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The Köhler Effect:
Definition of terms, empirical observations and theoretical concept

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Summary

This study tries to define relevant terms. It outlines those components which influence the processes of motivation gains and losses in groups, namely the unit of research, the measure of performance, the concatenation operation and the type of task. Because of its topicality the Köhler effect is the focus of this study. This effect can be further differentiated into: a) an additive, b) conjunctive, c) loss-avoiding, and d) compensatory Köhler effect, depending on the baseline used, e.g., the average, poorest or most capable group member, or whether a Ringelmann effect can be expected.

In addition, the optimal performance ratio needed to produce motivation gains in groups has to be examined. In some cases this ratio remains unspecified, whilst in others it is specifically determined in an attempt to produce gains in motivation. This differentiation of empirical effects can be extended by introducing intervening variables by which the effects can be explained. Here, two kinds of variables are introduced; situational incentives (instrumentality / challenge) and personal dispositions (self-monitoring and the tendency to compete).
With these assumptions in mind, a questionnaire study was conducted to supplement existing experimental findings. According to these data a performance ratio can be determined which results in a general Köhler effect, and the situational incentives within varying performance constellations can be assessed and predicted on account of personal motivation dispositions.

Finally, the motivation theory based on these findings is used as an extension of the "collective effort model" (Karau & Williams (1993), and suggestions for further research are made.

Key words : Motivation, group, Köhler effect, performance increase.

1. Introductory remarks

The following study is concerned solely with group performance that can be objectively assessed; personal attitudes, opinions or judgements are not taken into account. The main focus of the analysis will be on those elements of motivation which are central to the induction of behavior. This is in keeping with current research, for recent years have seen an increasing number of studies that have brought to light conditions which promote gains in group performance through an increase in motivation. For a long time this view was distorted due to extensive research into motivation losses, beginning with the Ringelmann effect (Moede, 1927; Kravitz & Martin, 1986), research into social inhibition (Moede, 1920; Lück, 1969) up to the most recent studies on social-loafing (Latané, Williams & Harkins, 1979). Nonetheless the study of motivation gains also has its historical roots and follows a line of development beginning with social facilitation research (Triplett, 1897/98; Allport, 1924), the Köhler effect (Köhler, 1926, 1927; Witte, 1989) through to the compensatory effect (Williams & Karau, 1991; Karau & Williams, 1997). Scientific research has fluctuated between these two views. At present intensive research is being carried out into motivation gains (Hertel, 2000; Hertel, Kerr & Messé, 2000). A future venture could be the systematic development of a theoretical concept which combines motivation losses and gains on the one hand with performance losses and gains on the other. One should however beware of the misconception of equating performance losses with motivation losses (Witte & Lecher, 1998). These two theoretical conceptions are not mutually reducible, and the way they relate to one another still has to be theoretically and empirically determined (see point 7).

2. Definition of terms

Bearing in mind the number of years this research tradition has been followed, it is no wonder that ambiguities and unclear definitions have found their way into this field. This in turn leads to theoretical and empirical problems, because different phenomena are subsumed under the same term or various terms are used to denote the same phenomena. I believe we have reached a stage where systematic clarification has become indispensable and this will be our first objective.

Based on empirical results and theoretical observations in small-group research we can differentiate the following aspects:

1. The subject
    a) the individual in a specific group environment;
    b) the interaction between individual group members;
    c) the group as a unit and its relationship to other groups.

2. The measure of performance
    a) individual performance in diverse group situations;
    b) group performance as undifferentiated overall performance;
    c) group performance differentiated according to the performance level of each group member (performance constellation).

3. The concatenation operation of individual performance levels and group performance
    a) discretionary tasks performed by a randomly selected group member to determine group performance;
    b) additive tasks performed by a selected average group member to determine group performance;
    c) conjunctive tasks performed by the poorest group member to determine group performance;
    d) compensatory tasks performed by the best member to determine group performance. [2]

4. Task content

   a) problem-solving, i.e., finding the correct solution;

   b) physical tasks, i.e., performing actions as fast or with as much persistence as possible;

   c) creativity, i.e., generating ideas that show as much originality as possible.

These four dimensions describe the most relevant differentiation factors for the empirical effects observed in this field of research. Let us begin by considering the performance and motivation losses of the Ringelmann effect. It relates to the group as a unit, the measure of performance is the undifferentiated group performance determined by the addition or average of individual performances and the type of task is physical (”tug-of-war” task).
Social inhibition research is concerned with individuals within a group situation and considers solely the individual performance of discretionary tasks. Task contents are primarily physical (Ingham et al.; 1974) and intellective (Dashiell, 1930; Cottrell et al., 1968).
Social-loafing research is an extension of the two previously mentioned approaches and deals with both individual productivity within the group situation and group performance under additive task conditions. It includes all three previously mentioned task contents.
However, these three approaches all fail to take into account the relative performance levels of the group members. They focus either on individual performance or group performance, but not on the differentiation of internal performance discrepancies among group members. A pioneering study of the necessary conditions that constitute performance and motivation gains is social-facilitation research and the widely known performance gains effect in the classic work of Triplett (1897/98). Here the individual within a group situation and individual performance in various contexts are observed. Task contents were primarily physical (Moede, 1920) but to some degree also problem-solving (Dashiell, 1930).
This study focuses on the Köhler effect primarily because of the current follow-up experiments which have stimulated small-group research in recent years (Stroebe, Diehl & Abakoumin, 1996; Hertel, Kerr & Messé, 2000; Hertel, 2000). When considering the following

experiments on the Köhler effect we have to differentiate two levels; first, the way subjects interpret the experimental conditions, and second, the scientific observation of the researchers, as during the observation phase information is added, of which the subjects are unaware during the sessions.

For the subject the situation presents itself roughly as follows:

1. The tests are concerned mainly with group performance, although performance discrepancies between members of the dyads become apparent or have already been established.
2. Individual inputs are measured and combined to obtain the group performance, either under conjunctive or additive conditions.
3. It is a physical task.
4. The objective is to a achieve consistent group performance.

The scientific level supplements and defines the impressions of the subjects more precisely:

1. The performance ratios of the group members are defined and quantified under individual conditions.
2. Above all the performance variation of the weaker group member is contrasted with individual performance in previous individual trials.
3. This performance variation is differentiated according to the performance constellation of the group.
4. Tests are carried out to determine whether there is a significant performance increase between the individual and group performance of the weaker member and whether this performance increment is dependent on the performance constellation.

To investigate productivity gains there are various ways of defining a baseline to determine group performance. An evaluation method which aims to find evidence for a Köhler effect and postulates that performance gains occur only under group conditions with specific performance constellations results in qualitatively varying types of the Köhler effect. These have to be differentiated to avoid becoming entrenched in a scientific dispute which is caused solely by the use of differing evaluation methods which are significant in some instances but not in others.

In the most recent studies only the weakest group member has been used to measure and determine the group performance and its variations. In such instances one can speak of a conjunctive Köhler effect (CKE), because it is based on the assumption that a conjunctive task necessarily excludes any compensation effects through the stronger group member. This is a position which reacts with great sensitivity to performance increase. In line with tradition Köhler used the average or additive individual performance level as a baseline to determine the group performance of both members. This evaluation method of comparing performance levels makes it more difficult to detect a Köhler effect when there are tendencies among group members to match their performance levels to that of other group members. One could call this view of determining performance gains the additive Köhler effect (AKE). Next, one can examine whether performance levels are higher in certain performance constellations than in others, e.g. members of equal strength as compared to members with performance ratios of 1: 0.70. This can be defined as a specific Köhler effect (SKE). It stipulates that only specific performance constellations can generate increased productivity. One therefore determines that section of the performance constellation where performance gains are expected and compares this with other sections, whereby only the relative performance under group conditions has to be compared. There need be no improvement in an absolute sense, but only a relatively better performance under group conditions with certain constellations. One could also focus on one specific section and compare this with all the others, to avoid having to undertake any further theoretical differentiation. In such cases the group performance can be derived by employing a conjunctive or additive concatenation operation. This would then be a specific conjunctive Köhler effect (SCKE) or a specific additive Köhler effect (SAKE). The precondition is that specific performance constellations are theoretically determined. An additional significant aspect of research into the Köhler effect is the use of a Ringelmann effect as a baseline, an effect which has been found repeatedly and should theoretically result in group performance losses (Zysno, 1998). One could define a positive deviation from this prediction as a loss-avoiding Köhler effect (LKE). In such instances a theoretical instead of an empirical baseline is used to detect a Köhler effect. The method of determining group performance then

depends on theoretical assumptions but the prevention of expected performance losses can be seen as an additional positive influence on group productivity.

These four definitions of the Köhler effect, resulting respectively from the baselines that are used, have led to the development of a copious terminology. A common factor of this terminology is the fact that a certain performance constellation results in a relative performance increase. Group performance gains that occur under other conditions should, if possible, not be included when defining the Köhler effect (Hertel, Kerr & Messé, 2000).[3] In the following, when reference is made to the Köhler effect we will not be differentiating in terms of various baselines but will base our assumptions on the fact that at least one of the four effects will result in performance gains. In principal, a compensatory Köhler effect (CKE) could, of course, also be possible, if allowed for by the task structure. In such instances the group performance is determined according to the performance level of the best group member. Studies into the compensatory effect (Williams & Karau, 1991; Karau, Markus & Williams, 2000) have so far not been able to state the relationship between the performance constellation and performance gains, other than the fact that a significant difference in performance is recognizable. The extent of this difference has, however, not been used as a means of differentiating or explaining the effect. It is therefore not appropriate to speak of a Köhler effect when discussing existing experimental findings. Instead it lends itself to expand this research tradition by employing performance constellations as a differentiating variable.

Finally there is also a general “social-facilitation”-effect, which is induced by inter-group competition (Erev, Bornstein & Galili, 1993). The motive to compete with other groups is mentioned here for the sake of including all pertinent factors, although in the following description it plays only a marginal role.

When experimenting under various group conditions in an attempt to generalize the effect, it becomes evident that in future group size, type of task and performance discrepancies have to be systematically introduced, so that their influence on motivation and performance gains can be observed. Furthermore, it will become necessary to develop measures of motivation that are independent of measures of performance, so that incentives for motivation and the relationship between motivation and performance can be studied in greater detail.

This necessitates intensive research into internal motivation processes under varying group conditions based on questionnaire studies that assess internal processes. In this way one could avoid the tendency of accounting for ambiguous experimental performance effects by means of simple internal motivation processes, as the theoretical interpretation of performance gains and losses is still in its early stages (s. Shepperd, 1993; Witte & Lecher, 1998; Hertel, 2000). It is important to systematically combine external measures of performance with questionnaires on internal processes in order to arrive at specific application methods for gains in group performance. In this study the experimental approach, which is essential for verifying the Köhler effect and has been predominant up to now, is complemented by a targeted questionnaire study which will in turn allow for greater accuracy and improvements when designing experimental conditions in the future.

