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MOTIVATION AND ACTION IN SELF-REGULATED LEARNING

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I. INTRODUCTION AND CONCEPTUAL FRAMEWORK

It is not particularly novel to state that people can learn without being forced and without direct tutoring. For example, Piaget (1936) described in detail how children gain a more realistic image of their environment by alternating between accommodation and assimilation—even if there is no instructing teacher. His student Aebli (1963) declared self-initiated learning to be a teaching principle: Students should be their own teachers.

The processes that direct this learning (accommodation, assimilation, curiosity driven attention, etc.) are quite basic in nature. Their initiation and regulation is partly automatic in that they do not require a deliberate decision by the learner to engage in learning. However, it is likely that goal-oriented and intentional learning increases in importance as the learner becomes older. Such self-directed conscious learning becomes necessary when acquiring competence with the more complex material of school or university. Consciousness is not restricted though to school learning: It is also required when training for a driver's license, acquiring athletic or artistic competence, learning how to work with a computer, and so on. We call such intentional learning activities that are not under a tutor's control, but under one's own direction, *self-regulated learning* (SRL). This rather general definition may be specified by additional components like self-regulated learning strategies, self-monitoring of effectiveness, and self-motivation (Schunk & Zimmerman, 1994; Zimmerman, 1995a). However, enriching the definition too much might create a problem in that we subsume many components under a normative concept instead of studying them empirically as effects of SRL. Thus we adhere to the more general definition just mentioned.

In SRL, a tutor's direct guidance and support is missing, so there are many learning options, but also many opportunities for distractions. Therefore, in SRL we are interested in at least two questions: First, why does a learner engage in learning activities at all instead of doing something else? The question of why people learn has been addressed under the topic of learning motivation and, under certain conditions, volition. Research concerning this first question conceives motivation–volition as dependent variables. The second question is how does motivation influence the learning process and the learning outcome? In this case, motivation–volition are understood as independent or mediating variables. Figure 1 presents a framework in which these and similar questions can be understood.

The diagram starts with the antecedents of current learning motivation and ends with the learning outcome achieved on a specific learning task in a specific learning episode. Following Lewin (1951), we assume that motivated behavior is always a function of the person and the situation. This fundamental assumption also holds for SRL. On the person side (box 1) we have to consider motivational traits, such as competence-related motives (e.g., Atkinson, 1957), personal interests (Krapp, 1992), superordinate goals (Heckhausen, 1977), self-efficacy beliefs (Bandura, 1977), motivational orientation (Dweck & Leggett, 1988; Nicholls, 1984), and similar variables that describe rather stable characteristics of the person. On the situation side (box 2) we have to consider task characteristics, such as the subject matter or the task's structure and difficulty. Furthermore, we have to take into account more general features of the learning situation, for example, the social setting (learning alone vs. learning within a group) and potential gains and losses the learner could face or anticipate in this situation. Possible gains may be new information about one's own ability, good marks, being in close contact with an appreciated subject matter, praise from relevant agents, prestige, prizes, or trophies for excellent results, the competence to use a powerful instrument such as a car or a computer, and so on. In some learning situations, certain aspects may be salient; in others, they may not.

It should not be supposed though that personal characteristics and situation are always independent in their impact on current motivation for SRL. Depending on the learners' motivational traits, some of these situational characteristics could rise in relevance and, therefore, have an impact on current motivation to SRL. More precisely, the interaction between personal and situational characteristics influences the goal setting, the

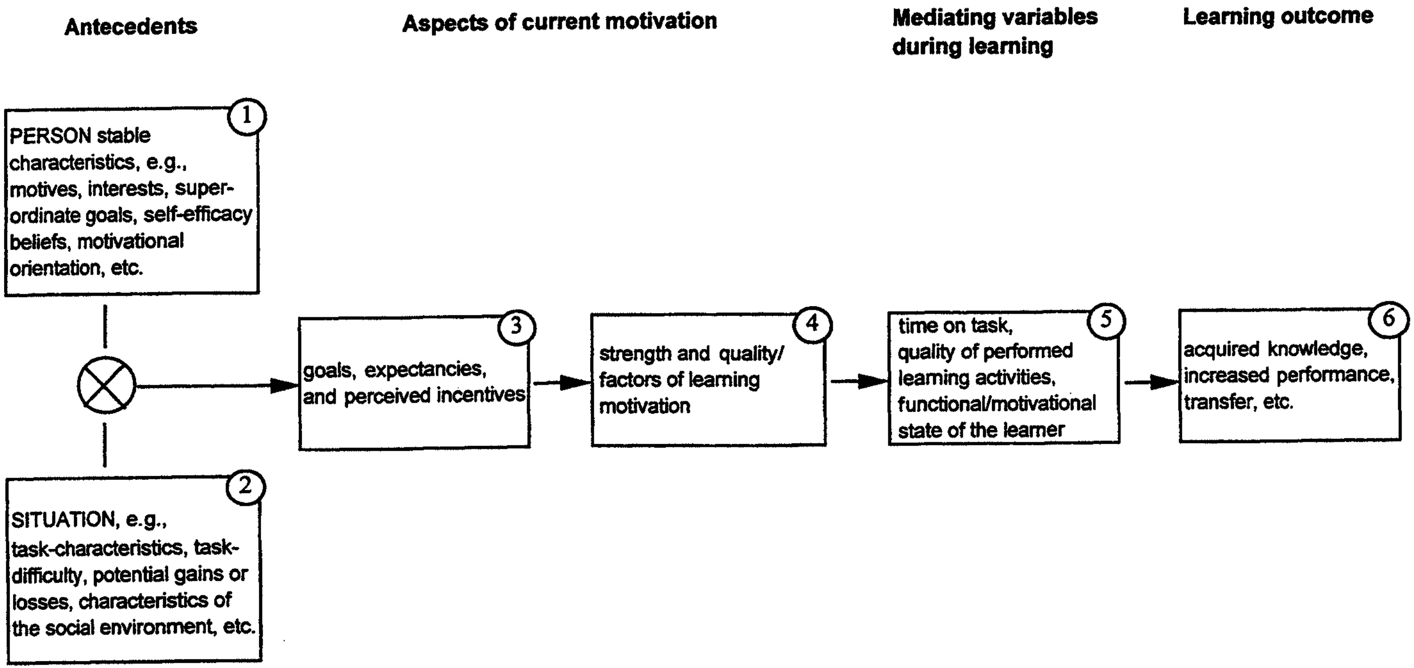

FIGURE 1 A framework for learning motivation and its effects on self-regulated learning.

expectancies, and the incentives the person perceives in this situation (see box 3). These variables determine both the strength of learning motivation and the quality of this motivation (box 4). The *quality of learning motivation* refers to the type of striving. For example, students may engage in text learning because they became very interested in the topic described in the text. On the other hand, they may enjoy the challenge of a very difficult task, anticipate applause from others, and so on. (In Section III of this chapter we report a way to measure such qualities as motivational factors.)

