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Conjunctive and additive group work reduce academic procrastination: insights from a vignette study

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Abstract

Group work can increase individual effort, performance, and positive affect, if group members perceive their own contribution as indispensable for the group product. A vignette methodology was applied to investigate whether group work may also reduce procrastination. The vignettes described a typical academic assignment, while varying the task structure (individual work vs. conjunctive group work vs. additive group work) and group member ability (high vs. low). For each vignette, student participants ($N = 443$) provided ratings on their perceived indispensability, procrastination of the assignment, and affect. When group member ability was high, procrastination was lower in additive group work as compared to individual work. When group member ability was low, procrastination was lower in conjunctive group work as compared to both individual work and additive group work. As predicted, perceived indispensability mediated the difference in procrastination between conjunctive and additive group work. Moderation analyses further revealed that the effects were more pronounced for high trait procrastinators. Further, both types of group work led to increases in task-related positive affect as compared to individual work. By demonstrating the relevance of group work as a social factor, the results should be useful for the extension of existing programs targeting procrastination, and may inspire measures for preventing procrastination by changes in the study environment.

Keywords Academic procrastination · Conjunctive and additive group work · Effort gains · Indispensability perceptions · Affect

Procrastination, defined as "the voluntary delay of an intended course of action despite expecting to be worse off for the delay" (Steel, 2007, p. 66), is common among students, with negative consequences for academic performance (e.g., Kim & Seo, 2015) and psychological well-being (e.g., Çelik & Odaci, 2020). Much research has been conducted on person-related antecedents and correlates of procrastination, such as personality traits and motivational variables (e.g., Steel, 2007). Programs against procrastination typically address strategies concerning participants' cognitions, emotions, motivation, and self-control (cf. van Eerde & Klingsieck, 2018). Because human behavior is commonly explained not only by individual factors, but also by situational factors as well as their interaction (e.g., Furr & Funder, 2021; Lewin, 1951), the question arises whether procrastination could also be reduced by changes in the social context (i.e., by situation-related variables). In light of the finding that group work can lead to increased individual effort and performance (e.g., Johnson et al., 2007; Torka et al., 2021), this study investigates whether different forms of group work can reduce procrastination as compared to individual work. Because procrastination has been explained by high negative or low positive task-related affect (e.g., Sirois & Pychyl, 2013), measures aiming at the reduction of procrastination should closely monitor

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their influence on task-related affect. Thus, this study also investigates positive and negative affect. In a vignette study, the task structure (individual work vs. two types of group work) and relative ability (high vs. low) were manipulated to investigate their combined effects on procrastination as well as on task-related affect. The results should be informative for the theoretical understanding of procrastination as a self-regulation failure that may not only be explained by dispositions of the individual, but can also be reduced (or amplified) by social factors. Further, the results should be informative for the improvement of existing programs.

Literature review and hypotheses

Procrastination in higher education

As a common self-regulation failure, procrastination is characterized by a voluntary and unnecessary discrepancy between an intended action and the implementation of this action[1] (Steel, 2007). Such discrepancies are often coined intention-action gap (Steel, 2007; cf. Gollwitzer & Sheeran, 2016). Procrastinators do not differ from non-procrastinators in the amount of effort they intend to exert (Sirois & Giguère, 2018, Study 2; Steel, 2007; Steel et al., 2018), however, procrastinators do not put their intentions into action. Students reporting high levels of procrastination show decrements in academic performance (Kim & Seo, 2015) and in psychological well-being (Çelik & Odaci, 2020). More specifically, procrastination is associated with increased stress (Argiropoulou & Patra, 2020), and feelings of shame (Giguère et al., 2016), and regret (Ferrari et al., 2009). Further, procrastinators report higher levels of self-consciousness about procrastinating, especially in social contexts (cf. Ferrari et al., 2007), whereas findings regarding guilt seem inconsistent (e.g., Fee & Tangney, 2000; Giguère et al., 2016; Pychyl et al., 2000).

Studies on the antecedents of procrastination have identified a number of variables that are located within the individual, such as higher neuroticism, lower conscientiousness, as well as aspects of motivation, and self-control (for an overview, see Steel, 2007). Only recently have researchers started to focus more on situational factors that affect procrastination (cf. Bäulke & Dresel, 2021; Klingsieck 2013; Svartdal et al., 2020). Higher levels of procrastination have been associated with distraction by peers (Nordby et al., 2017), task-related stereotype-threat by peers (Deemer et al., 2014), and with a lack of social networks or a lack of peer support (Patrzek et al., 2012). Lower levels of procrastination have been associated with social norms, such as the norm of starting assignments promptly (Ackerman & Gross, 2016). These findings demonstrate that procrastination may not be fully explained by person-related variables, but may also be influenced by situational and especially social factors. This notion is supported by both theoretical and empirical work stressing the importance of the social environment on self-regulation (e.g., Bandura, 1991; Sassenberg & Woltin, 2008), and on self-regulated learning (e.g., Hadwin et al., 2017; Zimmerman, 2000). Moreover, especially factors inherent in group work are theoretically promising for reducing procrastination: For instance, perceiving that the own performance is indispensable for the performance of a whole group and, thus, perceiving responsibility for others may counterbalance or even exceed the tendency to procrastinate. However, little research exists on social variables such as group work that may have a (beneficial) effect on procrastination as a prevalent form of unsuccessful self-regulation.

Interventions against procrastination

The strong focus on personal antecedents may have shaped an understanding of procrastination as a problem that is caused mainly by the individuals themselves. Consequently, interventions against procrastination have mostly focused on changing person-related variables, e.g., by supporting the identification and correction of dysfunctional thoughts or the enhancement of planning skills (cf. van Eerde & Klingsieck, 2018), or by training emotion regulation skills (Eckert et al., 2016; Schuenemann et al., 2022). Meta-analytic evidence suggests that these programs are effective in reducing procrastination (van Eerde & Klingsieck, 2018). However, heterogeneity of the effects points towards the need to refine programs, e.g., by considering situational and social factors.

