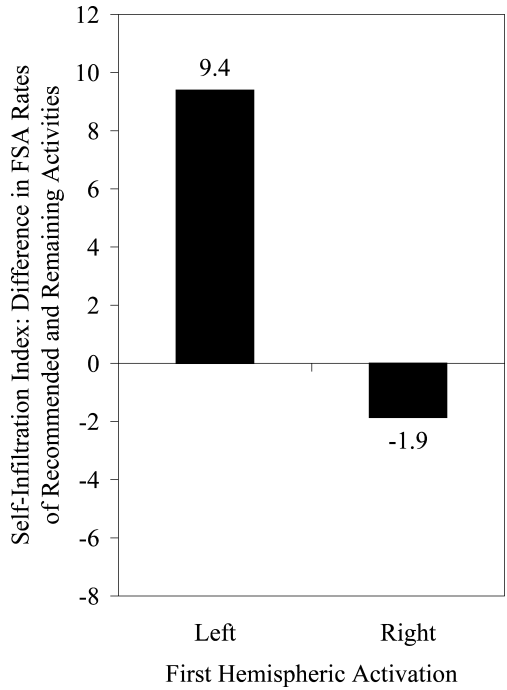

Fig. 2. Mean difference rates (%) of false self-ascription (FSA) of low-attractive activities originally recommended by experts minus remaining, as a function of experimentally induced hemispheric activation (i.e., ball-squeezing in the contralateral hand before item selection phase) in Study 2. Positive values on the ordinate indicate higher FSA rates from assigned activities (i.e., self-infiltration), whereas negative values indicate higher FSA rates from remaining activities.

ball-squeezing (i.e., right-hemispheric activation). FSA rates were 15.50.% for recommended versus 17.36% for remaining items.

To further explore the nature of the self-infiltration effect after left-hemispheric activation, separate FSA rates were calculated for moderately versus highly unattractive items. The self-infiltration effect depicted in Fig. 2 was mainly due to highly unattractive items (10.64%), $t(13) = 2.58$, $p < .025$, and not significant for only moderately unattractive items (8.28%), $t(13) = 1.23$, *ns*.

Consistent with expectations, additional analyses including the factor Personality (state versus action orientation) did not yield any significant main or interaction effects for Personality. The hemispheric activation by means of unilateral muscle contractions was not moderated by state and action orientation.

Alternative Measure of Hemispheric Activation. To replicate the relationship between left-hemispheric activation and self-infiltration with an alternative measure of hemispheric activation, difference scores from the line drawing task (i.e., mean left section length minus mean right section length) were regressed on FSA rates of recommended items, controlling for FSA rates of remaining items. There was a significant positive relationship between the alternative measure of relative left-hemispheric activation and self-infiltration, $\beta = .29$, $t(1, 25) = 2.07$, $p < .05$: The longer the left sections of the lines (i.e., the stronger the left-hemispheric dominance) the higher participants' tendency to misperceive recommended items as self-selected. The 16 participants with longer left sections (i.e., relative stronger left-hemispheric activation) had significantly higher FSA rates of recommended compared to remaining items (25.00% vs. 16.25%), $t(15) = 2.55$, $p < .025$, whereas the 12 participants with longer right sections (i.e., relative stronger right-hemispheric activation) did not differ in FSA rates between recommended and remaining items (18.04% vs. 20.92%, respectively).

False Other-Ascriptions (FOAs)

To test whether participants had a tendency toward false externalization, FOA rates were analyzed using a First × Second Hemispheric Activation × Source (self-selected vs. remaining) ANOVA, with Source as a within-participant factor. There was a significant main effect of Source, $F(1, 24) = 8.15$, $p < .01$. Self-selected items (47.6%) were more often falsely ascribed as assigned than remaining items (34.3%). This FOA effect was significant after initial right-hemispheric activation (self-selected 45.9% vs. remaining 29.3%, $t(13) = 2.97$, $p > .02$) but not after initial left-hemispheric activation (self-selected 49.4% vs. remaining 39.2%, $t(13) = 1.40$, $p > .18$). The First Hemispheric Activation × Source interaction was not significant, $F(1, 24) = .47$, $p > .50$. Consistent with expectations, the FSA effect obtained after left-hemispheric activation was not correlated with FOA rates, $r(14) = -.03$, *ns*. In contrast, after right-hemispheric activation there was a significant correlation between FSA and FOA rates, $r(14) = .57$, $p < .05$.

Discrimination Index

To test an alternative hypothesis that left-hemispheric activation reduces working memory capacity and leads to source monitoring failures, we computed the signal detection measure of discriminability d'. The First × Second Hemispheric Activation ANOVA on d' yielded no significant effects. Source discriminability after left-hemispheric activation ($d' = .79$) was not significantly different from source discriminability after right-hemispheric activation ($d' = .95$) prior to the selection phase, $t(26) = .91$, $p > .35$.