3. Intervening variables of the Köhler effect

Up to now experimental research into the Köhler effect has been conducted without controlling personality variables or the differential effect of the group condition on individual group members. When these variables influence results, this leads to an increase of the error variance so that the actual effects cannot be found due to insufficient test power. Theoretically the consideration of personal dispositions limits the generalization of the effect, but it increases the impact of the effect on certain theoretically predetermined groups of individuals. In this respect one should take another look at the studies conducted by Otto Köhler (1926, 1927) for a better understanding of what they involve:

A rowing club uses weights for its winter training sessions.

Weight-lifting performance relates to rowing performance and is therefore an important indicator for the position of the group member within the self selected group of sportsmen.

Individual performance levels are known within the group as training has gone on for some time.

If rowers have the same performance level this has already been clarified during training sessions. This similarity in performance creates a sense of mutual solidarity, not of competitiveness, because through individual training the position of all rowers within the group has already been determined (status congruence) in both conditions; (Wilke, 1996).[4] When dyads are formed the group members make use of this information and in the specific dyad they now behave as a subgroup relating to the performance level of the entire group. Similarity creates solidarity within the dyad and hence to behavior patterns based on solidarity. These in turn result in performance losses, as individual performance is lowered so as not to outperform the other member (Ringelmann effect). When there are substantial performance discrepancies neither of the members expects any great productivity gains due to the conjunctive nature of the task (doubling of the weight). Only when both individuals recognize a slight, just noticeable difference in the performance of the entire group will the weaker member want to exert as much effort as possible to compensate for this difference as the difference is not perceived as unduly high. In addition the weaker member can demonstrate in direct collaboration that if he exerts special effort he performs only slightly below the level of the stronger member, that is, the position within the overall group – determined after individual trials – can be altered, when there is a direct comparison within the dyad and the possibility of outperforming the better member. Furthermore, individual performance is variable, depending on daily fitness and particular task demands. The weaker member is aware that he must exert special effort to outperform the stronger member, but does not conceive this to be impossible. A situation in which interpersonal comparison is possible is experienced as a challenge and leads to higher exertion.

The recorded individual inputs during training are not an indication for maximum performance levels. Members still have energy reserves which can be employed e.g., in the dyad situation. If one accepts this hypothesis the nature of the task attains both conjunctive and additive elements: in the Köhler experiments the conjunctive nature of the task is produced by doubling the weights in the dyad

condition. But as the weight is doubled only at a medium level and not adapted to the performance level of each dyad respectively, the stronger member can to a certain degree compensate for the lower productivity of the weaker member, even if he is not able to lift the weight alone. Yet, above all, on account of the assumed energy reserves during individual trials, the conjunctive nature of the task is once again partly eliminated.[5] For this reason the baseline chosen by Köhler, that is, the average of the individual inputs of both members, can be regarded as a conservative estimation of the effect, namely the additive Köhler effect (AKE), whilst the baseline chosen by Stroebe et al. (1996) and Hertel et al. (2000), that is, the performance of the weaker member, can be seen as a very optimistic interpretation, namely the conjunctive Köhler effect (KKE). By knowing the standard deviations (s) of individual performances (p) it would be possible to use the lower performance level of the weaker member (p+s) instead of (p), as in the purely conjunctive interpretation of the task. Other correctives are also feasible, such as performance averaging, which would be in keeping with the additive nature of the task structure.[6]

Defining the nature of the task more precisely even poses the question whether in forming the groups a Ringelmann effect should be taken into account and tested. It would then be possible to observe the loss-avoiding Köhler effect (LKE). That would correspond to a validation of the experimental conditions: in the control group of the Köhler experiments this effect should be clearly evident in group members of equal capability. A further possibility would be to observe a specific performance constellation and test this against the other areas, to see where a specific Köhler effect (SKE) occurs (Witte, 1989).

The existing experiments and findings leave open a number of basic questions which have to be clarified if future experiments to test theoretical assumptions are to be designed more systematically. Some of these questions are listed below.

The first question applies to the performance discrepancy in the dyad, which is necessary if one member is to perceive the other as “better”. This is the essential precondition for all types of Köhler effect, as according to the classical experiments certain performance

constellations seem to be advantageous. In addition, there is a need to review task contents, as these can also lead to variations in performance that can be measured using interval or ratio scales. If experiments with varying task contents are conducted one has to know whether the performance constellation is such that the performance level of one member is just one subjective performance unit higher than his partner's but not so much higher that comparison between the partners is no longer possible. This corresponds to the determination of a just noticeable difference (jnd) in a social context.

The second question involves the difference in individual performance under conditions where performance expectations vary. An aim of this study is to discover which internal motivation processes are evoked in subjects under such conditions: When group performance is of central importance the question arises which internal processes are induced when a subject collaborates with a partner who is, a) much “better”, b) slightly “better” or c) of decidedly lower capability than himself. Reference should be made to the varying situational incentive processes, that is, whether they can be broken down into various motivation dimensions.

The third question is concerned with group work in general from the point of view of the individual member (disposition effect). Which aspects of motivation can be differentiated and how do these correspond with variations in the observed group performance and with internal processes when collaborating with a partner of different capability (incentive process)? Here, it is necessary to refer to general motivation theories.

The fourth question revolves around the problem of differentiating task contents. This raises the question whether the three types of task (problem-solving, physical, creativity) should be differentiated dimensionally according to performance evaluations. In addition, is it valid that differences in performance measures are closely linked with favorable or unfavorable conditions?

Once these questions have been answered they will afford a theoretical framework for the development of more specific experimental settings in which to create a Köhler effect or general group performance gains, and also to examine theories, which of course still have to be formulated, in greater detail.

4. Method

A questionnaire focusing on internal processes was compiled, which covers the following variables (see Appendix):

1. Estimation of the subject's own performance variability when performing all three types of task, by comparing productivity gains under favorable conditions and productivity losses under unfavorable conditions with the subject's standard level of performance.
2. Information on a just noticeable difference (jnd) in the actual performance gains of another individual compared with the subject's own standard performance for three types of tasks (difference threshold).
3. Self-categorization of the subject's own internal motivation processes for all three types of task in three different performance constellations, that is, with a partner of higher capability, of lower capability and with a partner whose performance level is slightly, but noticeably higher (incentive effect).
4. Determination of general internal motivation tendencies in groups and their qualitative differentiation as personality components of motivation within the individual (personal disposition effects).
5. Social demographic features for a description of the sample.

With the help of these variables it should be possible to test the specific hypotheses that relate to the general Köhler effect. To do this it is necessary to examine the relationship between external performance measures, that can be objectively assessed, and internal motivation processes which will be primarily based on the questionnaire study. Even so, objective, empirical findings are always equivocal and subjective self-categorization data poses problems as to reliability and validity. These setbacks can best be tackled through a combination of both approaches plus the development of theoretical concepts.

5. Hypotheses

The first hypothesis concerns the question mentioned above whether, as Köhler discovered (1926, 1927), the subject's estimation of his own performance level and that of a subject who is considered to be clearly more capable corresponds to a ratio of 0.70 to 1. When such a ratio is given the other member's performance level is typically perceived to be recognizably higher. This assumption is based on the findings that when this ratio was present the dyads in Köhler's experiments demonstrated the highest performance gains (specific additive or conjunctive Köhler effect, SAKE or SCKE).

The second hypothesis assumes that a subject perceives a noticeable difference in his own performance when the task is experienced as a challenge or when rest periods are possible. This variability is a precondition for the Köhler effect as the individual must principally be in a position to increase his performance in comparison to his standard performance level; without incentives a maximum individual performance will not be achieved. This now poses the question whether comparable differences in performance are apparent for all three types of task.

The third hypothesis claims that the evaluation of performance has three dimensions that correspond to the differentiation in the above mentioned types of task. In this point it also assumed that there is a negative correlation between performance estimation under favorable and unfavorable conditions and that evaluation of the performance of a just noticeably higher-capability subject correlates positively with the performance evaluation under favorable conditions (dimensional validity of performance values).

The fourth hypothesis stipulates that typically the degree of motivation varies when collaborating with partners with different performance levels. This is the basis for motivation in all types of the Köhler effect regarded as a performance gain (incentive effect).

The fifth hypothesis assumes that general motivation in group work does not allow for any prediction of the performance values of an subject who is perceived as being of higher, lower or nearly equal capability. Such a relationship could be regarded as artefactual or as an indication of a third-variable that influences both individual motivation and performance evaluation, e.g., cognitive models of subjects participating in the questionnaire study that

construct links because they have been asked about two different contents at the same time. That would make the interpretation of relating values more difficult (discriminatory validity).

The sixth hypothesis also assumes that the individual range of variation does not relate to the general motivation experienced in group work. This, too, would have to be regarded as an artificial result, as in this case third-variables which equally effect the other two variables could not be ruled out. The validity of the motivation variables would then be questionable (discriminatory validity).

The seventh hypothesis is based on the idea that motivational processes in the various group constellations (incentive effects) are determined by the individual's influence on the general motivation apparent in group work. In such instances it becomes evident that situational conditions have varying effects on the group members and that increased performance gains can only be expected from certain individuals (personal disposition effect). As such the Köhler effect should occur primarily when subjects experience the group situation as motivating and have a personal motivation structure that reacts positively to group situations (see point 7., but also the classical approaches of: Byrne, McDonald & Mikawa (1963) as well as Sorrentino & Shepperd (1978)).

6. Empirical findings

6.1. The sample

76 psychology students participated in the experiment, comparable with other studies of this kind. The average age of the subjects was 31, 48 were female and 28 were male. Almost half the number of subjects, 46 %, had worked before commencing studies.

6.2 Testing the first hypothesis: The optimal performance ratio is 1:0.70

The three types of tasks, which we have differentiated up to now, were included in the questionnaire: first, problem-solving, determining performance through an IQ-test; second, physical tasks, based on the number of potatoes subjects can peel; third, a creativity task assessing performance by the number of unusual uses that can be made of a brick.

In the IQ-test subjects were asked at what point they believe another person to be more intelligent if they themselves have an IQ of 115. This is gauged using an interval scale. Regarding the physical task, the question is how many potatoes can a person of higher capability peel, if the subject is able to peel 20 potatoes in 5 minutes. This performance measure is based on a ratio scale.