When investigating means to reduce procrastination, it is fruitful to distinguish between procrastination as a habit or tendency that is relatively stable (i.e., trait procrastination) and procrastination behavior as a discrete episode, during which an intended activity is delayed (i.e., state procrastination). High trait-procrastinators exhibit more state procrastination, as indicated by relationships between trait and state measures (e.g., Gadosey et al., 2021; Krause & Freund, 2014; Sirois & Giguére, 2018). Because high trait-procrastinators also report more negative consequences due to their procrastination (e.g., Kim & Seo, 2015), interventions are needed that effectively reduce state procrastination in this group. One factor that may help to reduce state procrastination is group work where group members depend on each other. This has been suggested before (Heath & Anderson, 2010; Klingsieck et al., 2013) and first evidence exists in

[1] Some researchers also include negative affect or subjective discomfort as a typical element of procrastination (cf. Klingsieck, 2013).

support of this notion (Koppenborg & Klingsieck, 2022a; Koppenborg & Klingsieck, 2022b).

Group work, effort gains and procrastination

According to Social Interdependence Theory, group as compared to individual work can increase individual effort and performance when there is interdependence between group members (i.e., members depend on each other's resources, roles, or contributions to reach a group goal; Johnson et al., 2007; Johnson & Johnson, 2015). Findings from Social Psychology show that group as compared to individual work can lead either to gains or losses in individual effort and performance (Karau & Williams, 1993; Torka et al., 2021). The Team member Effort Expenditure Model (TEEM; Torka et al., 2021) explains under which circumstances individuals exhibit effort gains in group as compared to individual work. TEEM is based on expectancy-value theories of motivation by Shepperd (1993) and Vroom (1964) and postulates three components that are multiplicatively linked. They comprise (i) the relationship between one's own behavior and the outcome (i.e., the expectancy component), (ii) the value of the outcome, and (iii) the cost/benefit ratio of effort expenditure. If individuals perceive any of the three components to be stronger in group as compared to individual work, they should exhibit gains in effort and performance (i.e., individual effort and performance should be higher in group as compared to individual work).

Indispensability perceptions reliably lead to such effort gains. They arise when group members perceive that "their performance not only affects their own personal outcome as during individual work, but also the outcome of other persons" (Hertel et al., 2008, p. 1332). When perceived indispensability is high, an individual's effort and performance can have more of an effect, because the own performance affects both the own outcome and other members' outcomes. Thus, TEEM postulates that high perceived indispensability is tantamount with an increased expectancy component. This, in turn, should lead to increased individual effort expenditure and performance in group as compared to individual work. Meta-analytic evidence supports the prediction of TEEM across many different types of tasks and settings (Torka et al., 2021).

TEEM shares central features with current expectancy-value theories of motivation in educational contexts such as the Situated Expectancy-Value Theory (SEVT; Eccles & Wigfield, 2020). One of the differences between both theories is that indispensability perceptions are linked to the expectancy component in TEEM, but to the value component in SEVT. According to the latter, indispensability perceptions should increase the utility value of a given task, which refers to a task's usefulness to reach personal goals. In other words, if the individual aspires a positive outcome for the other group members, then higher perceived indispensability should imply higher usefulness of the task. Despite this difference between TEEM and SEVT, both models would make the same prediction, namely that indispensability perceptions should result in gains in individual effort. TEEM also predicts losses in individual effort and performance in group as compared to individual work. Perceived *dispensability* of the own contribution for the group product results in effort losses in group as compared to individual work (for meta-analytic results, see Torka et al., 2021; see also the Collective Effort Model by Karau & Williams, 1993).

Indispensability perceptions can be induced by certain combinations of task structure and relative member ability. The structure of a task defines how the individual members' contributions relate to the group's performance (Steiner, 1972). In conjunctive tasks, the group product depends on the contribution of the least capable member (Steiner, 1972) and effort gains occur among these least capable members. Such effort gains in conjunctive tasks have been replicated in many studies across different types of tasks and settings (i.e., physical and mental tasks, in the lab and in the field; Torka et al., 2021; Weber & Hertel, 2007). For example, in conjunctive group work, weaker participants expended more effort and performed better in a physical persistence task (Messé et al., 2002) and a cognitive task (Hertel et al., 2003) as compared to individual work. In both cases, these increases can be explained by the higher perceived indispensability of the weaker member in conjunctive as compared to individual work (Hertel et al., 2003; Messé et al., 2002).

In additive tasks, that is, where the group product is determined by all members' contributions (Steiner, 1972), effort gains can also occur. For example, in professional sports, relay swimmers starting in later positions exhibit increasing effort gains compared to the effort spent in individual races (i.e., they swim increasingly faster in the relay as compared to the individual competition). Similar to conjunctive tasks, this can be explained by the higher perceived indispensability that is associated with these later positions (e.g., Hüffmeier et al., 2020).

Individual members with low relative ability do not always exhibit effort gains in additive tasks, because a relatively weak performance can be compensated by better performances from high-ability members (Hertel et al., 2000). By contrast, individual members with high relative ability should exhibit effort gains in additive tasks, as these members should perceive their contributions as more instrumental for the group product. Taken together, these findings raise the question whether group as compared to individual

work can help to reduce procrastination when the task structure of group work facilitates indispensability perceptions.

Because the individual's behavior not only affects the own outcome but also the outcome of other group members, indispensability perceptions may activate prosocial motives, that is, aspirations to have a positive impact on other peoples' lives (cf. Yeager et al., 2014), or social norms of altruism and social responsibility, which require to help and not cause harm to others (cf. Penner et al., 2005). Procrastinating the intended action during group work would jeopardize the group product and result in the non-satisfaction of prosocial motives and transgression of salient norms. In contrast, implementing the action as intended (i.e., working on the group task) contributes to the group product and should, thus, result in the satisfaction of prosocial motives and compliance with norms. Indirect support for these notions is provided by the relationship between social norms and procrastination (Ackerman & Gross, 2016), and by procrastinators' concerns about their public image (Ferrari, 1991). Thus, for students who have to work on an academic assignment, perceiving their contribution as indispensable to their group's product should result in lower procrastination as compared to a situation, in which the contribution is not perceived as indispensable (e.g., individual work).

