The Development and Psychometric Evaluation of the Group Flow Inventory (GFI)

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Conflict of Interest

We have no conflicts of interest to disclose.

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Data availability statement

The data that support the findings of this study are available from the corresponding author upon request.

Abstract

Objective: Group flow is a positive phenomenon of group action. As the previous questionnaires for measuring group flow had shortcomings (e.g., potential for more extensive consideration of theoretical elements, missing validation), the aim of the present work was to elaborate a new questionnaire. Method: Based on the Integrative Group Flow Theory (IGFT) and based on clear methodological considerations, the Group Flow Inventory (GFI) was therefore developed as a new questionnaire and evaluated two studies in the sport domain (Study 1: *N* = 152 German hockey players; Study 2: 486 German athletes of different team sports). Results: The GFI measures group flow from a self-oriented and a group-oriented perspective of the responding individual. Corresponding to the IGFT, factor analyses of the two studies have confirmed that the GFI consists of two factor levels: primary fit (i.e., the degree to which all group members within the group system fit together in the light of a group task) and secondary fit (i.e., the degree to which the group system as a whole fits the group task) at the higher level, which are each composed of behavior, state of mind and skills at the lower level. Correlation analyses for validation have shown relationships between group flow on the one hand, and performance, motivational climate, intrateam communication and well-being on the other hand. Conclusions: The GFI offers various application possibilities. Its development and the results of the two studies not only stimulate group flow research, but also offer new starting points for individual flow research.

Keywords: team flow; assessment; measurement; instrument; validation

Highlights and Implications

- The Group Flow Inventory (GFI) is a validated questionnaire that measures group flow.
- The GFI assesses two higher level factors of group flow – primary fit (i.e., the degree to which all group members fit together in the light of a group task) and secondary fit (i.e., the degree to which the group system as a whole fits the group task).
- Two studies evaluating the GFI have shown that correlations exist between group flow on the one hand, and performance, motivational climate, intrateam communication and well-being on the other hand.
- The GFI can be used particularly in research, following further investigation, its use in practice is also conceivable.

The Development and Psychometric Evaluation of the Group Flow Inventory (GFI)

The phenomenon of group flow describes situations in which a group manages to accomplish an interactive task harmoniously, perfectly tuned and seemingly effortlessly, as if in a natural flow (Sawyer, 2003). Studies indicate that group flow is beneficial for the group as a whole (Salanova et al., 2014) and for the individual group members (Zumeta et al., 2016). Given these benefits, further studies are necessary to understand how group flow occurs, persists and drops. Such studies require measurement instruments assessing group flow which are particularly applicable for research. Although some first self-report (e.g., Aust et al., 2023) and objective (e.g., Gloor et al., 2013) instruments already exist, many of them have methodological shortcomings. Moreover, the existing instruments do not represent the existing theoretical approaches to group flow in total. In more detail, the recent integrative group flow theory (IGFT; Pels & Kleinert, 2023b) which addresses specific aspects of GF has not been part of the existing questionnaires. Therefore, the aim of this paper is to elaborate a new questionnaire as a self-report instrument assessing group flow based on the IGFT specifically for research purposes.

The Concept of Group Flow

Building upon (group) action theory (Cranach et al., 1986; Nitsch & Hackfort, 2016) the IGFT (Pels & Kleinert, 2023b) defines group flow as balanced group action which is “a continuously perfectly fitting handling of the task by the [acting] group system” (Pels & Kleinert, 2023b, p. 10) in the given environment. In this regard, IGFT describes that group flow is a ***dynamic equilibrium*** (Mazzola & Cherlin, 2009), meaning that each sub-action is naturally, as if automatically followed by another congruent sub-action of the group (Pels & Kleinert, 2023b) which appears as a “perfect working of [a] groupmind” (Sawyer, 2006, p. 159). Group flow, thus, consists of the dynamically coherent interconnection of successive sub-actions of the whole group – even in the case of interim disturbances, there are

corresponding coping actions that also flow into one another. In brief, group flow therefore describes perfect group action and not necessarily a perfect result of group action (Lampitt Adey, 2018).