As previously mentioned, quality and strength of learning motivation depend on the person and the situation. If, for example, the learning task consists of a very simple routine (e.g., learning a couple of facts by heart), this situation creates no challenge. However, whether a potentially challenging task (like trying to handle a complex system) actually functions as an incentive for learning depends on a person's competence-related motives.

Until now we have restricted the discussion to motivational features. Certainly, motivation in the context of SRL is a very interesting and important topic to study. Nevertheless, we need to take the next step and ask how, in detail, do motivational variables influence learning and how can we understand the impact they can have on the learning outcome? These questions lead us to variables that mediate the influence motivation may (or may not!) have on learning (box 5). In the case of SRL, in which the learner has numerous degrees of freedom for how to learn, we assume that *time on task* and the quality of performed learning activities are relevant mediating variables. (The term "quality of learning activity" refers to things like reading relevant sections repeatedly, mapping schemata, writing down main ideas, learning by heart, speaking aloud difficult words, etc.; see Pintrich & De Groot, 1990.) A further mediating variable may be the student's *functional state* during learning. This variable can refer to activation or concentration during learning. Last, but not least, we think that the learner's motivational state during learning mediates the effects the initial motivation has on the learning outcome. The term *motivational state* refers to the momentary strength and quality of (learning) motivation that can be measured repeatedly during a learning phase (see Section III.B). Whereas the initial motivation (i.e., the motivation that led the student to start learning) may change considerably during a long learning period, it is not tautological to regard motivational state (during learning) as a mediating variable for the impact of initial motivation on learning outcome. Of course, there could be more mediators. For the moment, we restrict the list of mediators to those we studied in our research.

Learning outcome (box 6) marks the end of the functional chain presented in Figure 1. What kind of indicators for learning are used depends on the nature of the task and the questions the researcher is interested in. We should keep in mind that the effects motivation has on measured learning outcome may depend strongly on the performance measures we use. Under certain conditions, increasing motivation may, for instance, lead to increased quantity and, simultaneously, to decreased quality of performance (Schneider & Kreuz, 1979; see Heckhausen, Schmalt, & Schneider, 1985). Thus, two researchers may find opposite motivational effects in their experimental data if one of them used quantitative and the other more qualitative measures for learning outcome. Obviously such results may produce confusion and lead to ignorance of motivational variables in learning experiments by researchers who prefer to study simple models.

In the following part of this chapter, we first discuss questions of motivation and volition referred to in boxes 1 to 4 of Figure 1 (antecedence and aspects of current motivation to learn). Next, we step forward to boxes 5 and 6 in Figure 1 and discuss questions of how, in detail, initial motivation affects learning and learning performance (the effects motivation has on SRL).

II. AN ACTION MODEL FOR THE PREDICTION OF LEARNING MOTIVATION

A. RESEARCH STRATEGY

Even a quick glance at Figure 1 gives an impression of the spatial distance between a person's motivational traits (box 1) and the learning performance in a specific learning episode with a specific learning task (box 6). Thus it is not very surprising that the measured correlations between traitlike variables and learning are at best low: The common variance between personal interest, for example, and learning performance on the topic of interest, is about 9% on average (Krapp, 1992; Schiefele & Schreyer, 1994). Even if we take into account relevant situational factors (box 2), as was done in early achievement motivation research (e.g., Karabenick & Yousseff, 1968), we get at best results that may be useful for testing a theoretical model (e.g., the risk-taking model by Atkinson, 1957). However, these results are not sufficient to understand the motivational processes in such a way that we can successfully predict the learning motivation for a single person (Heckhausen et al., 1985; Schiefele & Rheinberg, 1997). To gain deeper insight and greater power in predicting individuals' motivation to learn, we must study the relationship between variables that lie closer together in our diagram presented in Figure 1. Thus, the gap to be bridged is smaller and there are fewer uncontrolled influences that obscure the relationship in question. In the following section we summarize a series of studies that explore the relationship between goals, expectancies, and incentives (box 3), and explore the strength of learning motivation (box 4). All were studies of intentional learning at home, a situation in which there was no guiding instructor and in which the students were free to do activities other than learning. In our opinion this is a typical condition for SRL.

B. A COGNITIVE MODEL OF MOTIVATION IN SELF-REGULATED LEARNING

Imagine a student who has just been told that an exam in a particular subject will be given next week. What are the conditions under which this student will study for this exam on his or her own? That is, when will SRL be engaged in? According to the general structure of expectancy-by-value models (Feather, 1982), two conditions must be fulfilled: First, the student has to believe that learning activities will improve the result he or she will receive in this exam (expectancy); second, receiving a good result in this exam has to be sufficiently important for her or him (value).

This simple structure of expectancy-by-value models becomes more differentiated if we start to ask, "On what does it depend, whether a good result is important to the student or not?" That is a question of what consequences the student expects from the result. Thus, we need to know each consequence perceived by the student and the subjective value (i.e., its incentive value) it has for her or him. Furthermore we have to know how certain the student is that this consequence actually will occur if the desired result is reached.

Obviously things become complex if we analyze learning motivation in real life settings. Therefore, a model would be helpful that specifies and links the different components (i.e., expectancies, consequences, incentive values) we have to consider in this context. Such a model was proposed by Heckhausen (1977, 1991, pp. 413–418) and specified for learning situations (Heckhausen & Rheinberg, 1980; Rheinberg, 1989).

We use this model to bridge the gap between boxes 3 and 4 in Figure 1. It helps us to organize the elements within box 3 in such a way that we can predict the strength of motivation in box 4. Figure 2 presents a modified version of this model.