Two studies exist that demonstrate that interdependence in group work can lead to reduced procrastination of an individual group member (Koppenborg & Klingsieck, 2022a; Koppenborg & Klingsieck, 2022b). These studies compared an individual task with a consecutive group task, meaning that the other group members depended on the timely and accurate contribution of the focal participant to start their own work. The current study extends the previous findings by shedding light on the role of indispensability perceptions, which have been a blind spot in the previous studies. As described above, indispensability perceptions result from certain combinations of task structure and member's relative ability (cf. Torka et al., 2021; Weber & Hertel, 2007). The current study considers relative ability as a moderator of the expected effect of group work on procrastination and includes conjunctive group work as another task structure. It also analyzes the underlying mechanism by including indispensability perceptions as a potential mediator, and social comparison as a control variable. This approach is relevant for theoretical reasons because it allows to attribute differences in procrastination on indispensability perceptions that result from combinations of task structures (as independent variable) and relative ability (as moderator variable). It is further relevant for the design of group work in practical settings. Such settings may require different forms of group work and groups typically consist of members with different levels of ability.

Group work and affect

One prominent explanation conceptualizes procrastination as a dysfunctional form of mood regulation with the purpose to escape negative emotions associated with the intended activity by pursuing an alternative activity instead of the intended activity (e.g., Sirois & Pychyl, 2013). Indeed, procrastination episodes are preceded by lower positive affect (Sirois & Giguère, 2018), higher negative affect (Pollack & Herres, 2020), or a failure to modify negative affect (e.g., Eckert et al., 2016). However, empirical evidence also shows that the attempt to regulate negative emotions by procrastinating is ineffective, as indicated by unchanged or even higher negative affect during procrastination episodes (e.g., Gadosey et al., 2021; Gort et al., 2021). These findings underline the importance of considering positive and negative affect when investigating measures designed to reduce procrastination.

Perceived indispensability as a central psychological mechanism of motivating teamwork does not only increase effort and performance, but also influences affect (i.e., the subjective feeling that accompanies emotional reactions; Watson et al., 1988). Perceived indispensability may enhance an individual's feeling of self-worth, and, thus, increase positive affect (e.g., Johnson et al., 2007; Weber & Hertel, 2007). Theoretical assumptions from other fields of research support the idea that a higher significance of an individual's activities results in increased satisfaction (e.g., Hackman & Oldham, 1975). Further, positive relationships have been reported between indispensability perceptions and positive mood (Hertel et al., 2018) and task enjoyment (Hertel et al., 2003).

Indispensability perceptions may also result in higher negative affect. This might be the case when perceived indispensability is felt as a burden (i.e., a group member fears that they may disappoint the other members by not showing a good individual performance; cf. Weber & Hertel, 2007). So far, no quantitative evidence has been reported on the effect of indispensability perceptions on negative affect.

The present study

This study is motivated by the recent turn to situational and social factors of procrastination (e.g., Klingsieck, 2013; Nordby et al., 2017; Svartdal et al., 2020), by initial evidence on the effects of interdependent group work (Klingsieck et al., 2013; Koppenborg & Klingsieck, 2022a; Koppenborg & Klingsieck, 2022b) as well as by the need to extend current programs against procrastination (cf. van Eerde & Klingsieck, 2018). Given the theoretical arguments made above and the related empirical evidence (Torka et al., 2021; Weber & Hertel, 2007), we expect that, when a group

members' relative ability is low, their individual contribution has a larger instrumentality in conjunctive as compared to individual work and to additive group work. Therefore, when a group member's ability is low, his/her state procrastination is lower in conjunctive group work as compared to individual work (Hypothesis 1a)[2]. Further, when a group member's relative ability is low, his/her state procrastination is lower in conjunctive group work as compared to additive group work (Hypothesis 1b). Group as compared to individual work can also lead to losses in effort and performance when the own contribution is perceived as dispensable (Karau & Williams, 1993). Therefore, when a group member's relative ability is high, his/her state procrastination is higher in conjunctive group work as compared to individual work (Hypothesis 1c). An additive task structure can also cause perceptions of indispensability and effort gains as compared to an individual task (e.g., Hüffmeier et al., 2020), especially among group members with high relative ability. Therefore, when a group member's relative ability is high, his/her state procrastination is lower in additive group work as compared to individual work (Hypothesis 1d)[3]. Regarding indispensability perceptions as our central underlying mechanism, we assume the following: When a group member's relative ability is low, indispensability perceptions are higher in conjunctive group work as compared to additive group work (Hypothesis 2a); and perceived indispensability mediates the difference in state procrastination between conjunctive and additive group work (Hypothesis 2b)[4].

Theoretical accounts and empirical findings show that indispensability perceptions are related to higher positive affect (Hackman & Oldham, 1975; Johnson et al., 2007; Weber & Hertel, 2007). For members with low relative ability, a conjunctive task structure renders these members' contributions indispensable for the group. Therefore, when a group member's relative ability is low, positive affect is higher in conjunctive group work as compared to individual work (Hypothesis 3a). For members with high relative ability, an additive task structure renders these members' contributions indispensable for the group. Therefore, when a group member's relative ability is high, positive affect is higher in additive group work as compared to individual work (Hypothesis 3b). Turning to the idea that indispensability may sometimes also be perceived as a burden (cf. Weber & Hertel, 2007), we ask the following research questions: When a group member's relative ability is low, is there a difference in negative affect between conjunctive group work and individual work (RQ1a)? And, when a group member's relative ability is high, is there a difference in negative affect between additive group work and individual work (RQ1b)?