According to the IGFT (see Figure 1; Pels & Kleinert, 2023b), structurally underlying the dynamic equilibrium are relations between the individual members of a group (primary fit; i.e., inter-person fit), and between the group as a whole and the demands of the given task (secondary fit; i.e., group-task fit) (see also Peifer & Wolters, 2021). ***Primary fit*** means that the group members are similar to each other in their characteristics (i.e., symmetric primary fit; Pels & Kleinert, 2023b; Zepp & Kleinert, 2015) or add something to each other to overcome a deficiency (i.e., complementary primary fit; Muchinsky & Monahan, 1987; Pels & Kleinert, 2023b). In more detail, this concerns the functions (a) *skills* (e.g., all players have the same tactical skills (symmetric); one player is physically robust and good at blocking, while another is particularly strong technically with the stick (complementary)), (b) *state of mind* (e.g., the players all have a positive mood (symmetric); the players have individual goals that each of which contributes to the group goal (complementary)) and (c) the *behavior* of the individual group members (e.g., the defenders all move at the same level on the pitch in a certain sub-action (symmetric), whereas one of the offense player sets up a block so that another can run free to receive a pass from a midfielder (complementary)) (see Figure 1). Primary fit leads to a distinct systemic emergence of group skills, group state of mind and group behavior at the group level (Pels & Kleinert, 2023b). ***Secondary fit*** means that the group skills, state of mind and behavior perfectly fit the *group task* – as in the case of individual flow, for example, “demands and skills are in a perfect balance” (Peifer & Tan, 2021, p. 202). In terms of hockey, for example, imagine a game situation (i.e., a sub-action) in which a team, with the necessary skills (group skills; compiled, among other things, of the individual movement, tactical and technical skills), jointly covers the opponent's passing routes like a spider's web, based on agile movements in

defense (group behavior; compiled of intertwining individual defense movements) towards the group goal (group state of mind; compiled of individual states of mind involving, for instance, individual goals) demanded by the group task (e.g., defending one's own goal situationally in order to win the game) (see Figure 2). Since group flow is dynamic, these sub-actions always follow on from each other (e.g., after winning the ball back in defense, immediately switching to offense, with each player knowing the running path of the other and the ball being passed between teammates as a completely natural sequence of moves) with structurally underlying primary and secondary fit (Pels & Kleinert, 2023b) – making group flow a rare and extraordinary, but still achievable experience (Łucznik & May, 2021).

Figure 1

Model of the Structure of Group Flow according to the IGFT

<<<insert *Figure 1* here>>>

Note. (1) = primary fit (i.e., inter-person fit). (2) = secondary fit (i.e., group-task fit).

The figure depicts the components of group action: the group system (consisting of the individual level and the group level with three functions each (behavior, state of mind, skills)), the present task, the given environment.

(figure taken from Pels & Kleinert (2023) with licensed permission of the American Psychological Association; Copyright © 2022, American Psychological Association))

Existing Questionnaires Assessing Group Flow

To the best of our knowledge, there are seven questionnaires that have been used to assess group flow[1] (for an overview of existing questionnaires, see Supplement 1). All questionnaires are related to a theoretical concept. Most of these (Aust et al., 2023; Kaye, 2016; Salanova et al., 2014; van Oortmerssen et al., 2022; Zumeta et al., 2016) involve Csikszentmihalyi's (1975, 1990, 2000) individual flow concept. Only two are exclusively based on specifically elaborated group flow theories: The questionnaire by Primus and Sonnenburg (2018) is based on Sawyer's (2003, 2006, 2007) group flow concept, the questionnaire by van den Hout et al. (2019) is based on the authors' preceding conceptualization of team flow (van den Hout et al., 2018).

As a result of the different theoretical foundations, the questionnaires differ in their factors, structure and item content. In the case of questionnaires based on a specific group flow theory, for example, the Team Flow Monitor (TFM; van den Hout et al., 2019) consists of eleven factors that query the theory's prerequisites (e.g., mutual commitment) and characteristics (e.g., holistic focus) of group flow with multiple items each. In contrast, the questionnaire used by Primus and Sonnenburg (2018) consists of only one global factor whose items each separately query one factor of the group flow

[1] (a) Only group flow questionnaires that have been presented in peer-reviewed publications are included. (b) In addition to the questionnaires reported here, there are several studies (for an overview, see Pels et al., 2018) that purport to capture group flow by asking individual group members to report their individual flow, which is summed across all group members to produce a group value for group flow. However, this is not a capture of group flow as an emergent state of a group. Instead, it is an assessment of social interactive flow as a form of individual flow (cf. Hackert et al., 2022).

concept (e.g., continuous communication). In the case of questionnaires based on the individual flow concept sensu Csikszentmihalyi (1975, 1990, 2000), for example, group flow was conceptualized by Zumeta et al. (2016) via nine lower level factors that are aligned with the nine dimensions of individual flow (e.g., autotelic experience), which can be combined into one global higher level factor.

The existing questionnaires have rarely been evaluated psychometrically. A complete psychometric examination of the quality criteria was only conducted for the TFM by van den Hout et al. (2019). This includes, in particular, an empirical validation (for instance, van den Hout et al. (2019) have proven the construct validity via the predictive validity of the TFM group flow factors on team positivity and team performance as outcomes), but also a systematic item analysis. Such comprehensive analyses have not yet been carried out for the other questionnaires.