The model subdivides a learning episode into a sequence of four stages: perceived situation, action, intended outcome–goal, and consequences. In the previously described exam example, the situation is created by the announcement of the exam and what this exam means to the student. *Action* is the activity or activities that the student believes will lead to a desired result in the exam (the goal). In the case of SRL, these activities are performed intentionally and under the student's own control. Intended *outcome–goal* refers to the desired result. The student's perception of the consequences follows from assumptions about the effects the intended outcome will probably have, once attained. Our studies with students

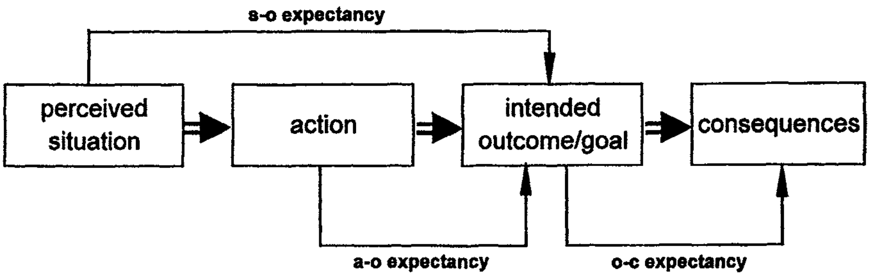

FIGURE 2 A modified version of the expanded cognitive model of motivation. *Note.* The incentives to act lie in the (evaluated) consequences. Abbreviations: s–o, situation → outcome; a–o, action → outcome; o–c, outcome → consequences. Adapted from Heckhausen and Rheinberg (1980), Lernmotivation im Unterricht, erneut betrachtet, *Unterrichts wissenschaft*, *8*, 7–47.

identified a number of such consequences, such as contentment–pride in the result (self-evaluation), praise and acceptance of teachers, parents, and classmates (other evaluation), good learning chances for the subsequent classes, increased chance of getting a good job or university place, profitable usage of the learned skills outside school (e.g., learning foreign languages), monetary rewards, certainty that a good result will decrease the need for further study of this subject, and so on (Rheinberg, 1989).

Whether these and other consequence are perceived depends on their salience in the situation (box 2 in Figure 1) as well as on the student's attentional focus. Such focus is directed by the student's motivational characteristics (box 1 in Figure 1). However, these motivational characteristics not only influence perception, but also the evaluation of the perceived consequences. A perceived consequence, for example, acceptance or admiration by classmates, may be quite irrelevant for student A, but an extremely important, desirable, and activating issue for student B. We refer to such evaluations with the term *incentive value*. This incentive value may be higher or lower and may be positive or, in the case of feared consequences, negative. Differing from Aktinson's well known way of indirect incentive assessment (1 minus the probability of success; Atkinson, 1957), we measured incentive values more directly when we analyzed students' motivation to learn: We asked them how many weeks without allowance each consequence was worth to them. As just mentioned, this incentive value is influenced by a student's motivational traits (see Figure 1, box 1). We found, for example, significant correlations between students' achievement motives (as measured by AMS; see Gjesme & Nygard, 1970) and the incentive value of self-evaluation and of superordinate goals (as measured by the week-without-allowance scale; Rheinberg, 1989).

The four stages of the model (situation, action, outcome, and consequence, see Figure 2) are bridged by three expectancies. The action →

outcome (a–o) expectancy is the subjective probability that one's own learning action will lead to the desired outcome. This kind of expectancy is quite similar to the probability of success in achievement motivation theory (Atkinson, 1957; Heckhausen, 1967) or Skinner's (1996) agency–outcome expectancy. It integrates Bandura's (1977) early concepts of self-efficacy and behavior–outcome expectancy: To have a high action → outcome expectancy, the person must be sure that action X can produce the intended outcome Y (Bandura's behavior–outcome expectancy). Simultaneously, the person must be sure that action X is under his or her control (Bandura's self-efficacy expectancy). Low action → outcome expectancy can arise from either low self-efficacy expectancy or low behavior-outcome expectancy, or can be due to both conditions.

The situation → outcome (s–o) expectancy is the (subjective) assumption that the just given situation will lead to the desired outcome on its own, without the need to take any action. This kind of expectancy usually is neglected by motivational psychologists, but, nevertheless, is important for learning motivation under everyday conditions. Bolles (1972) discussed this kind of expectancy as the $S - S^*$ component of the so-called *psychological syllogism*. (The other component is the $R - S^*$, which is quite similar to the action → outcome expectancy just mentioned.) The third expectancy is the outcome → consequence (o–c) expectancy (see Figure 2). It refers to the subjective probability that the outcome will actually have the specific consequences the learner desires. In the field of industrial psychology, this outcome → consequence expectancy is known as *instrumentality* (Vroom, 1964).

The three types of expectancies described in the preceding text do not really fit into the classification scheme Skinner (1996) proposed, because this scheme does not discriminate between outcome and consequences. Both are conceived as "ends" (Skinner, 1996, pp. 553, 554) and thus the substantial difference between action → outcome expectancy and outcome → consequence expectancy becomes blurred.

This expanded cognitive model fits situations in which a person has a certain action outcome as a goal (e.g., to get a good result in an exam, to understand the difficult instruction for a video recorder, to master a particular coordinated movement in sports). However, the goal's attractivity depends on the expectancy of all possible outcome consequences anticipated by the learner. Such goal-oriented situations often exist in everyday life, particularly in learning situations in which there is more to be gained than just the joy of increased competence or contact with a topic of interest.

The expanded cognitive model bridges the gap between boxes 3 and 4 (Figure 1) in predicting that learning motivation (i.e., the tendency to perform learning activities) is only strong enough to result in self-directed action if the following conditions are fulfilled: (1) The intended outcome–goal does not occur by itself (low s → o expectancy) and (2) can be influenced by one's own learning activity (high a → o expectancy); (3) the perceived outcome's consequences have a sufficiently high incentive value; (4) at the same time they are closely linked with the intended outcome (high o → c expectancy). These four conditions are presented as a flow diagram in Figure 3.