The third task also involves an amount, so that here too a ratio scale is appropriate (questionnaire, see Appendix).

The interval scale only allows differences to be divided as a ratio. If the mean of intelligence performance under favorable conditions is calculated, one arrives at the equation $M_1 = 122.8$ ($s = 7.7$). A person who is then estimated to be really more intelligent, obtains an average IQ of $M_2 = 126.4$ ($s = 9.7$). If one subtracts from this value 115 as the normal value ones arrives at the formula $K_1 = \frac{122.8 - 115}{126.4 - 115} = \frac{7.8}{11.4} = 0.68$, that is, the possible individual productivity increase is only 0.68 of the difference to a performance level that is estimated to be really higher.

The second task produces a mean of $M_3 = 29.3$ ($s = 6.3$) as the average number of potatoes that a person of higher capability can peel. If this is divided by the standard value of 20 one arrives at the equation $K_2 = \frac{20.0}{29.3} = 0.68$. If we now use the subject's estimated performance maximum as a basis, one arrives at the value $M_4 = 22.5$ ($s=5.8$) and if we relate these two values the result is $K_3 = \frac{22.5}{29.3} = 0.77$. Maximum performance of the subject is only 77 % of the performance level regarded to be higher.

Third, we will examine the creativity task. Individual standard performance amounted to 10 ideas. A person who is ranked as really better, manages to generate $M_5 = 16.4$ ($s=4.0$) suggestions. The ratio is then $K_4 = \frac{10}{16.4} = 0.61$. If here we also use the individual best performance, we arrive at $M_6 = 10.5$ ($s=3.2$) resulting in $K_5 = \frac{10.5}{16.4} = 0.64$, in other words

the highest input that can be achieved is 64 % of a performance level that is higher than the subject's own.

If we look at the three K_i-values that relate to the individual performance maximum and from which point a noticeable difference can be registered, then the average of these values corresponds to K = 0.70. This value leads to a maximum measure of motivation, as assumed, as the subject has seen that the other person's performance level is one subjective unit higher than his or her individual level of optimal performance. The other person's performance level is however not so much higher that the subject could not, or on account of the group unit should not be able to reach this performance level, because the performance discrepancy is only one performance unit higher [7].

The values based on the questionnaire correspond entirely with the hypothesis K = 0.70. Neither is the variation of K_i so great, so that for the present no differentiation need be made between the types of task.

Next, the empirical data obtained from the experimental research is to be examined as to what extent it complies with the hypothesis, in an attempt to combine these two methods - experiment and questionnaire study. The most relevant experiments will be analyzed in greater detail.

If one looks at the physical task in Experiment 1 conducted by Stroebe et al. (1996) in which dyads of equal strength are compared to dyads with a performance ratio of 1:0.7, then the Köhler effect occurs through the performance increase of the weaker partner who matches his performance level to that of the stronger member. The latter shows no sign of performance variations. In Experiment 2 conducted by Stroebe et al. (1996) dyads with a performance ratio of 1: 0.7 also show a slight increase of 5 %, whereby the weaker partner increases his performance by approx. 10 % and the performance level of the stronger partner shows a 5 % decrease, leaving an average performance gain of 5 %. In the same condition members of equal strength dyads both reached a performance gain of approx. 5 %, indicating that in this situation external factors, such as inter-group competition, could have produced a global increase of motivation. Theoretically, with subjects of equal strength, one would expect a Ringelmann effect to occur, as Köhler himself and other experiments using

this type of task discovered. In the third experiment there are also performance gains in dyads of equal strength, again contradicting the usual Ringelmann effect, so that it seems that the experimental setting includes additional components which lead to a general increase in performance levels. In the two dyads with performance ratios of 1 : 0.6 and 1: 0.8 performance increases were almost identical. These performance gains were just over 20 %. In these two types of dyads there is also a substantial increase in the performance level of the weaker member. The performance ratio of the stronger member remains constant at the performance constellation of1: 0.6. The stronger partner slightly increases his performance by 1: 0.8, because in this case although the performance discrepancy to the weaker member is recognizable it is so slight that it presents a kind of incentive to the stronger member. There were no differences between additive and conjunctive tasks. Experiment 4 can be left out as it was of a technical nature and tested feedback between the two members. Finally in experiment 5 dyads with six different performance ratios were formed. The result was that performance gains of 6 % were only achieved in dyads with a performance ratio of 1 : 0.87. In this experimental condition performance losses were especially noticeable for dyads of equal strength (1 : 1), showing performance decrements of 23 %. According to the findings of both Ringelmann and Köhler (cf. Zysno, 1998) these losses should only amount to 10 %, so that this condition, too, must have been influenced by other factors. The performance losses in dyads of equal strength is also the theoretical baseline that should be tested to determine a loss-avoiding Köhler effect (LKE), as without additional motivation effects a performance decrease is to be expected. If performance gains are now even apparent in dyads of equal strength, there is a strong indication that the entire experimental setting produces a source of motivation which leads to productivity gains, for example, competition between the dyads (general social-facilitation effect). The experimental condition seems to induce competition with other dyads, canceling out a Ringelmann effect. On account of this the Köhler effect is masked as internal competition within the groups, because all the dyads concentrate on the element of external competition which leads to the maximum productivity of the subjects.
If we now take a look at the two experiments conducted by Hertel et al. (2000), especially at the experimental instructions, it is all too easy to assume that the Köhler effect may have

been masked. In the first place six-person groups are formed, whose group identity is based on the fact that they are to compete with other six-person groups on a remuneration basis. Members of these six-person groups are observed partly under individual conditions and partly in dyads. A total sum is calculated for the reward which could result in a high extra bonus for the best 6-person group. The allocation of this extra bonus is not dependent on performance, but instead will be divided equally among all group members, so that inter-group competition provides the main incentive. In addition the experimental instructions include competition between men and women, producing an additional source of motivation. These general “social-facilitation” conditions ensure competition among the groups and evoke maximum performance through the element of inter-group competition which means that the detection of varying types of the Köhler effect are necessarily distorted.

In the second experiment conducted by Hertel et al. (2000) these six-person groups were reduced to four-person groups with the same incentives and instructions. The experiment instructions lead one to assume that in both experiments it is primarily a form of global motivation (general “social-facilitation” effect) that occurs and not a conjunctive Köhler effect. The interpretation of the experimental conditions by the subjects is very likely extremely complex and focuses to a lesser extent on inter-member competition within the dyads. In addition the selected form of evaluation using non-linear regression is technically very differentiated, because all the values are directly used, but due to the minimal experimental control of performance constellations are difficult to interpret. The number of dyads with a performance ratio of 1 : O.7 is too small to ensure a specific conjunctive Köhler effect (SCKE), in other words, as the test power is insufficient to find statistical evidence for the effect. In this case it is advantageous to conduct experiments in which the performance constellations are specifically manipulated. Within this bivariate standard deviation diagram there are areas which produce the expected reversed u-shaped relationship between performance variations and performance gains of the weaker member. These are mainly dyads in which the absolute performance difference is not unduly high. In this specific sector the expected performance gains can be recognized to some degree. In this respect the advantage of experimental control of the performance variations in testing the specific

conjunctive Köhler effect becomes apparent, although when the specific Köhler effect occurs experiments can appear to present a higher determination of variance than a continuous variation because only the theoretically relevant differences in performance are used. There are therefore dyads in which it is possible to observe the specific conjunctive Köhler effect (SCKE). In the whole sample, however, there were only very few such dyads, so that on account of the low power for testing a significant effect cannot be expected. Finally the overall experimental conditions with their complex experimental instructions were not suited to a concentration of competition within the dyad and so not suited to testing the specific conjunctive Köhler effect, which was the original aim of this experiment. In the meantime another experiment has been conducted which arrived at the performance ratio of 0.70 to 1.0 and made a point of informing the subjects of this fact. The result was a specific conjunctive Köhler effect (Messé, Hertel, Kerr, Lout & Park, in press). The fact that subjects are informed about the performance ratio is an important variable, which reduces the standard deviation of error because less depends on assumptions and the insecurity about the real difference. It would now be interesting to carry out a specific comparison of the self-categorization of dyads in which a Köhler effect occurred and those which produced a Ringelmann effect. Such information does, however, not exist.

To achieve a better understanding of the subjective interpretation of the experimental conditions we can take a look at some of the data gained through a questionnaire. Compared with the individual trials the stronger subject exerts more effort under conjunctive conditions than under additive conditions because through the close collaboration with the other member the situation evokes a greater element of challenge. The same applies to the self-categorization of the subject's input in the dyad situation under conjunctive and additive conditions. The stronger subject estimates his own performance in this way, although in actual fact because of his higher capability less is demanded of him in conjunctive tasks because the result depends on the weaker subject. This seems to speak in favor of motivational influences that are evoked through external competition with other groups.

The weaker subject is not aware of a difference in exerted effort between conjunctive and additive tasks, which also indicated that there are motivational effects generated through

inter-group competition. During conjunctive tasks the weaker subject's perception of the importance of his own performance increase is greater than in additive conditions. This result substantiates the experimental conditions with regard to the validity of both concatenation operations and their subjective representation.

The four possible comparisons of performance gains between the weaker and stronger member demonstrate that the stronger partner experiences more effort during conjunctive tasks, feels more responsibility during conjunctive and additive tasks, but experiences only a slighter increase in exertion during additive tasks, because in this case the weaker partner is also able to make a contribution which effects competition with the other groups. As such, from the point of view of the stronger member, the conjunctive nature of the task does not become apparent. This self-categorization clearly shows the complexity involved in the perception of experimental conditions per se. Thus, one cannot regard these experiments as a test as to whether a specific, conjunctive Köhler effect (SCKE) occurs when there is a performance ratio of 1 : 0.7. The experimental situation and the method of evaluation could not prove that this hypothesis is not adequate, because on the one hand, due to the complex interpretation of the group situation, other motivation processes influence performance, and on the other hand, the evaluation of testing the determined variation through linear and quadratic regression function is not specific enough. The statistical power for testing the SKKE is too low because there are not enough dyads with the 1 : 0.7 performance ratio. Performance gains in dyads with a just noticeable difference in the performance levels of both partners can be discerned but cannot be statistically verified, above all when other performance gains occur at the same time. However, the setting and approach of this experiment do not disprove the existence of a special, conjunctive Köhler effect when there is a performance ratio of 1 : 0.7. As such the hypothesis can be retained.

6.3 Testing the second hypothesis: There is a substantial range of variation under conditions with varying task demands.

A precondition for any type of motivational effect in groups is the variability of individual performance under varying conditions in comparison to a standard reaction which as a rule

occurs in individual trials. This hypothesis claims that such variations are inherent in the various types of task.