Finally, because students who report a stronger tendency to procrastinate (i.e., who are high in trait procrastination) also exhibit more procrastination behavior (i.e., state procrastination; cf. Gadosey et al., 2021; Wieland et al., 2018), and, thus, experience more negative consequences (e.g., Argiropoulou & Patra, 2020; Kim & Seo, 2015), we pay special attention to this group by investigating the following research questions: Are the differences in procrastination as postulated in Hypothesis 1a and 1d larger for high as compared to low trait procrastinators (RQ2a and RQ2b)?

Method

To test our hypotheses, we conducted a vignette study, which we preregistered under https://osf.io/9h8b3?view_only=0e0eb3a2d9384323aef7d77e55fc6337. Previous research has demonstrated the utility of vignettes for investigating procrastination (cf. Krause & Freund, 2016), motivation (cf. Dietz et al., 2007), and effort gains (cf. Hüffmeier et al., 2013) as well as the comparability of results from vignette studies, behavioral experiments, and field studies for the domain of motivation research (see Hüffmeier et al., 2022). Six different vignettes described a typical academic assignment. Participants immersed themselves into each of the six situations and rated their state procrastination of the assignment as well as positive and negative affect with regard to each situation. In pretests using cognitive interviews (cf. Presser et al., 2004), students of social science majors had indicated that they perceived the vignettes as very comprehensible, realistic, and easy to imagine, and indicated confidence in their ability to accurately rate their procrastination in each scenario. The study had a 3 (task structure: individual work vs. conjunctive group work vs. additive group work) by 2 (relative ability: low vs. high) design. Following pertinent recommendations (Aguinis & Bradley, 2014) we used a within-subjects design. In such designs, participants can directly compare different stimuli with each other. They are thereby provided with rich context information, and, thus, these designs are "useful in terms of uncovering judgment processes of a single individual" (Aguinis & Bradley, 2014, p. 361).

[2] Due to an anonymous reviewer comment, we changed the ordering of hypotheses to increase comprehensibility. Note that the order of hypotheses now diverges from our preregistration. The content of all hypotheses, however, remains unchanged.

[3] Although group member's relative ability is technically a moderator in our study, we are not interested in studying the whole interaction pattern for theoretical reasons. We accordingly do not test some possible comparisons (e.g., individual work and additive group work under low ability conditions, or conjunctive and additive group work under high ability conditions).

[4] Note that we marginally adapted the formulation of Hypothesis 2b from our preregistered formulation to increase comprehensibility. However, we did not change content of the prediction.

Participants

A priori power analyses revealed that a minimum of 210 participants was required to test our hypotheses (all $\alpha = 0.05$; all $1 - \beta = 0.05$; smallest assumed effect size $d = 0.25$). Students at a large German public university participated in our online survey within regular lectures. Participants provided informed consent. Participation was voluntary and anonymous. The study followed ethical standards as well as institutional guidelines of the university.[5] Participants were blind to the purpose of the study, and filled out the survey using their own devices (e.g., smart phones or personal computers). Four hundred ninety-six students participated in the study and 443 of them met the inclusion criteria (365 females, $M_{age} = 22.31$, $SD_{age} = 3.95$; for a description of the inclusion criteria, see below). Most were enrolled in Bachelor programs[6] ($n = 410$) in the humanities and social sciences (232 first-year students; 111 second-year; 100 third-year or above).

Procedure

Participants were informed that the study investigated how university students study. First, participants answered items on trait procrastination. Next, instructions asked participants to immerse themselves into the vignettes and to fill out the items listed below the text of each vignette as honestly as possible. Instructions further explained that ratings should reflect participants' typical behavior in situations as described in the vignette. At the end, participants provided their sociodemographic information. Upon finishing the survey, we offered participants the opportunity to take part in a lottery for a cash prize of € 50.

Vignettes varied in their task structure (individual work vs. conjunctive group work vs. additive group work) and in the ability regarding the assignment (low vs. high ability). As baseline conditions (cf. Torka et al., 2021), we first presented the two individual work vignettes (low vs. high ability) in a randomized order before presenting the four group work vignettes (our experimental conditions) in a randomized order. After reading each vignette, participants rated their (relative) ability to check whether they had processed the information on (relative) ability correctly. After each of the four group work vignettes, participants also rated their perceived indispensability (as our hypothesized mediator) and social comparisons with their fellow members (as control variable; cf. Weber & Hertel, 2007). As our primary dependent variables, after each vignette, participants rated their state procrastination as well as their positive and negative affect.

Procrastination is more likely for tasks that are perceived as boring (e.g., Ackerman & Gross, 2016; Blunt & Pychyl, 2000), or tedious and difficult (e.g., Pychyl et al., 2000; Senécal et al., 1997) and this relationship seems stronger for short-term tasks (Lay, 1990). Therefore, vignettes described an assignment of short duration that is likely to be perceived as boring and tedious (i.e., compiling a bibliography), that is common in all academic disciplines, and that can be completed regardless of prior knowledge. Vignettes are reported in Table 1. Each vignette asked participants to imagine taking part in an obligatory course for which they had to compile and submit a bibliography as assignment. Because the intention-action gap is a defining characteristic of procrastination (Steel, 2007), all scenarios described participants' intention to work on and finish the assignment in a defined time span (i.e., until the evening of the same day).

Variables and measures

Independent variables

Task structure Task structure had three levels. The task was either an individual task to be completed alone (as a baseline condition, see Torka et al., 2021), a group task with a conjunctive task structure, or a group task with an additive task structure.

Ability Ability had two levels. The vignette described the participant's ability either as low or as high.

Dependent variables

State procrastination We assessed state procrastination with regard to each vignette with a short version the Academic Procrastination State Inventory (APSI; Schouwenburg, 1995; German: Patzelt & Opitz, 2014). It measures core characteristics of state procrastination with four items on a five-point scale ranging from *never* (1) to *constantly* (5). We adapted the wording of the four items to the task of compiling a bibliography ("You would… put off the completion of the bibliography"; "…prepare to start with the bibliography at some point of time but then would not get any further"; "…do so many other things that there would be insufficient time left for the bibliography"; "…think that you had enough time left, so that there would really be no

[5] In Germany, such studies are exempt from institutional review board approval.