Discussion

Results of Study 2 extended self-infiltration findings to the domain of preference judgements: Asymmetric activation of left-hemispheric processes during preference judgements increased the likelihood of being infiltrated by recommendations of other persons. In contrast, the finding that self-infiltration did not occur after activation of the right hemisphere is consistent with the assumption of PSI theory that self-compatibility checking of external suggestions is supported by the right hemisphere and that it protected individuals from making FSAs of low attractive items. As in Study 1, hemispheric activation prior to the selection task was more effective than hemispheric activation prior to the classification task. The finding replicates previous results of Study 1 and suggests that the encoding phase is even more critical for the occurrence of self-infiltration than is the retrieval phase. The results of Study 2 indicate that right-hemispheric activation is able to prevent the self-infiltration observed after left-hemispheric activation, presumably through access to self-related information that allows participants to carry out a thorough self-compatibility checking of the items presented.

In contrast to FSAs of assignments in Study 1, FSAs of recommendations may be explained in terms of a tendency toward *self-presentation*: Participants may want to present themselves as "good raters," rating with high concordance with the ratings of the experts. However, this alternative interpretation can be ruled out on two grounds: (a) Study 2 findings exactly replicate Study 1 findings that can-not be accounted for by the self-presentation interpretation and (b) the FSA effect is mainly due to highly unattractive and not to moderately unattractive items. Why should participants choose especially these items for their self-presentation tendency? Taken together, results suggest that left-hemispheric evaluations of one's own goals and preferences may be infiltrated by the expectations or suggestions of other persons.

In addition to the variation in the self-infiltration measure, the experimental induction of hemispheric activation through unilateral muscle contractions was supplemented by a line-drawing task to estimate participants' hemispheric dominance throughout the experiment. This completely different "on-line" measure of left-hemispheric activation yielded analogous self-infiltration results and further contributes to the validity of the findings.

GENERAL DISCUSSION

In our previous research, self-infiltration occurred in state-oriented participants under stress (e.g., in a sad mood, under external control, and when reminded of threatening life-events). According to PSI theory, stress is assumed to inhibit self-access and right-hemispheric processes when the ability to reduce negative affect is low (i.e., when state orientation is strong). The present studies allowed to test

the assumed functional mechanism underlying self-infiltration and more directly: Right hand muscle contractions (presumably activating left-hemispheric processing) increased participants' tendency toward false self-ascription. In contrast, left hand muscle contractions (presumably activating right-hemispheric processing) protected participants from falsely attributing assigned goals as self-selected in memory and facilitated self-integration.

At first glance, the protective outcome of the right-hemispheric stimulation seems less obvious than the "alienating" outcome of the left-hemispheric stimulation: The absence of self-infiltration might simply reflect a neutral condition.[8] On the basis of our previous research on this topic, however, we believe that the right-hemispheric stimulation had a protective function for state-oriented participants: The left-hand ball-squeezing eliminated the tendency toward self-infiltration typically found in state-oriented participants (e.g., Kuhl & Kazén, 1994). If the manipulation were simply neutral, there should be self-infiltration effects for state-oriented participants. The absence of a Personality × Hemispheric Activation interaction supports the idea of a protective function.

Furthermore, research on the embodied nature of social cognition emphasizes the important role of actual bodily states and simulations of experience in modality-specific brain systems for social information processing (e.g., Niedenthal, Barsalou, Winkielman, Krauth-Gruber, & Ric, 2005). The closer connection of the right hemisphere with autonomic responses and bodily states (e.g., Dawson & Schell, 1982; Wittling, 1990) may increase "embodiment" and thus facilitate decision accuracy after right-hemispheric activation (cf., Damasio, Tranel, & Damasio, 1991), which is not to be expected after left-hemispheric activation, because of its proposed disconnection with bodily processes (cf. Weinberg, 2000). Nevertheless, this remains an interesting topic for further investigation.

Ball-squeezing prior to item selection was more effective than ball-squeezing prior to item classification in both studies. This finding suggests that FSAs are for the most part an encoding phenomenon. Presumably, asymmetric left-hemispheric activation during item selection deprives individuals of access to right-hemispheric implicit networks representing own needs, preferences, and other implicit self-aspects that form the basis for a thorough self-compatibility checking during self-selection and during encoding of social expectations such as goal assignments or preference judgements. The left-hemispheric advantage in processing verbal information and explicitly formulated goals may further contribute to a

[8]Whereas left-hemispheric activation is clearly associated with functional ability, increased right-hemispheric activation has been associated with functional disability (Rotenberg, 2004). Therefore, one might question whether the left-hand ball-squeezing was able to stimulate a higher-order, right-hemispheric function such as self-integration. However, Keenan et al. (2001) demonstrated that increased motor-related activity in the right hemisphere was associated with self-related functions. A neutral condition without ball-squeezing could clarify whether the experimental activation of the right hemisphere had actually stimulated self-integration or was simply not harmful.

premature adoption of assignments or suggested items even if they are not fully self-compatible. This assumption is strengthened taking into account the results of Keenan et al. (2001), concerning the left-hemisphere bias to process information about other persons (famous faces) and the right-hemispheric bias to process personal information (own faces).