In a set of studies by Rheinberg (1989), this model was used to predict whether students voluntarily would prepare at home for an exam or, instead would use their free time to do something else. Whereas these learning activities were done intentionally and were self-directed, this was

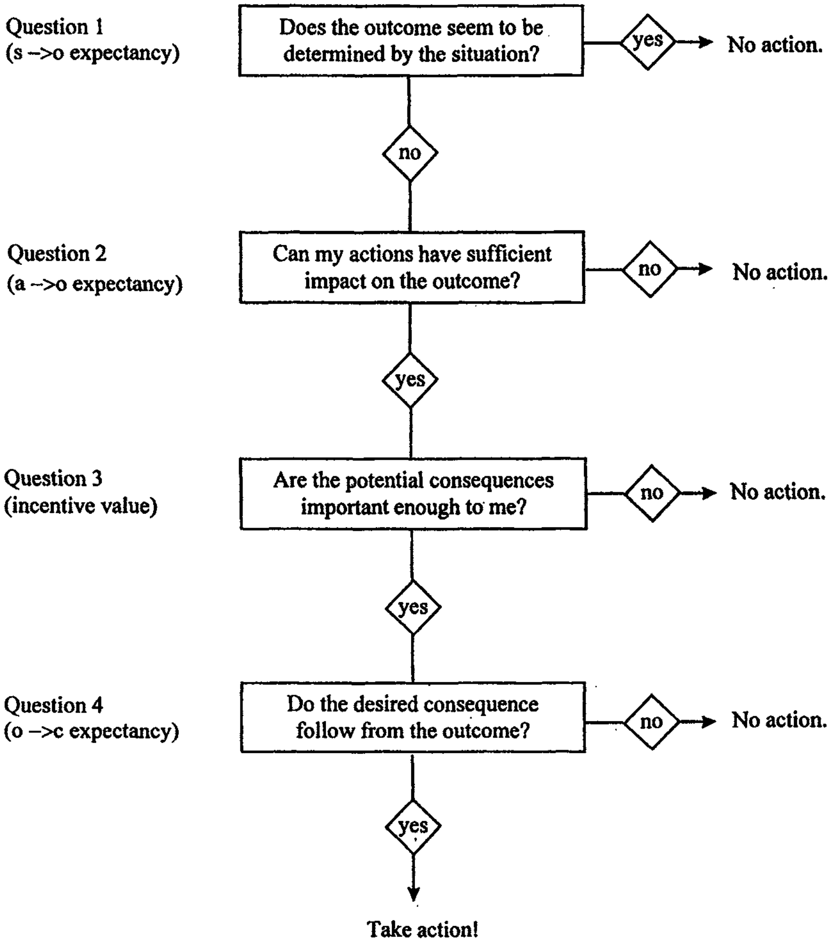

FIGURE 3 A flow diagram of questions and responses used by Heckhausen and Rheinberg (1980) and Rheinberg (1989) to evaluate the component of utility-centered motivation in SRL. For definition of the expectancies, see Figure 2.

a typical case of SRL as we defined it previously. To predict students' motivation, we measured the four parameters represented in the questions shown in Figure 3. The measurement was done one week before an announced exam was given. As a first step the students were asked what mark they were striving for in the announced exam. This was their intended outcome–goal. To assess the situation → outcome expectancy, students rated their probability to reach this mark without any further learning at home. This could be compared to their action → outcome expectancy; that is, the probability of reaching the desired mark if a maximum amount of self-regulated learning was engaged in at home (doing nothing else but preparing for this exam at home next week.). To predict sufficient motivation for SRL at home, the first expectancy had to stay below a critical value; the second one had to stay above.

To have adequate information concerning the consequences (Questions 3 and 4 in Figure 3) the students were asked what they thought would happen if they succeeded in reaching their desired mark. Each of these consequences was rated according to the outcome → consequence expectancy and its incentive value. For the latter, we used the previously mentioned week-without-allowance scale: The students rated how many weeks without allowance this consequence was worth.

On the basis of the question and answer sequence in Figure 3, it was predicted for each student whether she or he would be a case of no learning action or take learning action. To test these single case predictions, we assessed each student's preparation criteria immediately before the exam was given. Ten minutes before the exam took place, students reported how many hours of their free time they spent during the previous week preparing for the exam and whether or not they thought that this was enough to obtain the desired result. This last estimate was the main criterion against which the model was tested (preparation sufficient vs. unsure or insufficient; for further details, see Rheinberg, 1989). In five studies, 75% to 85% of the predictions came true (Rheinberg, 1989). At a first glance this seems to be extraordinarily high. However, we have to consider that the predictors have been developed specifically for this very episode and that they were valid exclusively for this single situation.

C. CONSEQUENCES FOR ENHANCING MOTIVATION IN CLASSROOMS

The flow diagram presented in Figure 3 indicates that there are at least four qualitatively different types of poor learning motivation (which result in no action). For each of these types we need quite different interventions to change the result no action to take action! Behavior modification programs in the tradition of Skinner (1968) try to influence Questions 3 and 4: They systematically induce desirable consequences (Question 3) that are contingent with a defined behavior outcome (Question 4).

In the 1970s, Rheinberg studied teaching strategies that increased action → outcome expectancies (Question 2) and simultaneously decreased situation → outcome expectancies (Question 1). Additionally, self-evaluation consequences (Question 3) were modified (Rheinberg, 1977; Rheinberg & Krug, 1993). The core concept for the interventions was the Reference Norm Orientation (Rheinberg, 1980). According to Heckhausen (1974) and Nicholls (1978) teachers (and students) can compare a student's learning outcome interindividually with the corresponding learning outcome of other students. This kind of comparison was called *social reference norm*. On the other hand, a student's learning outcome can be compared intraindividually with learning outcomes that the same student previously achieved on comparable tasks. This kind of comparison was called *individual reference norm* (Rheinberg, 1980).

It emerged that teachers who preferred individual reference norms created instructional conditions that were favorable for enhancing students' learning motivation. Students who received intraindividual feedback on their performance development had the experience that success (i.e., increase of performance) was very likely to occur if they practiced specific learning activities. Such experience leads to high action → outcome expectancy. Conversely, students experienced that without any learning activity, the probability to fail (i.e., stagnation or decline of performance) was quite high. Experiences such as these lead to low situation → outcome expectancy. Simultaneously these teachers trained their students to evaluate themselves on the basis of their own earlier performances and not on the basis of other people's results (Rheinberg, 1977; for further details see Rheinberg, 1983; Heckhausen et al., 1985). Up to now, 21 studies have found that teachers' use of individual reference norms has favorable consequences for their students' motivation to learn (Mischo & Rheinberg, 1995). Meanwhile, programs have been developed to train teachers to use individual reference norms in their classes (Rheinberg & Krug, 1993). Components of the individual vs. social reference norm orientation are also described in the more recent concepts of motivational orientation (Dweck & Leggett, 1988; Nicholls, 1984).

D. ACTIVITY-RELATED INCENTIVES

Looking back to the expanded motivational model presented in Figures 2 and 3, it is obvious that this model is utility centered. The incentives for action are anchored in the outcome consequences. Thus, learning motivation was conceived strictly instrumentally: Learning activity is performed to attain highly evaluated outcomes after successfully completing this activity. This is an important component of learning motivation, but not the only one.