For the intellective task (problem-solving) a normal performance level of 115 on the IQ scale was used. According to the estimation of the subjects an average of 122.8 (s=7.7) IQ points can be achieved under favorable conditions. Under unfavorable conditions the value falls to 104.6 (s=7.0). Evidently subjects believe they can observe such variations themselves. The overall-interval corresponds to an average of 18.2 points on the IQ scale. Based on this interval it is possible to achieve a performance increase of 43 %:

$B_1 = \frac{122.8 - 115}{122.8 - 104.6} = 0.43$. Here the increase of 7.8 points on the IQ scale is slightly lower than the decrease of 10.4 IQ points.

This means that it is indeed possible to create motivational effects that influence the performance of problem-solving tasks, if the subjectively estimated performance variation is taken into account. With regard to physical tasks the range of variation does not appear to be so high. Under normal conditions it is possible to peel 20 potatoes. If, however, the situation calls for higher performance subjects are on average able to peel 22.5 (s=5.8) potatoes, and under unfavorable conditions 18.3 (s=3.9). Based on the standard individual performance it is therefore possible to achieve an increase of 13 %. Under conjunctive conditions this is the maximum level of performance gains. This value is much smaller than the findings of Hertel et al. (2000), who report a general performance increase of 35 % under conjunctive conditions. Evidently the potential group productivity gains depend on standard individual performance levels. In some cases group performance gains cannot be expected because subjects have already reached their maximum performance levels under standard conditions. Here, the performance decrease of 1.7 potatoes is slightly smaller than the increase.

It appears that in this particular physical task the range of variation is necessarily limited. The best possible performance gain is 23 %, if one bases this on the reduced level of performance.

As to the creativity task there were no variations under favorable or unfavorable conditions. Standard performance was 10 suggestions, under favorable conditions 10.5 (s=3.2) could be

achieved and under unfavorable conditions 8.9 (s=2.8). With this type of task it is almost impossible to expect performance gains under conjunctive conditions. The highest percentage possible is 18 %, if the performance decrement is compared with the maximum performance level. Depending on the range of variation for a specific type of task it is possible to create motivational effects in groups. This range of variation must first be assessed in order to gain the empirical evidence for such an effect. The interval of potential gains in individual performance can also be produced by using other incentives, e.g., by offering monetary rewards, i.e., performance gains occur through interaction components in a group situation. Yet, even if motivation is increased, subjects may not always be able to increase their performance, as they are not capable of improving their productivity in comparison to their individual performance level. In general, ranges in variations exist, so that the hypothesis can be retained.

At the same time one has to bear in mind that because variations differ depending on the task structure, it is easier to create group motivation effects in some cases, e.g., problem-solving tasks, than in others, e.g., psychomotoric and creativity tasks.

6.4 Testing the third hypothesis: Performance assessment takes on three dimensions in accordance with the three types of task

The first possibility to clarify whether the estimation of performance assessments will result in a differentiation of the three types of tasks is through a correlation of the answers to the questionnaire study. Subjects were asked to give quantitative answers to the following questions: 1. If you have an IQ of 115 and the average is 100, a) how high is the IQ of a person who is really more intelligent; b) how high can your own IQ be if put more effort into the task; c) how low could it drop on a bad day. 2. If you can usually peel 20 medium-sized potatoes in 5 minutes, a) how many can you peel if your guests arrive earlier than expected; b) if your guests are delayed and there is time to spare; c) if you imagine a person who is really able to peel potatoes more quickly. 3. If you can produce 10 suggestions for the unusual use of a brick in 2 minutes (creativity task), a) how many suggestions could you make during a creativity task for a job you are really interested in; b) if you participated in a

creativity task you consider boring, but do not want to fail; c) how many suggestions must someone make who you consider to be really more capable than yourself.

The quantitative answers to these 9 questions can be correlated with the expectation of three relevant factors, whereby the answers to each type of task (problem-solving, psychomotoric, creativity) are loaded to one factor respectively. In addition, one can expect that conditions that presumably result in a performance decrease (1c, 2b, 3b) will correlate negatively with improved conditions (1b, 2a,3a) and the person who is estimated to be really more capable (1a, 2c, 3c). As one can see from the curve of "eigen-values" (table 1) and the varimax-rotated loading matrix (table 2), the differentiation in the three dimensions can be clearly recognized with a 62 % explained variance. Furthermore, the three types of task each form one factor. It is, however, recognizable that for the situation in which a performance loss can be expected, there is no high negative loading to the factor (1c, 2b), or there is even an extremely high positive loading (3b) as for the creativity task. The quantitative answers concerning performance gains therefore correspond with predictions, whereas performance losses seem to be influenced by additional factors. In fact, the performance variability for the creativity task under varying conditions is on average not very high at all, but according to the given answers remains constant regardless of the situation, which is shown by the high positive loading. Situational incentives have only slight effects on the subjects. Therefore the hypothesis can remain, with the exception that the creativity task only results in slight situational variations.

Table 1: Curve of "eigen-values" of performance results

	Total	**% of variance**	**cumulative %**
1.	2,47	27,43	27,43
2.	1,66	18,47	45,91
3.	1,46	16,22	62,12
4.	1,12	12,45	74,57

5.	,74	8,20	82,77
6.	,55	6,14	88,91
7.	,39	4,34	93,25
8.	,34	3,77	97,03
9.	,27	2,97	100,00

Table 2: Varimax-rotated loading matrix of performance results

	Components		
	1	**2**	**3**
IQ-test/more capable member	-,04	**,80**	,34
IQ-test/best individual performance	,03	**,87**	-,16
IQ-test/minimal performance	-,30	**-,33**	,45
Peeling potatoes/best individual performance	-39	-,15	**,63**
Peeling potatoes/minimal performance	,40	,29	**-,26**
Peeling potatoes/more capable individual	,05	,25	**,78**
Creativity task/best individual performance	**,85**	,03	,09
Creativity task/minimal performance	**,88**	-,12	-,03
Creativity task/more capable member	**,62**	,18	,39

6.5 Testing the fourth hypothesis: Motivation differences occur in varying performance constellations

When subjects collaborate with a partner of higher capability typically two motivational tendencies can be expected without knowing more specifically how these tendencies come about. These are first, the tendency to perceive the situation as a challenge which leads to an increase in the individual's performance, and second, the “social-loafing” effect, i.e., withdrawing and depending on the performance of the stronger partner.

We compiled a questionnaire which covers these two tendencies in three varying performance dyads (i.e., the other member is: a) considerably better, b) only slightly better, c) less capable) and three different types of task (intellective, potato peeling, creativity task) with the help of the same 5 items (challenge, effort, the motive not to appear unintelligent, relying on the other member, withdrawing). In a factor analysis based on the questionnaire we found 2 factors which explain 40 % of the variance. The varimax-rotated loading matrix of performance results shows a clear division of the two aspects (table 3). According to the type of task and performance discrepancies it is now possible to determine the average degree of motivation of both components, which in turn can be used to ascertain the internally experienced challenge and the degree of external conformity. If both incentives are considered separately as dependent variables it becomes possible to clarify whether there are differences between the type of task (3) and the performance constellation (3), which results in a 3 x 3 analysis of variance (ANOVA) with repeated measurement on both factors (table 4).

The means and standard deviations for both incentive components (the dependent variables) – challenge and conformity – can be found in table 5. The sequence of the means shows that the stronger partner evokes the motive to compete in the weaker member and additionally that the weaker member also adapts his or her performance level to that of the stronger member.

Although the effects of these differences are not very great, one can recognize the motivational changes in both components according to the varying performance levels of the

respective partner. This linear trend of the challenge-component is only interrupted during the creativity task, where the moderately better partner presents a greater challenge than an extremely more capable member. In all, the difference between the mean values is also slight, which in turn verifies the consistency which was already discernible for the performance evaluation of the creativity task. The conformity component shows a linear trend, as was expected, i.e., the degree of conformity becomes smaller when the other member's performance level is lower. All in all the hypothesis can stand, with the exception of the creativity task.

Table 3a: Curve of the "eigen-values" for incentive components

	Total	**% of variance**	**cumulative %**
1.	**10,11**	**22,46**	**22,46**
2.	**7,75**	**17,22**	**39,68**
3.	3,31	7,35	47,03
4.	3,00	6,67	53,70
5.	2,70	6,00	59,70
6.	1,88	4,18	63,88
7.	1,66	3,69	67,57
8.	1,54	3,42	71,00
9.	1,26	2,81	73,81
10.	1,19	2,65	76,46
11.	1,02	2,27	78,73

Table 3 b: Varimax-rotated loading matrix of incentive components

	Components

	Components	
	1	**2**
1.	**,56**	-,06
2.	**,71**	-,01
3.	**,50**	,02
4.	,05	**,62**
5.	,06	**,59**
6.	**,62**	,21
7.	**,75**	,20
8.	**,36**	,32
9.	,02	**,64**
10.	-,13	**,57**
11.	**,43**	,21
12.	**,60**	,26
13.	**,43**	,21
14.	-,15	**,56**
15.	-,28	**,33**
16.	**,51**	-,18
17.	**,52**	-,21
18.	**,10**	,06
19.	,16	**,57**
20.	-,12	**,54**
21.	**,56**	,02
22.	**,68**	-,13
23.	**,24**	,06
24.	,10	**,66**
25.	-,15	**,65**
26.	**,48**	-,16

27.	**,59**	-,32
28.	**,23**	,07
29.	-,17	**,52**
30.	,05	**,65**
31.	**,51**	-,19
32.	**,61**	-,21
33.	**,50**	-,05
34.	,15	**,75**
35.	-,03	**,66**
36.	**,78**	-,03
37.	**,87**	,00
38.	**,53**	,15
39.	,11	**,79**
40.	-,08	**,69**
41.	**,77**	-,05
42.	**,73**	-,10
43.	**,52**	,04
44.	-,08	**,62**
45.	-,13	**,49**

Table 4: Analyses of variance (ANOVAS) of both incentive components (challenge, conformity) for the three types of task and three performance constellations

Incentive components : Challenge

Effect	Wilks-Lambda	F	**Hypth. df**	Error df	Signfc
Task	,67	17,02	2,00	71,00	,00
Performance constellation	,57	26,26	2,00	71,00	,00
Task*performance constellation	,82	3,55	4,00	69,00	,01

Incentive components: Conformity

Effect	Wilks-Lambda	F	**Hypth. df**	Error df	Signfc
Task	,99	,19	2,00	72,00	,82
Performance constellation	,56	27,96	2,00	72,00	,00
Task*performance constellation	,68	8,23	4,00	70,00	,00