[6] Of the 443 participants, $n = 33$ were enrolled in Master programs or did not report their program. Sensitivity analyses showed no differences in the results when we excluded these participants from analysis. For this reason, all results reported below are based on the total sample of $N = 443$.

Table 1 Vignette formulations. Boldfaced text in the table was also depicted boldfaced in the survey

Task structure	Individual work		Conjunctive group work		Additive group work	
Ability	Low ability	High ability	Low ability	High ability	Low ability	High ability
Information on…						
Task relevance	Imagine taking part in an obligatory course of your program. For course credit, you have to do a literature research on a given topic and assemble a bibliography.					
Task structure	You have to work on this assignment **by yourself**. You have to assemble the bibliography with twenty entries.		You have to work on this assignment **with two fellow students**. Everyone has to assemble a bibliography with twenty entries.			
Task structure	The bibliography will be graded.		Each bibliography will be graded individually. The **worst individual grade** will then be used as a grade for the entire group.		Every bibliography will be graded individually. The **average of all three individual grades** will then be used as a grade for the entire group.	
(Relative) ability			You know that your fellow students are **quite good** in this type of task.	You know that your fellow students **aren't so good** in this type of task.	You know that your fellow students are **quite good** in this type of task.	You know that your fellow students **aren't so good** in this type of task.
	You know about yourself that you are **not so good** in this type of task.	You know about yourself that you are **quite good** in this type of task.	And you know about yourself that you are **not so good** in this type of task.	And you know about yourself that you are **quite good** in this type of task.	And you know about yourself that you are **not so good** in this type of task.	And you know about yourself that you are **quite good** in this type of task.
Intention	You have decided to carry out the assignment this afternoon. Your plan is to finish the task in the evening.					
Task relevance	The grade will make up 50% of your final course grade.		The grade will make up 50% of your individual final course grades.			

need to start working on the bibliography"). Cronbach's α ranged between 0.70 and 0.85 across the six vignettes.

Positive and negative affect We assessed participants' affect with regard to each vignette with a short version of the Positive and Negative Affect Schedule (PANAS; Watson et al., 1988; German: Krohne et al., 1996). The short version (Thompson, 2007) comprises 10 items (e.g., "nervous", "active"), which participants rated on a five-point scale ranging from *not at all* (1) to *extremely* (5). Cronbach's α ranged between 0.85 and 0.91 for positive affect and between 0.77 and 0.82 for negative affect across the six vignettes.

Mediator and moderator variables

Perceived indispensability As our mediator variable, in the group work vignettes, we assessed perceived indispensability of the own contribution to the group product with two items ("According to how you understood the situation: How dispensable or indispensable is your contribution for the group result?" and "According to how you understood the situation: How unimportant or important is your contribution for the group result?"). Participants rated both items on a five-point scale ranging from *completely dispensable* (*very unimportant*) (1) to *completely indispensable* (*very important*) (5). Correlations between the two items ranged between 0.55 and 0.73 across the four group work vignettes (all $ps < 0.001$).

Trait procrastination As potential moderator variable, we assessed trait procrastination with the short German Version of the General Procrastination Scale (GPS; Klingsieck & Fries, 2012). This scale comprises nine items ($\alpha = 0.90$; e.g., "I often find myself performing tasks that I had intended to do days before"), which participants rated on a four-point scale ranging from *very untypical* (1) to *very typical* (4).

Manipulation check and control variables

Perceived relative ability As a manipulation check for relative ability, we assessed participant ratings with regard to each vignette with one item ("According to how you understood the situation: How are your skills in the task [compared to the other group members]?"). Participants rated this item on a five-point scale ranging from *very low* (1) to *very high* (5).

Immersion To gauge the quality of all ratings, at the end of the survey, participants rated their immersion with one

item ("How well could you immerse yourself into the situations described above?") on a five-point scale ranging from *very bad* (1) to *very good* (5). Mean ratings were $M = 3.97$ ($SD = 0.78$). A one-sample bootstrapped *t*-test showed that the mean score for immersion significantly differed from the scale midpoint (i.e., 3), $M_{Diff} = 0.97$, 95% CI [0.89, 1.04], $t(442) = 26.11$, $p < .001$, $d = 1.24$. The results, thus, confirm that participants were able to immerse themselves into the vignettes.

Social comparison Social comparison is another source for effort gains in group as compared to individual work (e.g., Seta, 1982; see also Weber & Hertel, 2007). As control variable in the group work vignettes, we therefore assessed the extent to which participants compared their own performance to the performance of their fellow members. We used one item that was introduced by Hertel et al. (2018; "How important would it be for you to be better or at least not worse than the other group members?"), which participants rated on a five-point scale ranging from *very unimportant* (1) to *very important* (5).

Inclusion criteria

Check for honesty As inclusion criterion (see also our preregistration under https://osf.io/9h8b3?view_only=0e0eb3a2d9384323aef7d77e55fc6337), at the end of the survey, we assessed participants' honesty with regard to all previous questions with one item ("How likely is it that, in reality, you would act in the way you indicated in the answers above?") on a five-point scale ranging from *very unlikely* (1) to *very likely* (5). In accordance with our preregistration, we excluded participants from our analysis if their rating was below 3 (i.e., the scale midpoint; $n = 22$).

Check for attention Further, we indirectly assessed participants' attention (cf. Oppenheimer et al., 2009; see again our preregistration) by asking them to mark a specific point on a five-point scale ranging from *very unlikely* (1) to *very likely* (5). The item formulation was "For this question, please chose option 'rather unlikely (2)'". Again, in accordance with our preregistration, we excluded participants from our analysis if their rating was not 2 ($n = 31$).

Data analysis

We conducted repeated-measures ANOVAs with planned contrasts to test our hypotheses. Shapiro-Wilk tests showed violations of the assumption of normality for all dependent variables (i.e., state procrastination, positive and negative affect), the mediator variable (i.e., perceived indispensability), and all control variables (i.e., relative ability, immersion, social comparison). Therefore, we report Friedman ANOVAs and robust bootstrapped t-tests (4000 samples) with bias corrected and accelerated 95% CIs.