A further component of learning motivation emerged in an interview study in which students explained episodes of exam preparation; in particular, why they sometimes prepared themselves well and sometimes they did nothing (Rheinberg, 1989, Study E). In the case of intensive preparation, nearly 85% of the given explanations referred to the expanded motivational model, whereas 55% of the explanations for omitted preparation were in line with this model. However, the students reported that the incentives for intensive or omitted preparations were not anchored only in consequences external to the learning activity. There are also incentives embedded in the activity itself—no matter what the outcome and the consequences that follow. Such incentives are generated by carrying out the activity and not by the results that follow after the activity is finished (within-action vs. postaction incentives).

Obviously we have to distinguish two types of incentives. The first concerns the consequences of the action outcome the person is striving for. These incentives refer to future events that are expected to happen when an action in question is finished successfully. They may become powerful and gain behavioral impact when the person anticipates or imagines these future events. The expanded model of motivation to learn described in Section II.B operates with this type of incentives. The second type of incentives refers to the activity itself. Someone may hate learning lots of isolated facts by heart, but may feel good when mapping systematic overviews or discussing a text's main idea with other students. Such activity-specific incentives can be anticipated, too. Moreover, they may even influence SRL immediately during learning, because the aversion or attractivity of a certain (learning) activity are felt when the activity is performed. These activity-specific incentives may strengthen or weaken the consequence-derived tendency to start and continue with learning. Thus the model was again expanded by allocating the two types of incentives just described (see Figure 4).

According to McReynolds (1971), the activity-specific incentives could be called intrinsic. However, the distinction between intrinsic and extrinsic motivation has been used in several quite different ways (Csikszentmihalyi, 1975; Deci & Ryan, 1985; Harlow, 1950; Heckhausen, 1991; Schneider, 1996; White, 1959). Thus we prefer the term activity-specific incentive, because it stimulates and/or maintains activity-related motivation (as opposed to consequence-related motivation). These incentives are not anchored primarily in objects or subject matters, but in the actual learning activity like reading, creating coherent structures, drawing schemata, systematizing information, learning by heart, watching videos, having group discussions, and taking part in educational role play.

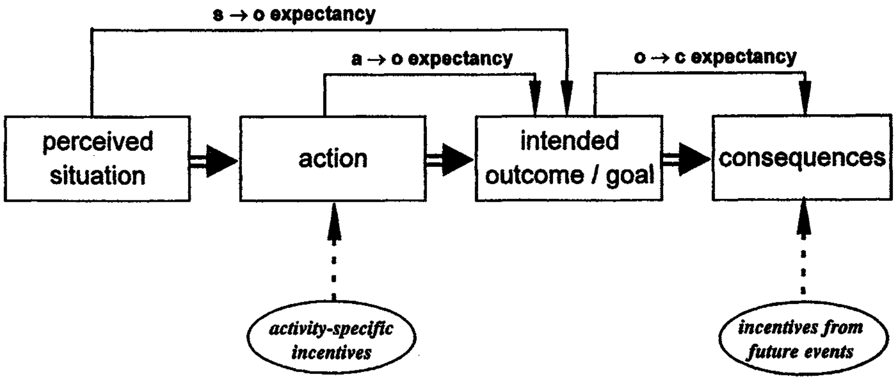

FIGURE 4 Two kinds of incentives in the expanded motivation model (Rheinberg, 1989).

Therefore, these incentives are not exactly the same that the educational *theory of interest* focuses on (Krapp, 1993; Renninger, Hidi, & Krapp, 1992), because this theory defines interest explicitly via the *specific object* or *subject matter* (interest in history, in cars, in insects, etc.). Someone may be very interested in history (i.e., the object of interest), but simultaneously hate to learn the data for the reigns of kings by heart (i.e., the learning activity). Thus, subject matters and learning activities can be independent sources of incentives to learn—both important, but sometimes different in nature. However, this distinction is analytic, and in everyday learning situations, both incentive sources may be correlated: Objects that are associated with many desirable activities are often interesting and activities done with desirable objects tend to be more pleasant. So, learning historical data by heart may be less aversive than, for example, learning chemical formulas by heart. In any case, incentives of activities and of objects–subject matters have one important quality in common: The incentive to learn is anchored within the learning process and not primarily in the consequences of learning outcome.

Further studies found that motivation during SRL is dependent both on the consequences and the activity-related incentives (Rheinberg, 1989). One important finding from these studies was that some learners were primarily consequence directed, whereas the focus of other learners was directed more by the immediate incentive of the activity itself. This interindividual difference can be measured with a questionnaire, namely, the Incentive Focus Scale (Rheinberg, 1989; Rheinberg, Iser, & Pfauser, 1997). These studies found that, depending on their dominant incentive focus, learners' performance was predicted better either by activity-related incentives or by the utility-centered structure of Heckhausen's (1977) expanded motivation model (i.e., the expected consequences of the outcome, see Rheinberg, 1989, Studies F and G).

However, the more (subjectively) important the consequences become, the less influential the activity-related incentives become (Rheinberg, 1988). To illustrate the underlying idea, think of monetary reward as a consequence of learning outcome. If reaching a specific performance level today (i.e., learning outcome) were rewarded with $10,000 (consequence), most students would perform even highly aversive activities as long as (only) these activities guaranteed success in achieving the crucial performance level: Very high consequence-related incentives may cause learners to overcome activity-specific aversions.

This hypothesis was confirmed by Rheinberg and Donkoff (1993), who found that incentives specific to the learning activity were the best predictors of learning activities for students who had a habitual tendency to focus on activity-related incentives, as long as the learning outcome was no more than moderately important. If the learning outcome was very important, however, then focus on activity-related incentives became less relevant, in that these students were more influenced by how efficient they expected the learning activity to be. Thus, they even used learning activities they regarded as aversive, just like students with a strong habitual tendency to focus on consequence-related incentives, as long as these activities seem to be highly efficient. (Momentarily, we ignore the issue that overcoming activity-specific aversions may reduce the actual efficiency of learning; see the next section.)