In conclusion, in contrast to the TFM, most of the existing questionnaires have shortcomings. Predominantly, this concerns pending psychometric evaluation and the use of Csikszentmihalyi's (1975, 1990, 2000) individual flow concept, although group flow is a group-based experience that differs from individual flow with distinct characteristics (Hackert et al., 2022). Nevertheless, the TFM (van den Hout et al., 2019) is a questionnaire whose psychometric goodness criteria have been thoroughly tested empirically and which has been properly developed according to the theoretical state of the conceptualization of team flow (van den Hout et al., 2018). Accordingly, the TFM was successfully used in subsequent studies (e.g., Feng et al., 2024) that were based on the conceptualization of team flow (van den Hout et al., 2018). However, certain aspects of group flow that have been considered in the recent IGFT (Pels & Kleinert, 2023b) have not been taken into account in the TFM (van den Hout et al., 2019) as it was derived from a different theoretical perspective (van den Hout et al., 2018). First and foremost, this includes the explicit distinction between an inter-person fit among the individual group

members (primary fit) on the one hand and a group-task fit between the group system as a whole and the group task on the other (secondary fit) made in the IGFT. These have not yet been separated within the TFM. For example, the factor "mutual trust" of the TFM includes both items that would be assigned to primary fit in the IGFT ("we have trust in each other […]"; van den Hout et al., 2019, p. 24; i.e., inter-person fit), as well as items that would be considered secondary fit ("we, as a team, trust that we will be able to complete the task successfully"; van den Hout et al., 2019, p. 24; i.e., group-task fit). Second, the characteristics of group flow, as defined in the conceptualization of team flow (van den Hout et al., 2018) and as operationalized in the TFM (van den Hout et al., 2019), do not consistently take into account that characteristics of group flow occur dynamically as if automatically.

Aim and Structure of the Present Work

For two reasons, the current status of the group flow questionnaires suggests the development of a new questionnaire that takes the IGFT (Pels & Kleinert, 2023b) into account: First, significant theoretical elements of the IGFT (Pels & Kleinert, 2023b) have not been incorporated sufficiently into the existing questionnaires, in other words, group flow has not yet been operationalized in accordance with the IGFT (Pels & Kleinert, 2023b). Secondly, a corresponding questionnaire would have the benefit that the two current and prevailing theoretical perspectives (Pels & Kleinert, 2023b; van den Hout et al., 2018) could then be compared with each other.

Therefore, the aim of the present work was to elaborate a questionnaire – referred to as the Group Flow Inventory (GFI): In stage 1 the GFI was developed, comprising the definition of guiding construction principles, the generation of item content, and the completion of an initial, pre-final GFI-version. In stage 2 the GFI was psychometrically evaluated by two studies, resulting in the final version.

Stage 1: Development of the GFI

Guiding Construction Principles

The construction of the GFI as a self-report instrument was based on theoretical and methodological considerations (Saris & Gallhofer, 2014). Both theoretical and methodological considerations are related as theoretical considerations determine a specific methodological realization of a measurement instrument (DeVellis & Thorpe, 2021). In terms of group flow, theoretical considerations regarding the (1) characteristics of group flow according to the IGFT as well as related theoretical considerations regarding the (2) perceptibility of group flow and (3) perspectives on group flow determine methodological consequences for the measurement instrument. The methodological consequences involve the overall structure of the GFI, the instruction of the survey participants, the item stem, the item content and the response scale, establishing an operationalization of group flow.

(1) Considerations Concerning the Characteristics of Group Flow

As outlined above, the IGFT (Pels & Kleinert, 2023b) describes group flow as a dynamic equilibrium which is structurally consisting of two interlocking facets of fit (primary and secondary fit) involving three psychological functions (behavior, state of mind, skills). Thus, the presence of primary and secondary fit means that group flow is present. Accordingly, in terms of ***factor structure***, a *two-level factor structure* is reasonable: On the higher level, there are primary and secondary fit (two factors); on the lower level, there are the psychological functions behavior, state of mind and skills – each nested within primary and secondary fit (six lower-level factors; see Figure 2). In turn, this means that the ***items*** should always *assess a form of fit* (primary or secondary) *related to one of the three psychological functions* (behavior, state of mind, skills). Thus, regarding the ***item content***, the items of a factor should *comprehensively represent the respective fit with appropriate wordings* (e.g., wordings for symmetric primary fit such as “exactly fitting”, wordings for complementary primary fit such as “perfectly

complementing each other"; cf. also expressions such as "in perfect unison" in questionnaires about individual flow, S. A. Jackson & Roberts, 1992) and the items should contain *different facets of the respective psychological function* (e.g., mood, motivational, and thought-related aspects as facets of state of mind; American Psychological Association, 2024a). In doing so, the item content should be constructed in a *context-unspecific manner* so that the GFI can be used in different contexts.