Apparently, deficient self-compatibility checking during encoding cannot be easily compensated by subsequent activation of right-hemispheric functions (i.e., the second ball-squeezing prior to the memory test), including processing of self-related information (Keenan et al., 2001). Nevertheless, there is some evidence that presumed asymmetries in hemispheric activation during retrieval make some individuals prone to FSAs as well: A sad mood induction prior to the item classification task increased self-infiltration in state-oriented participants (Baumann & Kuhl, 2003). According to the negative-affect modulation assumption of PSI theory, unattenuated negative affect reduces access to the self-system and right hemispheric processing. Presumably, classification of the internal (self-based) vs. external (assigned) item source does not only require retrieval of prestored information but *on-line computation* of own preferences and implicit self-representations (cf. Kazén et al., 2003). Therefore, access to implicit self-knowledge and episodic memory (autonoetic awareness; cf. Wheeler et al., 1997) is important during retrieval as well (cf. Ranganath & Paller, 1999; Tulving, Kapur, Craik, Moscovitch, & Houle, 1994): Even if a person had the chance to select self-congruent goals and check assignments for self-compatibility during encoding, he or she may lose access to this implicit knowledge when exposed, during retrieval, to a threatening situation or to conditions that otherwise inhibit right-hemispheric processing. Stated differently, it appears that "bad encoding" of external assignments cannot easily be compensated whereas "good encoding" may still be disturbed later on.

The FSA effect after left-hemispheric activation cannot be easily accounted for by alternative interpretations. First, the FSA effect cannot be explained by a general memory deficit because the number of false beliefs of having chosen an assigned or recommended activity is corrected for a baseline of general memory performance (i.e., the number of false beliefs of having chosen a "remaining" activity). Second, the FSA effect does not resemble an identification with external assignments because it occurred with low attractive items. Misperceiving highly attractive items as self-selected might indeed indicate an identification with external suggestions (cf. Baumann & Kuhl, 2003; Kazén et al., 2003). However, the present findings were obtained for low attractive items indicating a tendency toward self-infiltration that can be distinguished from identification (Deci, Eghrari, Patrick, & Leone, 1994). Third, the FSA effect cannot be accounted for by reduced working memory capacity after left-hemispheric activation (Luu et al.,1998) or more systematic processing of source cues after the unfamiliar left-hand ball-squeezing (i.e., right-hemispheric activation) because no hemispheric asymmetries were evident in false other ascriptions (FOA) or in source discriminability (d').

Finally, the relationship between self-infiltration and left-hemispheric activation has been obtained with two different operationalizations of hemispheric activation: An experimental induction of left-hemispheric activation by means of contralateral muscle contractions and a correlational measure of hemispheric dominance similar to the line-bisection task. Taken together, our findings contribute to an understanding of its neuropsychological basis: Self-infiltration is likely to occur in a left-hemispheric processing mode whereas right-hemisphere activation appears to prevent its occurrence.

The present findings on hemispheric asymmetries related to different types of internalization are consistent with other experimental research on the role of motivation in hemispheric asymmetries. Using the emotion of anger, Harmon-Jones (2003) showed that the left hemisphere is associated with approach-related motivation that does not involve positive affect. Self-infiltration may be described as approach-related motivation (e.g., trying to become a doctor as expected by the parents) associated with negative emotions (e.g., feeling guilty or ashamed if one does not try hard). Furthermore, Kuhl and Kazén (2005) demonstrated need-related hemispheric asymmetries supporting the idea that power-related stimuli activate the left and affiliation-related stimuli the right hemisphere. Consistent with the findings by Harmon-Jones (2003), these motivationally relevant hemispheric asymmetries were independent of valence (Kuhl & Kazén, 2005): Positive (e.g., "giving good advice") as well as negative (e.g., "feeling humiliated") power-related stimuli received greater attentional resources when presented to the right visual field (i.e., left hemisphere), whereas positive (e.g., "sharing feelings") as well as negative (e.g., "feeling lonely") affiliation-related stimuli received greater attentional resources when presented to the left visual field (i.e., right-hemisphere). Self-infiltration has to do with power and hierarchy: For example, state-oriented participants show a self-infiltration effect only when exposed to external pressure (Kazén et al., 2003). In the present experiments, self-infiltration was also related to the suggestions of authority figures (i.e., boss and experts). It remains an open question whether the same regularity is relevant to the suggestions of ordinary or "neutral" persons. The experimental activation of the left hemisphere may sensitize participants for the hierarchical nature of suggestions and stimulate self-infiltration. In contrast, the experimental activation of the right hemisphere may take away introjection pressure because communication is perceived as "among equals": Only when a recommendation is approved for, it will be integrated into one's personal set of goals, values, and preferences.