Table 5: Means and standard deviations for both incentive components for the three types of tasks and three performance constellations

Incentive component: challenge

	Mean	**Stand. Dev.**	**N**
IQ test/evidently more intelligent	3,50	,85	73
IQ test/slightly more intelligent	3,39	,98	73
IQ test/less intelligent	2,84	1,07	73
Peeling potatoes/ evidently faster	3,46	,93	73
Peeling potatoes / minimally faster	3,37	,91	73
Peeling potatoes/ evidently slower	3,11	,95	73
Creativity task/ evidently more creative	3,70	,81	73
Creativity task/ slightly more creative	3,84	,84	73
Creativity task/less creative	3,40	,94	73

Incentive component: conformity

	Mean	Stand. Dev.	N
IQ test/evidently more intelligent	2,17	,79	74
IQ test/less intelligent	1,58	,61	74
IQ test/less intelligent	1,58	,61	74
Peeling potatoes/ evidently faster	2,06	,97	74
Peeling potatoes/ slightly faster	1,72	,70	74
Peeling potatoes/ evidently slower	1,43	,57	74
Creativity task/ evidently more creative	2,04	,87	74
Creativity task/ slightly more creative	1,80	,72	74
Creativity task/ less creative	1,47	,57	74

6.6 Testing the fifth hypothesis: There is no relationship between general motivation dimensions, the estimation of performance values of a more capable member and the subject's individual performance under favorable conditions

In order to test the fifth hypothesis which deals with the relationship between the performance values of a better member and the general motivation that occurs in groups, we first have to ascertain the general motivation dimensions evoked by group work. For this, we have selected 11 items for the determination of the following three aspects; a) self-monitoring

or dependence on other persons (Snyder & DeBono, 1989) (for example: it is important to me what other people think of me); b) do subjects enjoy group work? (independence; for example: I prefer working independently of others) and c) how competitive are subjects? (competition, i.e., the tendency to compete; for example: I tend not to compete with others (reversed poling). These three aspects of motivation will be represented through a factor analysis of the 11 items followed by a varimax-rotation. The variance explained by the three dimensions is 61 %, which means that all three motives can be allocated to one of the three dimensions (see table 6 and table 7). One can now calculate the respective multiple regression using the three motivation dimensions as the independent variables and using the performance values of an individual whose performance level is markedly higher as well the subject's individual performance under favorable conditions as dependent variables respectively. This results in two marginally significant multiple correlations of six with R^2 = 0.18 when evaluating a member who is really more intelligent and R^2 = 0.10 with regard to optimal performance under creative task conditions. The remaining effects are below 10 % and therefore not significant when taking α = 0.05. Whereas in the first case the two predictors "self-monitoring" and independence contribute significantly towards the prediction, in the second case this applies solely to the predictor "competition". The theoretically irrelevant relationships found here can be said to have hardly any distorting influence on the interpretation of the data, because of 18 possible relationships between predictors (3), performance values (2) and tasks (3) there are three significant relationships, which could however be coincidental. The hypothesis can be retained (discriminatory validity).

Table 6: Curve of "eigen-values" and variance determination of personal motivation disposition

	Total	**% of variance**	Cumulative %
1.	3,26	29,64	29,64
2.	1,82	16,56	46,20
3.	1,61	14,60	60,80

Table 7: Varimax-rotated loading matrix of personal motivation dispositions: self-monitoring (1), competition (2), independence (3)

	Components		
	1	**2**	**3**
What others think of me	**,76**	-,13	-,06
Enjoy working in groups (inverted)	-,05	-,24	**,83**
Experience challenge through others (inverted)	,21	**,74**	-,07
Prefer working independently	,05	,02	**,92**
Higher achievement level through concentration on myself	,45	-,04	**,65**
Easily discouraged by others (inverted)	-,48	**,55**	-,27
Rely on others who are more capable (inverted)	-,23	**,71**	,00
Minimal motive to compete with others (inverted)	-,02	**,71**	-,07
Feel better, when not less capable than others	**,69**	-,01	,26
Motivated to achieve equal performance level	**,62**	-,38	,06
Feel better, when superior to others	**,67**	,26	,01

Correlation of the 3 scales: r_{12}=-0.23, r_{13}=0.26, r_{23}=-0.26

6.7 Testing the sixth hypothesis: There is no relationship between general motivation dimensions and the self-categorization of performance

An additional distorting factor which could result in a decrease in the validity of motivation components would be the prediction of an individual's variation range through parameters which are intended to determine group productivity. For this we take variations between values obtained under favorable and unfavorable individual conditions. These variations should now not be predictable in terms of general motivation components, if the components determine what is predicted, namely motivation processes in group work. The three variations, one for each type of task, can in fact not be predicted. None of the multiple correlations are significant and the effects are 5.7 %, 5.4 % and 2.7 % of the explained variance (R^2). Therefore, motivation within the group has hardly any influence on the prediction of the individual variation range, which means that this hypothesis, too, can be retained. Artificial method effects appear to be negligible (discriminatory validity).

6.8 Testing the seventh hypothesis:There is a relationship between general individual motivation to work in groups and the specific incentive in a performance constellation (personal disposition effect)

The central theoretical question concerns the relationship between motivation processes in various group situations and the global motivation dimensions in terms of personal disposition influences. Such disposition influences could be one of the reasons for the difficulty in detecting a Köhler effect. It occurs only with certain individuals, at least when the task is not considered as particularly meaningful, as it was in the original Köhler experiments. The typical experimental conditions are far more dependent on individual motivation dispositions, especially when they are not easy to interpret. This, therefore, raises the question whether the motivation effects in the specific group situation, assessed in terms of

the two incentive components, namely individually perceived challenge and individual conformity, can be predicted in terms of the three general motivation components, self-monitoring, independence and competition.

This question can be answered in terms of multiple regression, whereby in each performance constellation and each type of task two dependent variables can be predicted, that is, the individually experienced challenge and individual conformity using the three motivation dispositions as a predictor.

The explained variance should not only be significant it should also produce a clear effect, that can serve as a theoretical explanation. For this reason certain criteria are determined: the explained variance should deviate from random variation at $\alpha = 0.01$ and account for at least 15 % of the variance. The results of the 2 x 3 x 3 (motivation components, performance constellation and type of task) 18 multiple regressions present a simple picture in that, with one exception, individual conformity cannot be predicted. Individually experienced challenge can, however, in all instances be explained through the three predictors according to the two given criteria (table 8a, b). Individual conformity can only be predicted for the input of a clearly more intelligent individual participating in an intelligence test. In this instance it is primarily the element of “competition” that influences the prediction; the two other predictors are not significant. In all other cases it is impossible to predict the conformity components. This significant result could also be random if one considers the number of tests carried out for this sample. The above mentioned hypothesis must however be refuted with regard to individual conformity. In other words there is no personal disposition effect for individual conformity in a group situation.

Next, we will test the personal disposition effect for the incentive “individual challenge” according to the way this is experienced in the specific group situations. For this, individually experienced challenge as a dependent variable, will be solely determined through two of the three predictors, which individually make a significant, independent contribution in almost all instances, namely “self-monitoring” and “competition”. The third predictor, “independence” does not explain a significant amount of variance independent of the other two predictors.

So, as with many motivation theories we have in principle two components, namely the affiliation component, i.e., not wanting to be worse than others ("self-monitoring"), and the performance component, i.e., wanting to be better than others ("competition"). Both are relevant for a number of performance constellations and types of task, if one wishes to predict the experience of individual challenge (Heckhausen, 1980). At the same time each single incentive can be broken down into a positive and a negative component, for example, the performance incentive in Atkinson's classical research into hope of success and fear of failure (Atkinson & Raynor, 1974). But first a value for each individual motivation disposition has to be determined. A future aim could also be to combine these two lines of research – group motivation and individual motivation.

Thus, we can formulate the following theoretical statement: the more a situation is experienced as an individual challenge the more the affiliation and performance motives are evoked. The opposite, however, is also true, so that in otherwise identical conditions, subjects who tend towards the avoidance of negative performance discrepancies (affiliation motive) and also towards higher competition (performance motive) interpret the situation as a challenge because the correlations do not determine the direction of the relationship.

In performance situations the general global motivation disposition "independence" does not contribute towards an explanation of the incentive components, which, however, does not rule out that this component could be relevant for the prediction of changes in attitude, opinion or judgement within a group context.

In all 9 situations the ß-coefficient of the predictor "self-monitoring" is significantly positive. One can therefore say that motivation in group conditions is driven through comparison with other persons, if one considers the experience of challenge evoked by the performance constellation. Behind this, however, there is typically a masked personality variable which differs from one individual to another. The three situations of collaboration with a partner of higher capability which are relevant for the Köhler effect in two instances also result in a significant prediction through the competition component, namely the problem-solving and creativity tasks. This does not apply to the psychomotoric task. It is feasible that physical tasks only lead to performance gains through competition motivation if subjects perceive the

tasks as meaningful, as was the case for the rowers in Köhler's classical study. This kind of personal relevance is not inherent in physical tasks per se. In the case of intelligence and creativity tasks this is different. When considering the influence of a personal disposition effect with regard to motivation this applies above all to intellective and creative tasks. It does not, however, apply when there is an alteration in the performance evaluation of creative tasks. The challenge component generated by the situational incentive of collaborating with a partner who is clearly of higher capability can be predicted for the intellective task through "self-monitoring" and "competition" as 46 % of the variance and for the creative task as 35 %, whilst the psychomotoric task shows no more than 18 %. However, the values of performance discrepancies in various performance constellations were very slight for the creativity task, indicating that the two levels motivation and performance also have to be differentiated according to these data. Although only a slight differentiation was made between the performance constellations of the creativity task, measured by a production score, it is possible to make fairly accurate predictions about the experienced challenge induced by a partner of higher capability.

The creativity task presents a further deviation: for the dyad formation with a partner of lower capability the ß-coefficient of the predictor "competition" is also significant. There is no need to differentiate theoretically between these two situations, as can be seen from the high positive correlation between the performance values occurring in these two constellations.

The empirical findings therefore lead to the following specification of the seventh hypothesis: the more a specific group situation is experienced as an individual challenge (incentive parameter), the greater the impact of the personal motivation components "self-monitoring" and "competition"; and vice versa: the more a subject is motivated by "self-monitoring" and "competition" in general, the more a specific group situation is experienced as an individual challenge.

In this specific way one can demonstrate that the personal disposition effect determines one of the two incentive components and in this respect the hypothesis can stand.

Table 8a: Testing the significance of linear regression with the dependent variables "challenge" and "conformity" and the predictors "self-monitoring", "independence" and "competition" according to type of task and performance constellation.