E. VOLITIONAL ASPECTS OF SELF-REGULATED LEARNING

Nevertheless, there are students who cannot force themselves to engage in aversive learning activities, even if the consequences of the learning outcome are very important. In this case, we do not have a problem of motivation, but of volition. Long ago, Ach (1910) studied volition in learning situations experimentally. However, his work was forgotten until Heckhausen and Kuhl (1985) and Kuhl (1985) revived Ach's idea that people may be more or less able to direct themselves to perform an activity that goes against their immediate motivational tendencies (i.e., to act against the activity-related incentives). Kuhl (1983, 1987) described some volitional control strategies, which are summarized in Table 1.

People use the strategies in Table 1 when they force themselves to control their actions in aversive activities (Kuhl, 1996). However, people differ in their ability to do so. Kuhl and Kraska (1993) developed a computer-based method for measuring interindividual differences in volitional action control. Corno (1992, 1995) and Zimmerman (1995b) proposed various methods that teachers might use to improve the volitional control strategies of their students. Some of these strategies are similar to those in Table 1.

TABLE 1 Six Self-Regulatory Strategies (Volitional Control Strategies; see Kuhl, 1985, 1987)

1.	Attention control Active control of attentional focus so as to support the current intention and inhibit the processing of information supporting competing tendencies
2.	Encoding control Selective encoding of those features of a stimulus that are related to the current intention and its purpose.
3.	Emotion control Inhibiting emotional states that might undermine the efficiency of the protective function of volition
4.	Motivation control Strengthening the feedback link from the self-regulatory processes to their own motivational basis
5.	Environment control Manipulating the environment is a higher order strategy that supports emotion and motivation control strategies (e.g., making social commitments to create social pressure that may help maintain an intention)
6.	Cognition control Parsimony of information processing and stopping rules to optimize the length of the decision making process, especially if further processing may reveal information that undermines the motivational power of the current intention

Given that time is limited and many leisure activities are usually more attractive than studying for an exam, students and adults often have to use volitional control processes. If they are lucky, new incentives arise while doing the activity (activity-related incentives, see Figure 4). For example, fast progress in learning can make the learning activity more attractive than initially expected (for details, see Rheinberg, 1996; see also Table 2). If no such positive incentives arise, then the learning activity has to be maintained continually with volitional control strategies: Learners have to remind themselves why learning is important (i.e., awareness of consequence-related incentives; Figure 4) and have to consciously use self-regulatory strategies. Such strategies can be like either those described in Table 1 or those described by Zimmerman and Martinez-Pons (1988), which are more specific to learning.

For aversive but unavoidable actions, such as quitting smoking or forcing oneself to do tedious physical training, a pure volitional control would be joyless, but possible. However, pure volitional control may be problematic for learning activities. Sokolowski (1993) found that students experienced volitional control as unpleasant and especially effortful. We suspect, that such tightly controlled learning is more inefficient, because the working memory is permanently loaded with self-regulatory strategies. Therefore, less working memory is available for the learning process per se. Evidence for this speculation might be found by directly comparing learning processes that are volitionally regulated with learning processes in which people experience flow (Csikszentmihalyi, 1975). When in flow, the learner becomes so absorbed by the learning activity that they no longer feel the passage of time and do not have any problems focusing on the task; thus, all of their working memory is devoted to the task. Thus, performing the same learning activities might have different effects on learning outcome depending on the learners' functional state during learning (see box 5 in Figure 1). However, this issue still needs a thorough empirical analysis. (For further details, see Rheinberg, 1996; Schiefele & Rheinberg, 1997.)

The more aversive the activity becomes, the more necessary are volitional control strategies. So it has become important to know what makes learning activities per se attractive or aversive. Currently, Rheinberg (1999) is studying the origins of positive and negative incentives in SRL. Table 2 gives the preliminary results of an interview study.

Table 2 presents only sources for those incentives that are effective during learning. Anticipated outcome consequences are not included. Of particular importance are increases in feelings of competence: While learning, the learner feels that doing the task is becoming smoother and easier, and that she or he is becoming better at it. Such feelings are often reported when participating in sports or playing music, but when learning cognitive material, these feelings seem to be less common: Our participants reported these feelings less frequently when they talked about learning on academic tasks. This could be due to the fact that the process of creating these feelings demands comparisons between the current and a previous state. From other studies, it is known already that comparisons

TABLE 2 Sources of Activity-Related Incentives in the Learning Process (Examples from an Interview Study; Rheinberg, 1999)

Sources of positive incentives
- Learning situation fits the learner's motive structure (e.g., learning together with friends if the learner has a high affiliation motive)
- Learners evaluate the topic highly (fit between personal interest and learning topic)
- Learners feel an increase in competence while learning (requires a concise feedback system and free processing capacity)
- The mental interaction with the learning material makes a coherent structure out of many unlinked details; during learning things get simpler and clearer

Sources of negative incentives
- Learning material (e.g., a textbook) is incoherent
- Single issues do not make sense and have to be learned by heart
- The learning process is constantly interrupted because unknown things (e.g., words, formulas, etc.) have to be looked up and learned
- Intrusion of failing thoughts or emotions during the learning activity, such as when the learners notice that they cannot understand anything, or that even with a maximum effort, they do not succeed

during learning put a load on the working memory (Sweller, 1988). However, the working memory is fully involved in the learning activity itself. Thus, in the case of cognitive learning, it is difficult to perceive the increase in one's own competence during the learning activity and to enjoy such feelings. So, this learning may require additional support more frequently from positively evaluated consequences and volitional processes. Perhaps this is one (out of several) reason why, for many students, cognitive learning is less often a joyful activity in itself, unlike sports or playing an instrument, for example. If this assumption were verified, we would have to think about possibilities for how to improve the ease of evaluation during cognitive learning without interfering with the learning process as such.

III. MOTIVATION, LEARNING, AND PERFORMANCE

Until now we have dealt with questions regarding how motivation and volition arise in learning. Learning motivation even can be conceived as an educational goal that is important in itself (e.g., see Schiefele, Hausser, & Schneider, 1979). Additionally, we may ask how motivational factors influence the process and outcome of learning. We already know that there are only low to medium correlations between some indicators for motivation and some indicators for learning results (see Schiefele & Schreyer, 1994). Little is known, however, about the process by which motivation affects learning and its results. Of course, experts as well as laymen believe that motivation somehow positively influences learning—despite evidence that in some cases overmotivation can be detrimental (Atkinson, 1974; Yerkes & Dodson, 1908). Even if we disregard the latter fact, the question of how motivation in detail fosters learning remains. It could be that motivation and volition promote only contact between the self-regulated learner and the learning material, after which everything can be explained in terms of cognitive processes. Alternatively, could it be that motivational factors also determine how the material is learnt? Surprisingly little is known regarding these questions, perhaps because everybody was certain that motivation improves learning on a molar level, so there was thought to be little need to study the details of the process.