To test our mediation hypothesis, we adopted the analytic procedure by Montoya and Hayes (2017) for mediation analysis in within-subjects designs[7]. We used the MEMORE macro for SPSS (Montoya & Hayes, 2017) with bootstrapped 95% CI (5000 samples). To answer our questions regarding moderation, and in accordance with our preregistration, we divided the sample along the median of trait procrastination ($Md = 2.78$). This resulted in two subsamples of $n = 221$ low trait procrastinators and $n = 222$ high trait procrastinators. We then compared the differences between conditions across these two groups. For all analyses, we report effect sizes for all significant results and interpret them according to Cohen (1988) as small ($d = 0.2$), medium ($d = 0.5$), and large ($d = 0.8$).

Results

Descriptive statistics regarding all dependent measures, mediator and moderator variables as well as control variables are shown in Table 2.

Manipulation check

A Friedman's ANOVA revealed a significant main effect between conditions regarding perceived (relative) ability, $X(5) = 1767.64$, $p < .001$. Post-hoc contrasts that compared perceived (relative) ability between the three conditions of low ability and the three conditions of high ability revealed a mean difference in (relative) ability of $M_{Diff} = 2.20$, 95% CI [2.13, 2.28], $F(1, 442) = 3612.15$, $p < .001$, $d = 5.72$. The results confirm that the manipulation of (relative) ability was successful.

[7] Contrary to our preregistration, we did not use the procedure by Judd et al. (2001). Unlike the Judd et al. procedure, the procedure by Hayes and Montoya (2017) allows for testing multiple indirect effects with a single test in a path-analytic framework, yielding estimates for direct and indirect effects (Montoya & Hayes, 2017). This allowed us to estimate the indirect effect of task structure and relative ability on procrastination via perceived indispensability, while controlling for a potential indirect effect via social comparison (i.e., our control variable). Using this procedure yielded results that did not differ substantially from the results when using the procedure by Judd et al. (2001).

Table 2 Descriptive statistics for all dependent variables and control variables across the six conditions of task structure and (relative) ability

Task structure	Individual work		Conjunctive group work		Additive group work	
(Relative) ability	Low	High	Low	High	Low	High
	Condition 1 *M* (*SD*)	Condition 2 *M* (*SD*)	Condition 3 *M* (*SD*)	Condition 4 *M* (*SD*)	Condition 5 *M* (*SD*)	Condition 6 *M* (*SD*)
State procrastination	2.30 (0.70)	1.84 (0.59)	1.70 (0.68)	1.74 (0.68)	1.85 (0.69)	1.55 (0.53)
Positive affect	2.58 (0.86)	3.25 (0.87)	3.31 (1.00)	3.24 (1.03)	3.13 (0.95)	3.52 (0.93)
Negative affect	2.70 (0.87)	1.67 (0.69)	2.92 (0.95)	2.30 (0.92)	2.50 (0.88)	2.02 (0.79)
Perceived (relative) ability	2.14 (0.69)	4.02 (0.58)	1.71 (0.67)	4.20 (0.64)	1.90 (0.64)	4.22 (0.54)
Perceived indispensability [a]			4.10 (1.09)	3.68 (1.17)	3.76 (1.05)	4.62 (0.59)
Social comparison [a]			4.28 (1.02)	3.95 (1.05)	4.00 (0.97)	4.17 (0.90)

[a]Perceived indispensability and social comparison could only be assessed in conditions 3 to 6 (where the task structure involved other group members).

Main findings

State procrastination

A Friedman's ANOVA revealed significant overall differences across the six experimental conditions, $X(5) = 529.93$, $p < .001$. Supporting Hypothesis 1a, in the low relative ability condition, state procrastination was lower during conjunctive group work than during individual work, with a large effect size, $M_{Diff} = 0.61$, 95% CI [0.54, 0.67], $t(442) = 18.27$, $p < .001$, $d = 0.88$ (see Fig. 1). Supporting Hypothesis 1b, in the low relative ability condition, state procrastination was lower during conjunctive group work than during additive group work, with a small effect size, $M_{Diff} = 0.15$, 95% CI [0.10, 0.20], $t(442) = 6.0$, $p < .001$, $d = 0.22$. Contrary to Hypothesis 1c, in the high relative ability condition, state procrastination was also lower during conjunctive group work than during individual work, although this effect was only small, $M_{Diff} = 0.1$, 95% CI [0.04, 0.16], $t(442) = 3.17$, $p < .01$, $d = 0.16$. Supporting Hypothesis 1d, in the high relative ability condition, state procrastination was lower during additive group work than during individual work, with a medium effect size, $M_{Diff} = 0.29$, 95% CI [0.24, 0.34], $t(442) = 12.0$, $p < .001$, $d = 0.52$.

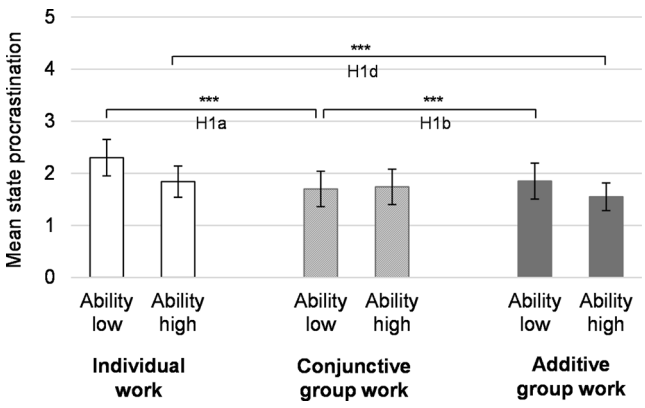

Fig. 1 State procrastination across conditions of task structure and relative ability. (Note: Error bars show standard deviations (*SD*). *** $p < .001$)

Mediation analysis: Perceived indispensability

A Friedman's ANOVA revealed significant overall differences in perceived indispensability across the four group work conditions, $X(3) = 255.12$, $p < .001$. Supporting Hypothesis 2a, in the low relative ability condition, perceived indispensability was higher during conjunctive group work than during additive group work with a small to medium effect size, $M_{Diff} = 0.34$, 95% CI [0.24, 0.44], $t(442) = 6.66$, $p < .001$, $d = 0.31$.