Model	F	Signf.	R^2
1. Intelligence task/evidently more intelligent/ challenge	19,6	**,00**	**,46**
2. Intelligence task/ evidently more intelligent/ conformity	5,26	**,00**	**,18**
3. Intelligence task/slightly more intelligent/ challenge	5,04	**,00**	**,17**
4. Intelligence task/slightly more intelligent/ conformity	,08	,96	,00
5. Intelligence task/less intelligent / challenge	5,38	**,00**	**,18**
6. Intelligence task/less intelligent / conformity	,08	,96	,00
7. Peeling potatoes/ evidently faster/ challenge	5,39	**,00**	**,18**
8. Peeling potatoes/ evidently faster/ conformity	2,07	,11	,08
9. Peeling potatoes/ slightly	8,12	**,00**	**,26**

faster/ challenge			
10. Peeling potatoes/ slightly faster/ conformity	,74	,53	,03
11. Peeling potatoes/ evidently slower/ challenge	5,69	**,00**	**,19**
12. Peeling potatoes/ evidently slower/ conformity	,21	,88	,00
13. Creativity task/evidently better/ challenge	13,00	**,00**	**,35**
14. Creativity task/evidently better/ conformity	2,89	,04	,11
15. Creativity task/slightly better/ challenge	6,37	**,00**	**,21**
16. Creativity task/slightly better/ conformity	,80	,49	,03
17. Creativity task/evidently less capable/ challenge	7,42	**,00**	**,24**
18. Creativity task/evidently less capable/ conformity	1,33	,27	,05

Table 8b: Differentiation of predictors according to their influence on each condition

	Beta	T	Sign F
1. IQ-test/evidently more intelligent/challenge			
Self-monitoring	**,66**	7,14	,00
Independence	,03	,35	,73
Competition	**,35**	3,73	,00
2. IQ-test/ evidently more intelligent/conformity			
Self-monitoring	,09	,80	,42
Independence	-,03	-,27	,78
Competition	**-,40**	-3,58	,00
3. IQ-test/slightly better/ challenge			
Self-monitoring	**,42**	3,72	,00
Independence	,01	,06	,95
Competition	,02	,16	,87
4. IQ-test/slightly better/ conformity			
Self-monitoring	,01	,08	,94
Independence	,04	,29	,77
Competition	-,03	-,26	,79
5. IQ-test/less intelligent / challenge			
Self-monitoring	**,42**	3,68	,00

Independence	-,12	-1,03	,30
Competition	-,11	-,94	,35
6. IQ-test/less intelligent / conformity			
Self-monitoring	,01	,08	,94
Independence	,04	,29	,77
Competition	-,03	-,26	,79
7. Peeling potatoes/ evidently faster/challenge			
Self-monitoring	**,36**	3,21	,00
Independence	,19	1,69	,09
Competition	,17	1,47	,15
8. Peeling potatoes/ evidently faster/ conformity			
Self-monitoring	-,01	-,05	,96
Independence	-,22	-1,77	,08
Competition	-,25	-2,10	,04
9. Peeling potatoes/ slightly faster/challenge			
Self-monitoring	**,49**	4,53	,00
Independence	,06	,55	,59
Competition	-,01	-,10	,92
10. Peeling potatoes/ slightly slower/conformity			
Self-monitoring	,07	,59	,56

Independence	-,11	-,87	,39
Competition	-,15	-1,17	,24
11. Peeling potatoes/ evidently slower/ challenge			
Self-monitoring	**,44**	3,95	,00
Independence	,04	,33	,74
Competition	,14	1,26	,21
12. Peeling potatoes/ evidently slower/ conformity			
Self-monitoring	-,03	-,20	,84
Independence	-,01	-,05	,96
Competition	-,10	-,79	,43
13. Creativity task/evidently more capable/challenge			
Self-monitoring	**,51**	5,03	,00
Independence	,02	,19	,85
Competition	**,45**	4,51	,00
14. Creativity task/evidently more capable/ conformity			
Self-monitoring	,02	,21	,83
Independence	-,09	-,72	,47
Competition	**-,34**	-2,8	,01
15. Creativity task/slightly more capable/challenge			
Self-monitoring	**,46**	4,16	,00
Independence	,05	,43	,67
Competition	,10	,89	,37

16. Creativity task/slightly better/ conformity			
Self-monitoring	-,09	-,75	,46
Independence	-,02	-,12	,90
Competition	-,18	-1,4	,15
17. Creativity task/evidently less capable/challenge			
Self-monitoring	**,44**	4,03	,00
Independence	,05	,45	,65
Competition	**,33**	3,02	,00
18. Creativity task/evidently less capable/ conformity			
Self-monitoring	-,08	-,65	,52
Independence	,17	1,37	,17
Competition	-,14	-1,1	,26

7. Theoretical considerations

A precondition for a conjunctive or additive Köhler effect is that in addition to the individual challenge among group members there should be no external element of inter-group competition (general “social-facilitation effect”). It should be possible to observe a Ringelmann effect among subjects of similar performance levels in the experimental control condition as a measure of validation of the experimental condition and instructions. If this is not the case one has look out for “social-facilitation-effects” which occur in this condition. According to the considerations mentioned above and the findings of this study the classical Köhler effect, bringing with it performance gains of the weaker partner, is only one indirect group effect. It is the inter-individual experience of challenge which generates this effect, as can be deduced from our data and interpretations. However, this motive to compete presents

itself by way of the motivational tendencies – "self-monitoring" and "competition" – which in turn depend on personality components. These tendencies do not, however, determine the "objective" performance evaluations or variations under varying conditions, because no correlation could be found between the production estimation and motivation in general. Performance levels or performance ratios are not distorted through motivational tendencies, but individual self-categorization in varying performance constellations (incentives) differs. According to our findings one could expect that a just noticeable difference (jnd) could induce an element of challenge but there are clear individual differences (personal disposition effect).

These findings present a distinct contradiction to the interpretation of Hertel et al. (2000). In this study the assumption is that the classical Köhler effect is induced by the interpersonal motive to compete between the two group members and cannot be regarded as a group effect by which the dyad becomes the central unit of research (s.a. Witte, 1989). Hertel et al. (2000) place the group unit into the center of their observations. They explain the "social-facilitation-effect" that occurs with the weaker partner in terms of the instrumentality experienced by this subject which make him feel that his contribution is important for the group product[8]. The unit of observation is therefore the group which competes with other groups. Of course, it is possible to combine several motivation effects. Especially with conjunctive tasks the maximum level of performance is attained very quickly because the performance of the weaker member simply cannot increase. Hertel et al. (2000) interpret the substantial correlation between performance discrepancies in the dyad and performance gains of the weaker member as a random effect, which can be corroborated through simulation, but which due to insufficient power for testing and the large confidence interval has to, for the present, remain unclarified[9]. Furthermore, not every performance variation is of equal significance for the conjunctive Köhler effect. The necessary incentive is only generated during a short interval which results in a specific, conjunctive Köhler effect (SCKE) as a basis for the investigation. This, however, is not possible using the method chosen by Hertel et al. who tested the effects using linear and non-linear regression analyses. It should also be taken into account that group conditions that lack additional motivation incentives

typically result in a Ringelmann effect, i.e., motivation losses are accompanied by performance losses if no differentiation is made when forming the dyads, an aspect which was not observed by Hertel et al. (2000). This is also due to the extremely complex experimental instructions which in the end resulted in an investigation of the general social-facilitation-effect more than an investigation of the Köhler effect.

Should the overall group, to which both members of the dyad belong, have been together for some length of time, as was the case for the rowers in the original Köhler experiment, and should the observed performance substantially determine the status in the overall group, then it is feasible that motivation effects occur which are the result of the possibility of changing the status in the overall group by means of the performance in the specific dyad (Witte, 1989). For this to occur the entire group must have been together for a longer time span and the subject must perceive the task as more meaningful than is usually the case in group experiments. In the Köhler studies these preconditions facilitated the status improvement in the overall group when a member of a dyad was able to "defeat" a partner who until then had been considered more capable. Naturally, competition of this kind is only realistic if the other partner's performance level is not too much higher than the weaker member's. For this a subjectively perceived performance discrepancy of one unit lends itself especially well, as subjects typically believe that in most cases such a difference can be surpassed. Equality of performance in the overall group provides no challenge incentive and should result in a Ringelmann effect, as has been empirically verified many times. In such instances subjects avoid competition because there is a social representation in group work by which normative influences further equality as opposed to inequality (Witte & Engelhardt, 1998). This effect can be clearly seen in the Köhler data and it is very probable that the process of similarity even produces a form of solidarity as opposed to competition. In this point, empirical findings are very clear; only the explanations for this effect differ (Witte, 1989; Stroebe, Diehl & Abakoumkin, 1996; Hertel et al., 2000).

We have now reached a point that calls for a unified observation of various theoretical concepts, which after 25 years of intensive research should bring us nearer to the goal of discovering and furthering motivation losses and motivation gains in groups, as Hertel et al.

(2000) write. In this, we can differentiate two key points in motivation research, namely the observation of situational incentives on the one hand and individual motivation dispositions on the other.

Up to now the main approach to examining incentives that may explain the Köhler effect has been in line with the expectancy-value model with its multiple combination of expectation, instrumentality and result evaluation (Karau, Markus & Williams, 2000; Sheppard, 1993; Hertel et al. 2000, 2000a) whilst the investigation of personal dispositions has played no role in explaining motivation effects in groups. Due to their complexity these dispositions cannot be examined separately, but in the observation of group work there are two individual disposition motives which occur time and again and which have a major impact on group co-operation, namely the individual affiliation motive and the individual performance motive (Wegge, 2001). These two concepts of individual disposition motives lend themselves to explaining the question posed by Hertel et al. (2000a, p. 206 ff.): “An interesting and still open question is what exactly drives this instrumentality effect, and which psychological processes are mediating these motivation gains”. How should we now interpret the term “instrumentality”? Hertel et al. (2000) define the concept as follows: “Note that we define instrumentality as the perceived contingency between a person’s effort and that person’s goal”.

This relationship (“contingency”) is generated by the individually perceived challenge in a performance context (“effort”) and varies from one individual to another. This individual variation is in turn dependent on the two general motivation dispositions (“person’s goal”) which in this study we have termed “self-monitoring” and “competition”. They can be regarded as elements of the two general concepts of affiliation motivation and achievement motivation. The former signifies consideration for others and avoidance of a negative deviation and is here determined in terms of the “self-monitoring” concept. The latter refers to the testing of performance capacity with regard to the concept of an individual’s tendency to compete (competition).