However, some researchers have begun to study how motivation affects the learning process—and not only the learning *result* (e.g., Pintrich & De Groot, 1990; Renkl, 1997; Schiefele, 1996; for a review, see Schiefele & Rheinberg, 1997). In our initial framework (see Figure 1), this research tries to link boxes 4, 5, and 6. The crucial question concerns box 5: What are the variables that mediate the effects motivation (box 4 in Figure 1) has on learning outcome (box 6) during the learning process?

A. MOTIVATIONAL INFLUENCES DURING THE LEARNING PROCESS: TOPIC INTEREST AND TEXT LEARNING

Schiefele (1996) studied this question for text learning. The motivational variable (box 4 in Figure 1) he measured was topic interest. The learning outcome variables (box 6) were based on van Dijk and Kintsch (1983) and were differentiated among verbatim vs. propositional vs. situational representations of the text. Several studies revealed that topic interest was related negatively to verbatim representations, but positively related to propositional representations (for details, see Schiefele, 1996; Schiefele & Rheinberg, 1997). Obviously, motivation (i.e., topic interest) does more than cause and maintain the contact between learner and text. In addition, motivation seems to influence, in some way or other, how the learner interacts with the text. However, what are the variables that mediate the relationship between motivation and performance? How can we understand the specific way topic interest influences text learning? Schiefele measured some affective variables (e.g., arousal, happiness, flow) during learning and some cognitive variables, such as learning strategies (elaboration, underlining, note-taking), attention, or concentration. According to our framework for learning motivation, these variables belong either to the category functional–motivational state of the learner or to the quality of performed learning activities (see Figure 1, box 5).

Schiefele (1996) showed that the affective variables during text learning indeed were related positively to topic interest. However, only one affective variable (i.e., arousal) out of five studies proved to have a significant mediating effect on learning outcome. With regard to cognitive variables, some of them were related to topic interest (e.g., elaborative strategies), whereas others were related to learning outcome (e.g., note-taking). However, for none of them could a significant mediating effect be found. Obviously, there can be no doubt that topic interest influences text learning, because there are reliable positive and negative relationships between these two variables. However, until now it was unclear via what specific variables this influence is mediated.

B. SELF-REGULATED LEARNING WITH A COMPLEX COMPUTER-SIMULATED SYSTEM

In our own research, we have studied motivational effects on learning when learners try to understand and control a complex computer-simulated system (the Biology Lab; Vollmeyer & Rheinberg, 1998; Vollmeyer, Rollett, & Rheinberg, 1997). During a learning phase, participants can detect the system's structure by manipulating input variables and analyzing the resulting effects on the output variables. Participants choose how they do this in detail and how long they work. However, participants know that they have to apply their knowledge after the learning phase. In this application phase, the participants receive goal states for the output variables that they have to reach by entering appropriate inputs. Although the learning situation is clearly structured, the learner is free to choose the activities used to learn how to reach the goal. According to our initial definition, this is a typical case of SRL.

Our experiments last between 1 and 4 hours, and allow repeated measurements of mediating variables during the learning phase. Whereas sophisticated analyses of motivational effects on learning outcome require a differentiation between specific qualities or factors of motivation (Schiefele & Rheinberg, 1997), we do not use a single indicator for learning motivation like strength of motivation or the just mentioned interest. Instead, we assess different motivational qualities with respective to factors of motivation with the Questionnaire for Current Motivation (QCM; Vollmeyer & Rheinberg, 1998). This questionnaire consists of 37 items that reflect motivational qualities participants can experience in this experimental setting (i.e., positive expectancies, fears, challenge, topic interest, etc.). In a series of studies (Vollmeyer & Rheinberg, 1998; Vollmeyer et al., 1997), four factors could be replicated: challenge ("This task is a real challenge for me" or "If I can do this task, I will feel proud of myself"); mastery confidence ("I think I am up to the difficulty of the task" or " I think everyone could do this task"); incompetence fear ("I'm a little bit worried" or "I'm afraid I will make a fool of myself"); interest ("After having read the instruction, the task seems to be very interesting" or "I would work on this task even in my free time"). These factors seem to be relevant for other experimental learning settings as well (e.g., Schoppek, 1997). They do not measure a person's generalized and stable characteristics (box 1 in Figure 1); instead, they assess situation-specific actualized motivation (box 4 in Figure 1).

If we relate these motivational factors to the expanded model of motivation (see Figures 2 and 4), we recognize that these empirically developed factors focus on specific parts of the model: The challenge factor reflects competence-related self-evaluation as a consequence of learning outcome; mastery confidence concerns high action → outcome expectancy; interest refers to object-specific incentives during learning (within-action vs. postaction incentives; see Section II.D); incompetence fear reflects low action → outcome expectancy combined with negative consequences of failure. In our experimental task, we expect positive effects on learning from the first three factors (challenge, mastery confidence, and interest), but negative effects from incompetence fear.

These four motivational factors measure *initial motivation*, that is, motivation when participants are instructed about the task, but have not started with the learning phase. Whereas the initial motivation can change dramatically after participants gain some experience with the task, we repeatedly measure the current motivational state with items such as, "The task is fun" or "I'm sure I will find the correct solution." Moreover, participants repeatedly rate their functional state during the learning phase (e.g., "I have no problems concentrating on the task"). A further repeatedly measured variable is the systematicity of the inputs' manipulations. It is known from earlier experiments (Vollmeyer, Burns, & Holyoak, 1996) that complex tasks like the Biology Lab demand a systematic approach to manipulating the inputs in order to analyze the outputs. However, to practice this systematic approach, learners have to invest some cognitive effort (i.e., for producing and controlling cognitions like hypotheses, complex comparisons, analytic plans, etc.). Unplanned trial-and-error operations require less cognitive effort. However, with this desultory surface strategy, there is no chance to detect the complex structure of the system that has to be controlled later on. In any case, systematicity of participants' approach to the task is repeatedly measured as a quality of performed learning activity. Thus, with the motivational and functional state and with the systematicity of the approach, we measured a set of variables that might mediate the effect initial motivation may have on learning outcome (see Figure 1, boxes 4, 5, and 6). The learning outcome variables are measured, on the one hand, as declarative knowledge about the system's structure and, on the other hand, as procedural competence in controlling the system.