Figure 2

Model of the Theoretical Factor Structure of the GFI

<<<insert *Figure 2* here>>>

As group flow is a dynamic equilibrium, this means that primary and secondary fit continue in the ongoing process of smooth task accomplishment. In other words, group flow is not a single-moment experience, but – as individual flow (Peifer & Engeser, 2021b) – lasts over a certain time as long as primary and secondary fit continue. The continuous maintenance of fit implies further consequences for the item content, for the response scale of the items and for the instruction. In terms of ***item content***, this means that there should not only be items that assess the mere presence of fit as described above, but also those that assess the dynamic process of smooth task accomplishment, which means capturing the resulting continuous maintenance of fit (e.g., with wordings such as that group members are aligning their behavior, indicating that a group is maintaining the fit during smooth task accomplishment). Regarding the ***response scale*** of the items, it is appropriate to design a response scale assessing the relative duration of group flow during a particular situation of group action using a Likert-type scale (ranging from "never" to "all the time"). As group flow does not have to be permanently

present during a task, but can vary dynamically (e.g., there can be group flow in the third quarter of a field hockey game, but not during the rest of the game), the response scale should capture the relative duration. The longer the overall duration of group flow during a task, the more positive the expected outcomes. From a theoretical point of view, it would not be reasonable to design a response scale that measures the intensity of group flow, because pure fit (and, thus, group flow) simply exists or not – of course, there can be also intermediate intensities of fit (i.e., different levels; e.g., low or moderate), but such intermediate intensities of fit are not defined as group flow in the IGFT (Pels & Kleinert, 2023b). Pure fit and its maintenance is therefore fixed by the item wordings (i.e., the items describe the issue that the highest intensity of fit and its maintenance is present), the following response scale finally records how long the fit lasted and whether it was present at all. From an empirical point of view, with a measurement instrument assessing duration of group flow, conditions of group flow (e.g., beneficial task designs for lasting group flow), consequences of group flow (e.g., whether a certain duration is necessary for positive performance outcomes of the group or increased well-being of the individuals) and consequences among these can be investigated in future research. The response scale in turn determines consequences for the ***instruction***. The instruction should clarify the frame of reference for the respondents' answers by specifying to which (phase of a) group action (i.e., during which task accomplishment and in which environment) the items and the response scale are to be related.

(2) Considerations Concerning the Perceptibility of Group Flow

It must be assumed that not all characteristics of group flow (and the mechanisms behind them as described and explained in the IGFT) are directly perceptible by the individuals involved (i.e., they are non-conscious), making it impossible to capture group flow as a whole explicitly and directly. The reasons for the restricted perceptibility of group flow can be found in both (a) intrapersonal and (b)

interpersonal aspects which implies further methodological consequences for the assessment of group flow in a self-report instrument such as the GFI. Regarding (a) intrapersonal aspects, there are restrictions because an individual has only limited perceptual access to one's own processes underlying typical psychological states during flow as can be inferred from the findings on individual flow (Bakker, 2008). Acting during flow is as if automatized (Csikszentmihalyi, 1975; Sawyer, 2003). According to action theory (Nitsch & Hackfort, 2016), acting during flow can, therefore, be assumed to be regulated by the automatic action control system which mostly involves sub-cognitive processes, be it acting alone or acting in a group. Since these sub-cognitive processes are not conscious and take place rapidly, it is not possible to capture them explicitly and directly. However, sub-cognitive processes (such as during group flow) can be regarded as being preconscious which means that they can be in general accessed by the acting entity and, thus, be brought to consciousness (American Psychological Association, 2024b). As with intrapersonal aspects, there are also restrictions on (b) interpersonal aspects because an individual has no direct access to the processes underlying typical psychological states of the other individuals. Instead, individuals can only establish a subjective construction of each other's psychological states and processes based on observations. By observing what a person says and does or how he or she appears, one can construct how his or her psychological states might be characterized. However, just as one can only implicitly perceive one's own psychological states and processes during group flow, one will also only implicitly observe and construct the characterization of the other individuals during group flow.

Due to the restrictions mentioned, it is not possible for an individual to explicitly access group flow as conceptualized by the IGFT, although the individual fully experiences group flow. Strictly speaking, first, it is not possible to explicitly perceive one's own continuous fit to the other individuals and also the continuous fit of all other individuals to the other ones (primary fit). Second, it is not

possible for the individual to explicitly perceive the extent to which a group function that has emerged (group state of mind, group behavior, group skills) has a continuous fit to the group task (secondary fit).