As a formalized representation we then arrive at the following statement for a motivation theory that can be seen as an extension of the “collective effort model (CEM)” (Karau & Williams, 1993):

$$E \cdot I \cdot V = MF$$

$$I = f(C)$$

$$C = g(SM+TC) \rightarrow$$

$$E \cdot [f\{g(SM+TC)\}] \cdot V = MF$$

$$P = h\,(MF)$$

$$L = h\{E.[f\{g(SM+TC)].V$$

E : expectancy

I : instrumentality

V : valence of outcome

C : challenge (incentive)

SM : self-monitoring (personal disposition)

TC : tendency to compete (personal disposition)

MF : motivational force

P : performance

f, g, h : functions

Using a formalized scheme such as this a simple relationship can be produced between incentive models and investigations into personal dispositions in motivation research. In many cases the functions f, g, h are not taken into account, for example when performance measures are used to directly infer the level of motivation (Witte, 1990). This straightforward conclusion is only possible in the case of a linear transformation. But there are also theoretical reasons why one should avoid mixing these two levels as it can cause a great deal of confusion. Each theoretical unit should have its own empirical variable which then allows the functions between the variables to be determined. It is very seldom that these are linear throughout and sometimes they are also composed of more than one function, as was demonstrated by the research into social loafing (Witte, 1990).

If one now attempts to explain the Köhler effect according to this model one could formulate the following statement: where there is equal expectancy (E) and equal valence of outcome

(V), a specific, conjunctive Köhler effect (SCKE) in terms of a performance gain of the weaker partner will occur in those dyads in which the weaker member is able to achieve 70 % of the stronger member's performance level. Under those conditions the subject experiences a high degree of challenge (incentive) and those subjects who have undergone socialization processes (disposition) in similar situations which cause them to conform to other people (high self-monitoring, SM) and develop a tendency to compete (TC) will show an increase in motivation . If the subjects are also able to increase their performance level (P) in relation to the increase in motivational force (MF) they will show a specific, conjunctive Köhler effect (SCKE).

A conjunctive or additive Köhler effect can be best produced when the challenge is maximal, which in experimental conditions was achieved with an average performance ratio of 1 : 0.7, whereby individual differences in motivation have no effect on the specific determination of the performance value in general. It is interesting that in classical research into achievement motivation it has been observed that subjects who are highly motivated select tasks that have a solution probability of around 0.30 and not 0.50 as was originally assumed (Witte, 1994). If one wishes to combine this result of the classical achievement motivation theory with the optimal performance ratio among group members one has to take into account the task difficulty and individual task-solving probability. A task is definitely too difficult when the probability of not solving the task is 1.0. The average, most attractive probability of a achievement-oriented individual not solving a given task is 0.70. As a result, if one considers the problem of individual achievement motivation in terms of failure, the ratio 1.0 : 0.70 occurs in this context too. In the case of the Köhler effect the exerted performance always had a positive outcome. One can therefore infer that a specific Köhler effect mainly occurs when this performance ratio is given, because in such instances the incentive to compete is high and the situation appeals to individuals with high achievement motivation. However, up to now there has been no research into this aspect because personal disposition effects have not been taken into consideration. The inclusion of personal disposition effects does not however mean that external incentives cannot produce an equally high degree of challenge. But there will almost always be inter-individual differences as to how highly challenge is

experienced. It is therefore possible to roughly differentiate between average influences on the experienced challenge through incentives (mean effect) and observed standard deviations due to personal disposition effects when the same incentives are given.

If one now considers general motivation gains in groups the central variable is the element of challenge experienced by the individual subject which in turn is induced through the situation. As in the Köhler effect, this situation can be created through collaboration with a partner who is recognized to be more but not extremely more capable. But a female member who masters a physical task with more aptitude than a male partner (Lount, Messé & Kerr, 2000) can also present a high degree of challenge. On account of their general personal disposition certain individuals will experience the challenge more easily (tendency to compete) and react to this challenge more readily (high self-monitoring) than others.

However, challenge need not occur only within the group, but can also be experienced through competition between groups (general social-facilitation effect). This type of challenge can also be experienced by the stronger partner, if the need to compensate is felt in order to increase the overall performance of the group. The experienced challenge can however only be transformed into performance if there are performance reserves that can be employed.

The central variable for motivation incentives is the creation of challenges. In groups this can occur through differences in performance levels between individuals and among groups through the given group situations. Thus, challenge can be evoked by a variety of factors. An individual can also create challenge himself by setting himself appropriate goals (Locke & Latham, 1990).

The question now is how to define challenge in terms of personal state in a psychologically adequate way, if one adds the super-individual aspect of the incentive situation. According to existing motivation research one can define successful “challenge” as follows:

> A challenge is the affective-cognitive condition of an individual creating a psychological exertion based on a high expectancy that a positively valued but higher performance goal appears to be attainable. The transformation of this psychological exertion in performance related actions will result in an increase

in performance if performance reserves are present and the induced behavior is oriented towards this specific goal.

Once more it has to be clearly emphasized that internal motivation processes and external performance oriented behavior are not directly related. External observation of performance cannot be used to deduce the internal level, and vice versa. For example, a Köhler effect may be masked if a “social-facilitation effect” is already present and performance reserves have been exhausted. Due to the challenge of competing with other dyads there is no longer a possibility of evoking an element of challenge within the dyad, as energy reserves have been used up. In other cases individuals may become highly active without concentrating their behavior on the goal, which means that more effort is exerted but not that performance is increased.

The concept of challenge chosen in this study also shows that for many individuals the created experimental conditions do not present a challenge because the observed difference between individual behavior alone and the individual behavior within the group does not create a goal that is positively evaluated by the subjects For many this difference is irrelevant. They feel no need to increase their performance, because the performance level has no relevance to them personally. This then means that no additional effort is exerted. This relevance to the subject’s personal identity was present in the original Köhler experiment. In the study of Lount, Messé and Kerr (2000) this effect also occurred when male subjects had to perform a task of physical strength in dyads with female subjects of higher capability. They show a substantially higher level of performance in comparison to dyads with a male partner of higher capability. The experienced effort is also accordingly higher. For all individuals it can be said that there is a positive correlation between effort and performance, which is significant but not very high, namely $r = 0.26$. These two levels have to be differentiated and do not simply comprise a linear relationship. For this reason the approach that uses measurements of performance to infer the degree of motivation is too simple; the relationship is far more complex and would make an interesting subject for future investigations.

8. Future research

To produce a Köhler effect, it is necessary to design a setting in which there is an element of challenge. Successful challenge can be produced and made visible in the performance increase, by firstly ensuring that the stronger partner is one just noticeable unit of performance more capable than the weaker subject, secondly, that this difference is considered to be personally relevant, that subjects are characterized by a high degree of "self-monitoring" and "tendency to compete", and thirdly, that the members are in a position to increase their performance behavior.

According to existing data one should concentrate on problem-solving tasks as these allow the differences in performance to be produced more easily and challenge can be easily predicted in terms of individual motivation dispositions.

Should the experienced challenge be the same it should make no difference whether the tasks are of an additive or conjunctive nature, although it is definitely easier to produce a challenge effect with conjunctive tasks, as group members are more dependent on one another. It is also possible to create a compensatory Köhler effect by ensuring that the task is experienced as meaningful and that subjects experience a sense of responsibility.

Thus, motivation gains in groups, if they relate to performance behavior (research into achievement motivation) can be regarded as special challenge effects that are created through the specific form of the performance constellation within the group. If one knows how to create these challenges it becomes possible to design settings which promote performance gains in groups. Numerous reports of a correlation between fun and performance gains (Hertel et al., 2000, 2000a; Lount et al., 2000) have shown that for many individuals it is more fun to be faced with a challenge and exert more effort, thereby increasing their productivity. On the other hand, this also means that group work that lacks the element of challenge leads to social loafing and performance losses (Ringelmann effect), and are experienced as unsatisfying. It seems that the most important practical consequence of re-discovering the general Köhler effect is to take into account the fun-component, accept the element of challenge and react to these challenges with a positive sense of competition.

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[2] This terminology varies from that used by Steiner (1972). It refers to the compensatory effect of Williams & Karau (1991).

[3] Differentiation of the Köhler effect depends more on the evaluation methods that are employed than on theoretical considerations, which nonetheless are inherent in the chosen method of assessment. In the meantime studies are being carried out to differentiate between a “Köhler discrepancy effect“ and a “Köhler motivation gain effect“ (e.g. Hertel, Kerr & Messe´, 2000). The first effect can be compared to the conjunctive Köhler effect (CKE) whilst the second one is a type of “social facilitation” effect. In Köhler’s original experiments there was no global performance increase when all the dyads were included (Witte,1989), in other words there was no “social-facilitation“ effect, but no Ringelmann effect either.

[4] This statement appears to contradict the “social comparison” theory, as there is a preference to compare with individuals of similar performance abilities to prove the own level of performance. This is correct for the assessment of individual performance, which is the sole aim of the social comparison theory. The theory of status congruence (Wilke, 1996) describes the expectation of the consistency of the performance in different contexts. The level of explanation used in the latter theory is the social group and its structure. It is not concerned with the concept of challenge which has been mainly dealt with in the aspiration level theory (Chapmann & Volkmann, 1939) and the theory of social comparison (Festinger, 1954).

[5] When a task is conjunctive the baseline used is the individual performance of the weaker member. If under individual conditions the weaker member has not used up all his energy reserves, then the performances gains are assessed in relation to the input of this member under individual conditions. The performance level assessed in this way can only be lower, because this subject has not exerted sufficient effort. The subject's performance level could be higher than that of the apparently more capable member. This throws a light on the motivation effects that also occur in the individual condition. The objective performance achieved under individual conditions is also dependent on motivation. As a result both motivation and performance should be assessed under individual conditions. A conjunctive task, however, demands only the measurement of performance of the less capable subject, on the assumption that this is the upper level which cannot be surpassed in the group situation. In addition the stability of a mean value of two subjects is greater than that of a single value which in turn leads to a higher degree of reliability of measurement. Something which has not been clarified is the high dependency of group performance on the member who is less willing to perform because the other member can only compensate for this behavior to a limited degree. However, this need not be the member whose performance level was lower under individual conditions. The more similar the performance levels, the higher the number of inversions under group conditions. If we now leave the classical Köhler experiment, which to a great degree was a power-test, i.e., it was aimed at the difficulties inherent in a physical task, the follow-up experiments are primarily speed-tests, i.e., tasks that focus more on time than strength, in order to avoid undue physical exertion. In a speed test this adaptation to the performance level may not be so necessary, if one disregards the aspects persistence and patience. This, naturally, leads to the question whether power and speed tasks lead to the same effects, something which as yet has not been clarified.