For analyzing our data, mastery confidence and incompetence fear are usually combined into a latent variable that represents initial motivation, because they correlate negatively. Results from Structural Equation Modeling (EQS; Bentler, 1992) revealed that the effects of these latent variables on the acquired declarative knowledge were mediated via the motivational state during learning and the systematicity of the learners' approach. These two mediating variables were related: A positive motivational state during learning increased the probability that learners kept on using a systematic approach in spite of the cognitive effort this kind of learning demands (Vollmeyer et al., 1997). The functional state was more likely to mediate motivational effects on the performance when the acquired knowledge had to be applied (Vollmeyer & Rheinberg, 1998). Unexpectedly, time on task (see Figure 1, box 4) seemed to have no mediating effects in our experimental setting. Probably, this will not be true for SRL in everyday contexts (Helmke & Schrader, 1996).

Similar to other studies (Krapp, 1992, 1993), topic interest correlated with learning outcome (Vollmeyer et al., 1997). However, just as in Schiefele's (1996) studies on text learning, we failed to identify the mediating structure for this relationship, so it remains unknown via which mediators topic interest influences learning. The challenge factor of initial motivation usually had no direct effects on learning outcome. However, this variable seems to be a relevant moderator, at least for experimental settings: Correlations between initial motivation and learning outcome were stronger for learners who perceived the task as a high challenge compared to those perceiving a low challenge. For low-challenged learners, cognitive variables, (i.e., an ability measure and the systematicity) were better predictors for learning than the motivational variables (Rollett, Vollmeyer, & Rheinberg, 1997; similar results were reported by Schoppek, 1997, using a different learning task). Analyses based on dividing participants into different types revealed that there are subgroups of learners with different patterns of relationships between motivational and cognitive variables (Rheinberg & Vollmeyer, 1997).

The results of these and similar experiments have been obtained using specific types of learning tasks and situations. Therefore, they are valid only for comparable learning settings (Boekaerts, 1996). Changing the type of task (e.g., learning a foreign language instead of problem solving) or changing relevant situational features (e.g., salient consequences, distracting incentives of alternative activities, the possibility of postponing learning, etc.) may alter the way motivational factors influence learning and its outcome. Regardless, the reported results are valid at least for individual learners who must use self-regulation when trying to understand and control a complex system. This situation might not be too far from everyday life.

IV. TWO AIMS FOR FURTHER RESEARCH

A. SEARCH FOR MEDIATING VARIABLES IN DIFFERENT SITUATIONS AND LEARNING TASKS

The search for mediators in different situations and learning tasks is an important next step. There is a need to examine to what degree and in what way motivational effects on learning depend on the task and the situation. To state the mere existence of such a dependency is neither novel nor enlightening. In future research, it is necessary to vary systematically relevant characteristics of the task and the situation to study how these manipulations affect the predicted paths between motivation and learning outcome. Stability or change in the pattern of mediating variables may aid understanding of the more fundamental relationships between motivation and cognition.

By searching for mediators, it is possible to gain sophisticated knowledge about learning motivation that is not trivial and already known to everyone. The layman's statement, "Motivation fosters learning—some way or other," will be true for many situations. To go beyond laymen's intuitions, researchers must gain the ability to specify what exactly is meant by "some way or the other" with a specific task in a specific situation. Models that could guide the empirical studies have been presented by Kanfer and Ackerman (1989), Revelle (1989), Rheinberg (1988), Sanders (1983), and Schiefele (1996) (for an overview, see Schneider, Wegge, & Konradt, 1993).

B. HOW TO OVERCOME AVERSIVE LEARNING ACTIVITIES

The second aim for future research arises from the fact that (according to our definition) SRL concerns intentional and deliberate learning activities that are free from external guidance and supervision. Using Heckhausen's (1977) utility-centered model of motivation in SRL situations, we found students who failed to engage in learning activities in spite of highly valued consequences and in spite of favorable expectancies. The reason for such seemingly irrational behavior was found in the activity-specific incentives (see Section II.D). In contrast to instructional controlled learning in school or university, SRL usually has to be engaged in despite competition from perhaps more attractive leisure activities. Thus, the combination of important and reachable consequences of learning outcome with relatively unattractive or even aversive learning activities is likely to occur.

Such a combination causes problems, especially for learners who usually focus on incentives immediately related to learning activity (Rheinberg et al., 1997; see also Apter, 1989). These learners have difficulty forcing themselves to engage in unattractive activities. Research suggests two strategies that could help these learners: one that accepts the relative joylessness of learning activity as something to be worked around, and one that seeks to remove this joylessness. The first strategy flows from the work of Kuhl (1985, 1987), who identified volitional control strategies (see Table 1). Now that such control strategies have been identified, perhaps methods can be developed for training people in the use of such strategies (will training). Such training could provide learners with methods for making themselves do things that have to be done, but are no fun or even are aversive. As discussed already, SRL of this kind will not be only joyless, but also might function on a suboptimal level because the volitional control processes continuously put a load on the working memory and disturb those cognitive processes that lead to learning outcome (see Section II.E; functional state of the learner). Nevertheless, learning takes place. There may be situations in a student's career in which the latter is the only crucial issue.

Corno (1992) and Zimmerman (1995b) discussed methods by which teachers may help their students to increase their self-regulatory competence. These attempts could be enriched by transforming the results from volitional psychology (Heckhausen, 1987; Kuhl, 1996) to training programs for students (e.g., how to practice attention control or encoding control?). In our opinion flow experience (Csikszentmihalyi, 1975) is a powerful instrument to cover relative unattractive action periods, therefore, components of the flow concept should be considered in such training: Students should learn how to arrange the situation, the task, and the sequence of their inner and outer activities to create an opportunity for flow experience (Rheinberg, 1996). Developing and evaluating such standardizable training programs seems a solvable and important task for future research on SRL.

The issue of flow experience leads to the second strategy for overcoming unattractive learning activities. On this path, the aim is to change or enrich unattractive learning activities systematically with components that usually are experienced with highly attractive learning activities. This seems to be a more long-term goal for research, because our current knowledge about sources of positive incentives during learning is quite limited (see Table 2). Thus, the first step is to study and describe such positive incentives during SRL. Building on this knowledge, the second step would be to develop and to evaluate programs that teach students (and teachers) how to make unavoidable learning activities more attractive. For one single component, namely, the incentives of competence-related experience, this two-step strategy already has been carried out (Rheinberg & Krug, 1993; see also DeCharms, 1976).

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