However, it can be assumed that group flow is indirectly perceptible. The indirect perceptibility is basically enabled by the experience during group flow. The positive experience manifests, for example, in positive feelings because group flow is pleasant and useful, and through introspection and retrospection, it can be assumed that it is possible for the individual to relate the positive experience to situational circumstances of group action. As a methodological consequence, the GFI should try to approach group flow taking into account the experience. More specifically, first, the ***instruction*** of the GFI should explain to the respondents that the items ask for the *experience* during group action and that they should respond to them *intuitively* as possible and *without extensive thinking*. The remark that it is about the experience, which is to be reported intuitively and without extensive thinking, is to ensure that no artificial cognitive construction of group flow is generated. Accordingly, and second, the ***item stem*** should consist of the phrase *"I had the impression..."* ("impression" is a typical expression for describing experiences to which one is asked to respond intuitively), followed by the ***items*** asking about *situational circumstances of group action* that represent characteristics of the structure and dynamics of group flow (cf. the considerations concerning the characteristics of group flow).

(3) Considerations Concerning Group Members' Perspectives on Group Flow

Members of a group can have a group-oriented and a self-oriented perspective on a group-level phenomenon (Carron et al., 1985). The group-oriented perspective refers to how a group member perceives the group as a whole with respect to the phenomenon. The self-oriented perspective refers to how a group member perceives himself or herself involved in the group in terms of the phenomenon. In theoretical respect, the two perspectives account for the fact that, in reality, not every member is

equally involved in a phenomenon that manifests at the group level. In epistemological respect, the two perspectives – if measured – enable researching how the involvement of the individual in a group phenomenon influences the phenomenon and subsequent outcomes for the group and the individual.

Accordingly, group flow should be assessed with these two perspectives. The group-oriented perspective would capture how a group member perceives group flow as a phenomenon of the whole group. The self-oriented perspective would capture how a group member perceives his or her personal involvement in group flow as a phenomenon of the group. In more detail, the self-oriented perspective would capture how a group member perceives himself as part of the group action during group flow. This self-oriented perspective on group flow should not be misinterpreted as an assessment of individual flow during a group task. While individual flow may certainly occur during a group task (Elbe et al., 2010), it is, however, related to the individual task accomplishment of the group member concerned (Hackert et al., 2022); in contrast, group flow always refers to the higher-level group action (Hackert et al., 2022; Pels & Kleinert, 2023b). Thus, the self-oriented perspective on group flow must always have a reference to group action, whereas individual flow must only have a reference to individual action (regardless of whether this individual action is embedded in group action or not).

In methodological regards, the two perspectives have implications for the superordinate structure and the item content of the GFI. Regarding the ***superordinate structure***, since the GFI was intended to be a comprehensive, two separate, independent parts should be designed, one for the self-oriented and the other one for the group-oriented perspective. In terms of measurement theory, the division enables the respondents to get deeper involved in the respective perspective, increasing reliability and validity of the measurement. This would be more difficult if the perspective is constantly

changing between items (Lam et al., 2002). In terms of content, for different purposes, the two parts can be usable, analyzable and interpretable separately without consideration of the other, if desired.

In terms of the ***item content***, the items should accordingly capture both perspectives, similar to established questionnaires in cohesion research (Carron et al., 2002). This means, on the one hand, that the items of the self-oriented perspective are intended to inquire how the respondent, as an individual group member, is positioned within the group action in relation to the others in the group (e.g., "My behavior exactly fits the behavior of the others in our group"). On the other hand, this means that the items of the group-oriented perspective are supposed to inquire how the group members act together as a whole group (e.g., "The behavior of the members of our group is exactly fitting to each other."). In addition, formally-linguistically, this implies using terms such as "I", "me", "my" for a representation of the individual in the self-oriented perspective and such as "we", "us", "our" for a representation of the group as a whole (including the responding individual) in the group-oriented perspective.

Generation of Item Content

Three approaches were used to generate item content: First, all items from existing group flow questionnaires (see Supplement 1) were collected as well as items from a questionnaire on networked minds social presence (Biocca & Harms, 2011) that captures some group flow related aspects (e.g., mutual understanding, behavioral interdependence). All of these items were translated into German. Second, the authors of the GFI generated item content for the intended factors in an expert discussion. Third, semi-structured interviews were conducted with individuals who have everyday experience of interactive group action. The aim of these interviews was twofold: On the one hand, the interviews aimed to obtain descriptions of group flow from practitioners that could make potentially new contributions to item content. On the other hand, the descriptions from practitioners were taken to

countercheck the theory-based item content: The theory-based items were checked by determining whether the descriptions of the practitioners could be basically assigned to them. In total, five persons were interviewed (one person who works interactively with others in the occupational context; one person who juggles with others; two athletes of a sport team; one coach of a sport team). Their central descriptions of group flow were excerpted after transcription and listed as potential item content.