[6] All considerations about the determination of a baseline are based on assumptions about the four descriptive dimensions for differentiating group performance (subject, measure of performance, concatenation operation, task content). Each observed performance is

explained by a function which combines elements of ability, motivation and group formation. For this reason the reference value for the choice of a baseline value has to be theoretically determined. This means that the relevant influence processes under individual and group conditions have to be taken into account and this sometimes necessitates the use of a complicated model that uses more than one parameter, as, for example, in determining the conjunctive Köhler effect (CKE).

[7] The questionnaire included questions about the assumed performance level of an individual who is really more capable, if the subject achieves a certain standard performance. This answer is then interpreted as the performance value of an individual who is one just noticeable performance unit more capable.

[8] The authors define this effect as a "motivation gain effect" for conjunctive tasks and separate it from the "motivation difference effect", which in this study is referred to as the conjunctive Köhler effect (CKE).

[9]It is difficult to differentiate between an artificial regression effect towards the mean and substantial conformity processes. Naturally it is also viable to interpret this correlation as a convergence process towards conformity due to the pressure toward uniformity which has often been observed. This is a point which at present cannot be definitively resolved.

1. **Imagine that you have an IQ of 115. The average is 100. You can choose another person, who has proved himself to be <u>really more intelligent</u> in order to solve a problem together. How high, at the very least, must the IQ of this person be?**

   a) To be certain that the other person is **really** more intelligent than I am, he or she should have an IQ of at least [ ] .

   b) If you repeat an IQ-test and put special effort into it, by how many points could you **improve** your result of 115 ? On a good day I could achieve a result of [ ] points.

   c) If you repeat an IQ-test on a bad day by how many points could your result **drop**, even though you make an effort?
   My result could drop from 115 to [ ] .

2. **Imagine that when you are preparing a meal <u>on average</u> you can peel 20 medium-sized potatoes in 5 minutes.**

   a) You are under time pressure because your guests arrive **earlier than expected**. How many potatoes could you then peel? ..[ ]..potatoes.

   b) You hear that your guests will arrive later than expected and you have **time to spare**. In other words there is no needy to hurry. In this case, how many potatoes would you be able to peel in 5 minutes? [ ] potatoes.

   c) How many potatoes can someone peel who is **really better** than you, if you can normally peel 20 potatoes in 5 minutes?

He/she can peal at least ☐ potatoes.

3. Imagine that in 2 minutes you can make 10 suggestions for the unusual use of a brick (creativity task).

a) A similar task (creativity task) is used at the interview for a job you would really like to have. How many suggestions for the unusual use of an object could you make in the same time in this situation?

At least ☐ suggestions.

b) If you find this kind of creativity task boring, and yet do not want to fail, how many suggestions could you make in the same time?

At least ☐ suggestions.

c) How many suggestions must a person make in the same period of time, who you consider to be **really** more creative than you?

At least ☐ suggestions.

4. You and another person work together on the same IQ task. One would like to know how two people manage this test together.

a) You have been put with a person, who you recognize to be <u>evidently more intelligent</u> on account of the results of a previous IQ test. How do you experience such a situation?

1. I experience a high degree of challenge through the other person.

□	□	□	□	□
not at all	a little	moderately	quite a lot	very much

2. I exert extra special effort because of the other person.

□	□	□	□	□
not at all	a little	moderately	quite a lot	very much

3. I do not want to appear unintelligent because of the other person.

□	□	□	□	□
not at all	a little	moderately	quite a lot	very much

4. I rely on the capabilities of my partner.

□	□	□	□	□
not at all	a little	moderately	quite a lot	very much

5. I stay in the background because of the other person.

□ □ □ □ □

not at all a little moderately quite a lot very much

b) You have been put with a person, who got only <u>slightly better</u> results in an IQ-test, but who is not very much more intelligent than you. How do you feel in such a situation?

1. I experience a degree of challenge.

□ □ □ □ □

not at all a little moderately quite a lot very much

2. I exert extra special effort.

□ □ □ □ □

not at all a little moderately quite a lot very much

3. I do not want to appear unintelligent.

□ □ □ □ □

not at all a little moderately quite a lot very much

4. I rely on the capabilities of my partner.

□ □ □ □ □

not at all a little moderately quite a lot very much

5. I stay in the background.

□ □ □ □ □

not at all a little moderately quite a lot very much

c) You have been put with a person who is <u>evidently less intelligent</u> than you as can be seen from the result of a previous IQ test. How do you feel in such a situation?

1. I experience a degree of challenge.

□	□	□	□	□
not at all	a little	moderately	quite a lot	very much

2. I exert extra special effort.

□	□	□	□	□
not at all	a little	moderately	quite a lot	very much

3. I do not want to appear unintelligent.

□	□	□	□	□
not at all	a little	moderately	quite a lot	very much

4. I rely on the capabilities of my partner.

□	□	□	□	□
not at all	a little	moderately	quite a lot	very much

5. I stay in the background.

□	□	□	□	□
not at all	a little	moderately	quite a lot	very much

5. During a camping trip the number of participants for a very attractive day trip has to be limited. A potato peeling competition has been thought up. This competition is for two-person groups, who are put together randomly. The combined number of peeled potatoes in five minutes count.

a) You realize very quickly that your partner is <u>very much faster and apt</u> than you. How do you feel in such a situation?

1. I experience a degree of challenge.

□	□	□	□	□
not at all	a little	moderately	quite a lot	very much

2. I exert extra special effort.

□	□	□	□	□
not at all	a little	moderately	quite a lot	very much

3. I do not want to appear unintelligent.

□	□	□	□	□
not at all	a little	moderately	quite a lot	very much

4. I rely on the capabilities of my partner.

□	□	□	□	□
not at all	a little	moderately	quite a lot	very much

5. I stay in the background.

□	□	□	□	□
not at all	a little	moderately	quite a lot	very much

b) You realize that your partner can peel potatoes <u>slightly more aptly and faster</u> than you. How do you feel in such a situation?

1. I experience a degree of challenge.

□ □ □ □ □

not at all a little moderately quite a lot very much

2. I exert extra special effort.

□ □ □ □ □

not at all a little moderately quite a lot very much

3. I do not want to appear unintelligent.

□ □ □ □ □

not at all a little moderately quite a lot very much

4. I rely on the capabilities of my partner.

□ □ □ □ □

not at all a little moderately quite a lot very much

5. I stay in the background.

□ □ □ □ □

not at all a little moderately quite a lot very much

c) You recognize, that your partner is <u>evidently less apt and slower</u> at peeling potatoes than you. How do you feel in such a situation?

1. I experience a degree of challenge.

□ □ □ □ □

not at all a little moderately quite a lot very much

2. I exert extra special effort.

□ □ □ □ □

not at all a little moderately quite a lot very much

3. I do not want to appear unintelligent.

□ □ □ □ □

not at all a little moderately quite a lot very much

4. I rely on the capabilities of my partner.

□ □ □ □ □

not at all a little moderately quite a lot very much

5. I stay in the background.

□ □ □ □ □

not at all a little moderately quite a lot very much

4. In a firm applicants for a job are selected according to their creativity. The aim, however, is not just to test their individual creative abilities but also their creativity when working in a team. For this two-person groups are formed.

a) Test results show you that your partner is <u>evidently more capable</u> than you. How do you feel in such a situation?

1. I experience a degree of challenge.

□ □ □ □ □

not at all a little moderately quite a lot very much

2. I exert extra special effort.

□ □ □ □ □

not at all a little moderately quite a lot very much

3. I do not want to appear unintelligent.

□ □ □ □ □

not at all a little moderately quite a lot very much

4. I rely on the capabilities of my partner.

□ □ □ □ □

not at all a little moderately quite a lot very much

5. I stay in the background.

□ □ □ □ □

not at all a little moderately quite a lot very much

b) Individual test results show that your partner is <u>slightly better</u> than you. How do you feel in such a situation?

1. I experience a degree of challenge.

□ □ □ □ □

not at all a little moderately quite a lot very much

2. I exert extra special effort.

□ □ □ □ □

not at all a little moderately quite a lot very much

3. I do not want to appear uncreative.

□ □ □ □ □

not at all a little moderately quite a lot very much

4. I rely on the capabilities of my partner.

□	□	□	□	□
not at all	a little	moderately	quite a lot	very much

5. I stay in the background.

□	□	□	□	□
not at all	a little	moderately	quite a lot	very much

c) Individual test results show that your partner is <u>evidently less capable</u> than you. How do you feel in such a situation?

4. I experience a degree of challenge.

□	□	□	□	□
not at all	a little	moderately	quite a lot	very much

5. I exert extra special effort.

□	□	□	□	□
not at all	a little	moderately	quite a lot	very much

6. I do not want to appear uncreative.

□	□	□	□	□
not at all	a little	moderately	quite a lot	very much

4. I rely on the capabilities of my partner.

□	□	□	□	□
not at all	a little	moderately	quite a lot	very much

5. I stay in the background.

□	□	□	□	□
not at all	a little	moderately	quite a lot	very much

Personal details

Age: .....years

Sex: female □ male □

Course of studies/Vocational training: _____

Job experience before commencing studies: Yes □ No □

1. It is important to me what other people think of me.

□	□	□	□	□
not at all	a little	moderately	quite a lot	very much

2. I like working in groups.

□	□	□	□	□
not at all	a little	moderately	quite a lot	very much

3. Personal challenge evoked by others are important for me.

□	□	□	□	□
not at all	a little	moderately	quite a lot	very much

4. I prefer working independently of other people.

□	□	□	□	□
not at all	a little	moderately	quite a lot	very much

5. I can achieve most when I can concentrate on myself.

□	□	□	□	□
not at all	a little	moderately	quite a lot	very much

6. Other people can easily discourage me if they are more able than I am.

□	□	□	□	□
not at all	a little	moderately	quite a lot	very much

7. I like relying on other people who are better than I am.

□	□	□	□	□
not at all	a little	moderately	quite a lot	very much

8. I slightly tend towards competing with others.

□	□	□	□	□
not at all	a little	moderately	quite a lot	very much

9. I feel better when my standard is not worse than others.

□	□	□	□	□
not at all	a little	moderately	quite a lot	very much

10. I can relax once I have achieved the same performance standard as others.

□	□	□	□	□
not at all	a little	moderately	quite a lot	very much

11. I feel better when I am better than others.

□	□	□	□	□
not at all	a little	moderately	quite a lot	very much

Many thanks for your time and effort.

If there is anything you would like to add, please feel free to do so:

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