The findings of the present studies connect left-hemispheric activation to one conflict-laden type of internalization: Self-infiltration (Baumann & Kuhl, 2003; Kuhl & Kazén, 1994). They are consistent with the postulated over-reliance in left-hemispheric functioning of suicidal persons (Weinberg, 2000). The present results inform only indirectly about a more positive type of internalization: Identification. This latter form of internalization has been related to subjective well-being and

is based on congruency between basic needs and personal goals (Deci & Ryan, 2000; Sheldon et al., 2003; Sheldon & Kasser, 1995). According to PSI theory, the neuropsychological basis of integration is unimpaired access to right-hemispheric functions, allowing the self-compatibility checking process to take place (Kazén et al., 2003; Kuhl, 2000). The present studies were designed to test the hypothesis of a relationship between left-hemispheric activation and self-infiltration. To test the hypothesis that right-hemispheric activation facilitates goal integration more specific designs are needed, in which after right-hemispheric activation, the degree of integration of personal goals is examined using additional measures of intrinsic motivation (e.g., free-choice behavior), conflict-free enactment, and personal satisfaction (cf. Baumann & Kuhl, 2005; Deci & Ryan, 2000; Sheldon et al., 2003).

Limitations and Future Perspectives

The present studies have a number of limitations. First, it could be argued that none of the activities in our experiments were truly self-selected because the PANTER procedure forced participants to select half of the items. However, research guided by self-determination theory supports the idea that even subtle differences in the wording of instructions for an uninteresting task ("Now you can press the key" vs. "Now you should press the key") can convey a choice and promote self-determination (e.g., Deci et al., 1994). Thus, the self may have been activated during self-selection in our studies despite the forced choice format of the task. Notice also that our forced-choice procedure is not ecologically invalid. It is similar to many everyday "free-choice" situations where self-infiltration is likely to take place, like family events, school, or job activities, in which explicit or implicit social pressure is present in self-selection. Second, falsely recalling an activity as self-chosen does not necessarily imply that participants believed they wanted to or actually were more likely to engage in the activity on their own volition. In previous studies, however, the self-infiltration index was clearly related to actual behavior (Baumann, 1998; Fuhrmann & Kuhl, 1998; Kuhl & Kazén, 1994). For example, participants who typically confuse external assignments as self-selected when negative affect or "stress" is present (state-oriented) actually engage in recommended activities when trying to maintain a healthy diet more often than in self-selected activities on their own volition (Fuhrmann & Kuhl, 1998). Nevertheless, it is an interesting question for future research whether the simple ball-squeezing manipulation can increase voluntary engagement in externally controlled activities and—if so—how long this effect can be observed. Third, personality differences may have been obtained in a larger sample and/or in conjunction with negative mood. It would be an interesting topic for future research to test the effects of state and action orientation when both, hemispheric activation and negative affect, were experimentally manipulated. Finally, the ball-squeezing manipulation as well as the line-drawing task lack specificity of hemispheric

activation. There may be regional differences within each hemisphere. Therefore, although they are theory consistent the present findings are only a first approach toward investigating the role of the two hemispheres in internalization. Neuroimaging studies could contribute to a regional specification of the neuropsychological basis of diverse forms of internalization.

Conclusion

The functional analysis of the present studies suggests that asymmetric activation of left-hemispheric processing impairs the ability of checking options for action according to their origin (self vs. other), which leads to self-infiltration, whereas right-hemispheric activation serves to prevent the occurrence of self-infiltration. The personality disposition of action orientation after failure is conceived of as the ability to retain access to right-hemispheric processes even under stress. The finding that the moderating effect of this disposition on self-infiltration (Baumann & Kuhl, 2003; Kazén et al., 2003; Kuhl & Kazén, 1994) could be circumvented by an activation of the right hemisphere in the two studies reported is consistent with the hypothesis concerning the functional basis of self-infiltration versus self-integration. Taken together, our findings shed light on the neurophysiological basis of self-infiltration and contribute to an understanding of personality development as a continuous integration of self-compatible expectations of others in terms of typical interactions between right- versus left-hemispheric functions of the human brain.

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