The pool of potential item content was then further analyzed to ensure content validity. First, all items of pre-existing questionnaires were excluded that were not related to group flow in the narrower sense. This mainly concerned items from the questionnaire on social presence (e.g., "The other individual didn't notice me in the room"; Biocca & Harms, 2011, p.5). Subsequently, all items of pre-existing questionnaires and the descriptions of group flow gained in the interviews and the expert discussion were checked for their fit to the intended factors of the GFI. Unsuitable item content was removed from the pool. Item content that could not be unambiguously assigned to a factor, but was in principle considered to fit the conceptualization of group flow according to the IGFT (Pels & Kleinert, 2023b), was assigned to a provisional residual category.

Development of the Initial Questionnaire

With the construction principles and the pool of item content in mind, an initial questionnaire was designed in German language. In this initial questionnaire the instruction, the item stem, the items for the defined factors and the response scale were specified.

Instruction and Item Stem

Given the indirect perceptibility of group flow, the instruction and item stem were formulated in a way that allows for capturing group flow experience based. The instruction is: “The following

questionnaire is about how you felt about [activity X][2]. Please think back to [activity X] and answer instinctively, without thinking for too long, as this is about how you felt during [activity X]. For each statement about [activity X], please indicate how long you felt that way." The item stem is: "I had the impression that…".

Items

The items aimed at assessing primary and secondary fit regarding the psychological functions of behavior, state of mind and skills, and the maintenance of fit. For each of the six lower level factors (see Fig. 2), at least three items were developed. More specifically, for each of the six lower level factors, the goal was to have at least *one item per factor for (1) the existence of symmetric fit, (2) the existence of complementary fit, and (3) the maintenance of fit during smooth task accomplishment*. For this purpose, at least three different expressions were used: For example, for an item on symmetric fit the term "fitting" was used, for complementary fit the term "complement" or "add to" was used, and for maintenance of fit the term "aligned with" was used. Existing questionnaires for the assessment of group flow also use such wordings (e.g., Aust et al., 2023). In addition, each of these terms was supplemented with the adverb triad "exactly/perfectly/precisely" to emphasize the pureness of fit that is present during group flow. The adverb triad was selected on specific purpose: Each of the three adverbs fundamentally represents pureness of fit which is why these adverbs and related adjectives have already been used in individual flow questionnaires in the past (cf. the use of the adverb "exactly" by Bakker, 2008; cf. the use of the adjective "perfect" by S. A. Jackson & Roberts, 1992). Nevertheless,

[2] The term in brackets is replaced in the original questionnaire by the group task on which the participants are surveyed with regard to group flow.

the adverbs differ in nuances, calling for a consideration of all three. Although it would have been possible to assign only one of the three adverbs to each item and to disseminate the adverbs evenly on each factor, such a dissemination might have evoked a response bias and, thus, problems with statistical factor analysis: When different signal words are repeated between items, there is a tendency for respondents to answer the items of a signal word consistently (cf. DiStefano & Motl, 2006; Podsakoff et al., 2003). Accordingly, there is a risk that a factor analysis will group items by signal words rather than by actual content. In terms of the GFI, a factor analysis might group items as matching each other that contain the same adverb rather than by facets of the items' psychological functions.

Furthermore, *all items per lower level factor together should comprehensively represent the facets of the respective psychological function* of the factor. For example, the items of the factors on state of mind should include motivational, cognitive and affective content as facets of state of mind. Accordingly, a specific facet and synonyms of a facet were used in all items per factor. For instance, in the items on state of mind, the terms "ideas" (representing cognition), "mood" (representing affect), and “goals” (representing motivation) were used, each representing a different facet of state of mind (American Psychological Association, 2024a; Hackfort, 2019; Pels & Kleinert, 2023b).

The procedure described above was applied to both perspectives. Accordingly, on the one hand, there are items for the self-oriented perspective regarding how the respondent is positioned as an individual group member within the group action in relation to the others. On the other, there are items of the group-oriented perspective, asking how the group members act together as a whole.

This led to a sum of 43 items, with 21 self-oriented items and 22 group-oriented items. To check the comprehensibility and plausibility of the items, they were presented to two members of interactive

groups from the context of sports who were interviewed about the items. The majority of the items were found to be comprehensible and plausible, with minor language adjustments made to only a few.

This resulted in the complete initial version of the GFI consisting of 43 items (see Table 1, Appendix). An example item is: "I had the feeling that [item stem][3] my [pronoun for self-oriented perspective] ideas of what we have to do [cognitive facet of state of mind] exactly/perfectly/precisely [adverb triad to represent the pureness of fit] fit the ideas of the others in our group [primary fit]."