Drawing on the analytic procedure by Montoya and Hayes (2017), and supporting Hypothesis 2b, the difference in state procrastination between both conditions was mediated by perceived indispensability. This was indicated by a significant indirect effect, $a_1b_1 = -0.04$, 95% CI [−0.06, −0.02], $ps < 0.001$, while controlling for the indirect effect of social comparison (i.e., our control variable) on state procrastination. This indicates that perceived indispensability mediated the effect on state procrastination, even when considering social comparison as a concurrent mediator that, however, also turned out to be significant, $a_2b_2 = -0.02$, 95% CI [−0.04, −0.01], $ps < 0.001$.

Positive and negative affect

With regard to positive affect, a Friedman's ANOVA revealed significant overall differences across the six conditions, $X(5) = 480.40$, $p < .001$. Supporting Hypothesis 3a, under low relative ability conditions, positive affect was higher during conjunctive group work than during individual work with a large effect size, $M_{Diff} = 0.73$, 95% CI [0.65, 0.81], $t(442) = 18.34$, $p < .001$, $d = 0.78$ (see Fig. 2). Supporting Hypothesis 3b, under high relative ability conditions, positive affect was higher during additive group work than during individual work with a small to medium

effect size, $M_{Diff} = 0.27$, 95% CI [0.19, 0.34], $t(442) = 7.08$, $p < .001$, $d = 0.29$.

As to our research questions regarding negative affect, two post-hoc tests revealed significant differences between conditions. Under low relative ability conditions, negative affect was higher during conjunctive group work than during individual work, with a small effect size, $M_{Diff} = 0.22$, 95% CI [0.14, 0.29], $t(442) = 5.84$, $p < .001$, $d = 0.24$. Under high relative ability conditions, negative affect was higher during additive group work than during individual work, with a medium effect size, $M_{Diff} = 0.35$, 95% CI [0.27, 0.42], $t(442) = 8.94$, $p < .001$, $d = 0.47$. These results provide a first answer to our research questions RQ1a and RQ1b. Compared to the appropriate individual work baselines, these results show that negative affect was higher in conjunctive group work where the focal group member had a low relative ability, and in additive group work where the focal member had a high relative ability.

Moderation analysis: Trait procrastination

In accordance with our preregistration, two bootstrapped *t*-tests for independent means tested whether differences between experimental conditions differed between the groups of low and high trait procrastinators (see Table 3 for the descriptive statistics). The difference between individual work and conjunctive group work under low ability conditions was more pronounced for high trait procrastinators than for low trait procrastinators with a medium effect size, $M_{Diff} = 0.1$, 95% CI [0.07, 0.32], $t(436.24) = 2.91$, $p < .01$, $d = 0.28$. Further, the difference between individual work and additive group work under high ability conditions was more pronounced for high trait procrastinators than for low trait procrastinators, also with a medium effect size, $M_{Diff} = 0.16$, 95% CI [0.07, 0.25], $t(416.46) = 3.33$, $p < .01$, $d = 0.32$. These results provide a first answer to our research questions RQ2a and RQ2b. They show that the positive effect in conjunctive group work where the focal group member had a low relative ability, and the positive effect in additive group work where the focal group member had a high relative ability were larger for the group of high trait procrastinators.

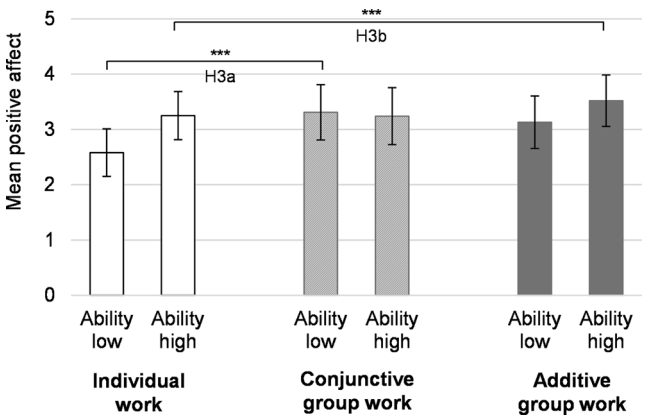

Fig. 2 Positive affect across conditions of task structure and relative ability. (Note: Error bars show standard deviations (*SD*). *** $p < .001$)

Discussion

Summary

The results of our preregistered study show that group as compared to individual work can lead to reduced state procrastination of an academic assignment and to increased task-related positive affect. When a group member's relative ability was low, state procrastination was lower and positive affect was higher in conjunctive group work as compared to individual work. Further, differences in state procrastination were found between conjunctive and additive group work. When a group member's relative ability was low, state procrastination was lower in conjunctive group work as compared to additive group work. This difference was mediated by perceived indispensability. Importantly, this mediation occurred when controlling for the indirect effect of social comparison. This is relevant because social comparison was a significant mediator in this study and is also another prominent source of effort gains in group as compared to individual work (Torka et al., 2021; Weber & Hertel, 2007).When a group member's relative ability was high, state procrastination was lower and positive affect was higher in additive group work as compared to individual work. These results converge with theoretical accounts and empirical findings on the effects of indispensability perceptions on effort gains (Torka et al., 2021; Weber & Hertel, 2007) and on positive affect (Hertel et al., 2003, 2018; Johnson et al., 2007; Weber

Table 3 Descriptive statistics for state procrastination of low versus high trait procrastinators for the relevant conditions

Task structure	Individual work	Conjunctive group work	Individual work	Additive group work
(Relative) ability	Low	Low	High	High
	Condition 1 *M* (*SD*)	Condition 3 *M* (*SD*)	Condition 2 *M* (*SD*)	Condition 6 *M* (*SD*)
Low trait procrastinators [a]	2.04 (0.63)	1.53 (0.60)	1.57 (0.41)	1.36 (0.42)
High trait procrastinators [a]	2.56 (0.66)	1.86 (0.71)	2.11 (0.62)	1.74 (0.56)

[a]Low versus high trait procrastinators were identified by splitting the sample at the median.