Response Scale

The Likert-type response scale is composed of the verbal anchors of the poles and the scaling. The verbal anchors of the poles consisted of the terms "never" and "all the time", as the relative duration of the group flow was to be measured. The scale ranged from 0 (= never) to 5 (= all the time). The value 0 was chosen as the low boundary, as it was meant to represent that group flow was actually not present the whole time from the respondents' perspective. An even number of levels (six) was used to avoid a tendency toward the midpoint (Chyung et al., 2017).

Stage 2: Psychometric Evaluation of the GFI

Study 1: Psychometric Evaluation of the Initial GFI-Version

Introduction

The aim of Study 1 was to psychometrically evaluate the initial version of the GFI in German language. The psychometric evaluation was twofold: First, the questionnaire was tested for its inherent properties including an analysis of the factor structure and item statistics. Second, both a first empirical

[3] The notes in brackets are not included in the original questionnaire, but are used here to illustrate the structure of the questionnaire.

criterion validation and a first empirical construct validation were conducted. For this reason, group flow was correlated with the criterion performance outcome and the construct motivational climate.

For the criterion of performance outcome, it was assumed that there is a positive relationship to group flow. This assumption is based on theoretical considerations and empirical findings. Theoretically, group flow should be associated with a positive performance outcome (e.g., win in a team sport game) as group flow involves a perfectly fitting handling of a group task (Pels & Kleinert, 2023b). From an empirical point of view, a group flow study (van den Hout et al., 2019) as well as studies on individual flow outcomes (Boudreau et al., 2020; Chirico et al., 2015; Harris et al., 2021; Perttula et al., 2017) consistently found out across contexts that flow is positively associated with performance outcomes.

Regarding the construct of motivational climate, it was assumed that there is a positive relationship between perceived contextual peer-created task orientation and group flow, and a negative relationship between perceived contextual peer-created ego orientation and group flow. The motivational climate can be described as the way significant others (e.g., group leaders, group mates) promote achievement goal orientations (Ames, 1992), with a task orientation representing an atmosphere in which all the individual members of a group aim at improving competence with respect to a task (mastery), and an ego orientation climate representing an atmosphere with all members of a group being in pursuit of being better than the others in a task (Duda & Balaguer, 2007). As for performance outcome, the assumptions for the relationship between motivational climate and group flow can also be grounded in theory and empirical evidence. Theoretically, the assumed positive relationship between contextual peer-created task orientation and group flow can be explained by the notion that group flow occurs when all group members try to contribute to a group action in the best possible way to solve the task in coordination with the others. Thus, task orientation climate can be

expected to promote group flow. This, in turn, cannot be expected for peer-created ego orientation, because ego orientation involves mutual outperforming of group members and, thus, it is likely that group flow does not arise because ego orientation particularly prevents primary fit. The empirical studies on individual flow and motivational climate all show a positive relationship between contextual task orientation and individual flow (Çağlar et al., 2017; González-Cutre et al., 2009; Moreno Murcia et al., 2008), supporting that this can also be assumed for group flow. However, regarding ego orientation, the findings are inconsistent, with some showing a negative relationship to individual flow (Çağlar et al., 2017), others a positive one (Moreno Murcia et al., 2008) or none at all (González-Cutre et al., 2009). However, despite this inconsistency, ego orientation is still expected to be negatively associated with group flow, because group flow – unlike individual flow – inevitably requires mutual cooperation.

Method

Sample

The sample consisted of 152 active indoor hockey players aged 17 to 49 years (M = 24.18, SD = 6.14; 50% female, 50% male, 0% diverse). Players were from a total of 26 teams taking part in German league competition at the medium (3rd Union League) to professional level (National League). Players had just completed a game of the regular league competition with their team. Per team, between three and 14 players were surveyed. Each of the teams was homogeneous in terms of sex.

Measures

Group Flow. Group flow was measured using the GFI with the characteristics as described in Stage 1 (for an overview of all items, see Table 1 (Appendix)).

Performance outcome. The performance outcome measured was the result of the game (loss, draw or win), after which the participants were asked about their group flow.

Motivational climate. Contextual motivational climate (i.e., domain-specific motivational climate in the respective hockey team in general) was measured using a validated German language version (Leineweber & Ohlert, 2010) of the Peer Motivational Climate in Youth Sport Questionnaire (Ntoumanis & Vazou, 2005) that can also be used for adults. The instruction of the questionnaire asked the participants to rate how the subsequent statements usually apply to the hockey team in general. Following the item stem "Most members of this group..." a total 21 items assessed the two factors peer-created task orientation (e.g., "… practice together when they can't do things well."; $\alpha = .85$) and peer-created ego orientation (e.g., "… are happy when they are better than others in the group."; $\alpha = .72$). The response scale ranged from 0 (= not true at all) to 3 (= very true).