& Hertel, 2007), and expand these findings to the phenomenon of procrastination.

When the focal group member's ability is high, conjunctive group work should lead to perceptions of *dispensability*, and thus, lower effort, and higher procrastination. Against our prediction, this relationship could not be found. However, a recent meta-analysis showed that, while self-reports provide valid measures of effort *gains*, this does not necessarily apply to effort *losses* (Torka et al., 2021). Put differently, even when objective (i.e., behavioral) data showed effort losses in this meta-analysis, this was not mirrored by subjective (i.e., self-reported) data. Therefore, it is possible that the postulated increase in procrastination could be found when using behavioral measures of procrastination, instead of self-reported measures.

Because procrastination episodes are often preceded by negative task-related affect (Pollack & Herres, 2020; Sirois & Pychyl, 2013), consideration of negative affect is important. When a group member's relative ability was low, negative affect was higher in conjunctive group work as compared to individual work; and when a group member's relative ability was high, negative affect was higher in additive group work as compared to individual work. This supports our notion that perceived indispensability not only leads to higher positive affect, but may also induce negative affect. Finally, the reducing effects of group work on procrastination were even more pronounced for the group of high trait procrastinators, adding to the relevance of our results for intervention and prevention practice.

Theoretical and practical implications

Our results have implications for the understanding of procrastination, for the literature on indispensability perceptions, and for interventions. By emphasizing the relevance of social factors in explaining procrastination, the results provide support for the understanding of academic procrastination as a self-regulation failure that is (partly) induced or at least amplified by aspects of the learning context (cf. Bäulke & Dresel, 2021; Klingsieck, 2013; Svartdal et al., 2020). This aligns with the notion that human behavior is a product of personal and situational factors (Furr & Funder, 2021; Lewin, 1951), and it expands the theoretical understanding of procrastination to also include group work as a relevant factor. This may lead to more nuanced research questions. For example, besides identifying the degree of individuals' procrastination it may be worthwhile to also identify the situational aspects that they respond to with procrastination. Further, while ample evidence describes the effects of group work and indispensability perceptions on effort and performance (Torka et al., 2021; Weber & Hertel, 2007), our results expand this literature to effect on procrastination. Also, the results indicate that affective reactions to perceived indispensability may not be purely positive.

If corroborated by experimental research involving actual behavior, teachers and counsellors may promote group work with perceived indispensability of individual contributions that in turn leads to higher effort and lower procrastination of individual members. However, creating groups with substantial differences in members' ability can have negative effects on the academic self-concept of the member with the lowest relative ability (cf. Trautwein et al., 2009; Wolff et al., 2018). Therefore, indispensability perception could be induced by other means such as composing groups that consist of members with unique roles, skills, or contributions (cf. Weber & Hertel, 2007). Techniques from the field of collaborative learning offer targeted measures to achieve this, such as the jigsaw puzzle (cf. Barkley et al., 2014). Further, integrating social factors into existing intervention programs against procrastination may improve their impact, especially for high trait procrastinators. Finally, our results may inspire new approaches in intervention practice that, in addition to treating procrastination, seek to prevent it. This may result in programs with a larger reach that require less intensive adjustments by students, as compared to small-scale interventions aimed at individuals (cf. Frieden, 2010).

Limitations and future research

Five limitations are worth mentioning. The first limitation concerns the ecological validity of our findings. Vignette studies and behavioral studies have yielded comparable results in research on procrastination (e.g., Krause & Freund, 2016) and on indispensability effects (e.g., Hüffmeier et al., 2022). Nevertheless, field experiments are needed to corroborate the current results. Second, our study was based on the assumption that procrastinators do not differ from non-procrastinators in the amount of effort they intend to exert (Sirois & Giguère, 2018, Study 2; Steel, 2007; Steel et al., 2018). However, other research shows that procrastination is associated with higher levels of work-avoidance motivation (Wolters, 2003), mastery-avoidance goal orientation (Howell & Watson, 207), and performance-avoidance goal orientation (Seo, 2009). This could be addressed in future research by including these variables as control variables. Third, our sample consisted by the majority of female participants. This may have led to stronger effects because females may show stronger indispensability effects (Weber & Hertel, 2007; although this was not replicated in a recent meta-analysis, Torka et al., 2021). This question could be investigated by including gender as a moderator variable. Fourth, future research could consider other potential moderator variables to further qualify the results of this study,

for example, collectivistic cultural norms (cf. Torka et al., 2021; Weber & Hertel, 2007) or the relationships between group members. Finally, using a median split for analysis of moderators has been criticized for the loss of information and power. Although studies have demonstrated the robustness of this method (e.g., Iacobucci et al., 2015), future investigations could conduct moderation analyses using a continuous measure of trait procrastination to avoid dichotomization.

Conclusion

This research shows that group work can reduce procrastination among students via their perceived indispensability, and that group work can increase task-related positive affect. The results may carry implications for our understanding of procrastination by demonstrating the relevance of factors beyond the individual, such as group work. Further, the results may inspire refinements of interventions to include situational and social aspects to a higher extent. In the long run, the results may contribute to the development of preventive approaches to procrastination.

Authors' contributions All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by Markus Koppenborg. The first draft of the manuscript was written by Markus Koppenborg and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

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Data, materials and/or code availability Data, materials and code will be made available upon request.

Declarations

Competing interests The authors have no relevant financial or non-financial interests to disclose.

Ethics approval APA standards were followed in the conduct of the study. Approval by an ethics committee was not necessary.

Consent Participants provided informed consent.

Conflict of interest On behalf of all authors, the corresponding author states that there is no conflict of interest.

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