Procedure

After the study was approved by the ethics committee of the German Sport University Cologne (approval no. 007/22), teams were contacted and informed about the possibility of voluntary study participation. The teams that agreed to participate were visited by an investigator on a match day. Approximately 10 minutes after the end of the match, the players of the team were given the complete questionnaire (collecting socio-demographic information, GFI (situational group flow), PMCYSQ (contextual peer-created motivational climate)). In addition, the investigator noted the teams' respective performance outcome of the match. Data were collected in 2022 and 2023.

Data analysis

All data collected (i.e., the information obtained from the questionnaire and the associated performance outcomes) were entered into IBM SPSS Statistics 28. The entered data were checked for plausibility to identify possible incorrect entries. The data set was then checked for missing values in the items. There were very few missing values with no more than three missings (< 2%) per item. Therefore,

the missing values were not treated with an imputation procedure; instead, if a participant had missing values for one or more items, the respective items of this participant were not considered for the further data evaluation, but the items with existing values were.

Given the aim of the study, the data were then, first, investigated regarding the inherent properties of the GFI (i.e., factor structure and item statistics). Based on the theoretical construction of the GFI, the assumed two-level *factor structure* was tested by confirmatory factor analyses (CFA) using IBM SPSS Amos 29. There was an initial CFA for the self-oriented perspective and an initial CFA for the group-oriented perspective involving all items as both perspectives were intended to be separate parts of the inventory. Before running the CFAs, the items of the self-oriented perspective and the group-oriented perspective were tested separately for multivariate outliers using Mahalanobis distance (Tabachnick & Fidell, 2014). Six outliers (cases) were identified for the items of the self-oriented perspective and five for the group-oriented perspective, each of which were excluded only for the respective CFA. Data were then imported into IBM SPSS Amos 29 using a covariance matrix. In order to meet the assumptions of the IGFT (Pels & Kleinert, 2022), the correlation between primary fit and secondary fit was taken into account on the second level in the CFAs. In addition, the correlations between the error terms of the paired psychological functions were considered on the first level (i.e., correlations of the error terms of primary fit–behavior with secondary fit–behaviour, primary fit–state of mind with secondary fit–state of mind, and primary fit–skills with secondary fit–skills). Both initial CFAs were followed by two further CFAs (i.e., one more CFA for each initial CFA): The goal of these two additional CFAs was to re-examine the factor structure upon exclusion of statistically non-fitting items, and to approach and test a reduced GFI version that has an equal number of items per first-level factor. Therefore, in this step, items of the full initial version of the GFI were excluded that had loadings below

the conservative minimum of λ = .60 (Bagozzi & Yi, 1988), deviated in a substantial negative direction from the factor loadings of the other items of the respective factor and/or – in case of a very strong similarity of the factor loadings – were judged to be least appropriate to the factor in terms of content. The *item statistics* involved a calculation of the descriptive statistics (*M* as an indicator of item difficulty; *SD*, *Min*, *Max* as indicators of item distribution), reliability (internal consistency as indicated by Cronbach's α and McDonald's ω), item discrimination (corrected item-factor correlation; r_{id}) and item homogeneity (mean inter-item correlation using Fisher's *Z*-transformation; *H*).

Second, the criterion and construct validity of the GFI was tested. For *criterion validity*, Spearman's rank correlations were calculated between performance (ordinal variable) and all factors of the GFI (interval variables). For construct validity, Pearson's product-moment correlations were calculated between contextual peer-created task orientation and ego orientation (interval variables) on the one hand and all factors of the GFI (interval variables) on the other hand. Based on the formulated directions of the hypotheses, the correlations were tested for significance (one-tailed).

Results

Analysis of Factor Structure

Full initial version of the GFI. The *fit indices* of the factor structure under investigation in the CFAs are shown in Table 2. For the two initial CFAs of the full initial version of the GFI, the fit indices were partly acceptable, partly not. The related *factor loadings* of these CFAs are depicted in Figure 3. There was one item with a loading of λ = .57 (item #7; factor primary fit–state of mind) which is lower than the conservative minimum of λ = .60 (Bagozzi & Yi, 1988) and, there were factors with rather strong deviations between their items' loadings (e.g., λ_{diff} = .17 for primary fit–state of mind of the self-oriented

perspective) which – taken together – statistically indicates a re-examination of the factor structure excluding inappropriate items (i.e., creation and investigation of a reduced initial version of the GFI).

Table 2

Fit Indices of the Confirmatory Factor Analyses of Study 1

<<<insert *Table 2* here>>>

Reduced initial version of the GFI. The reduced initial version of the GFI consisted of three items per factor for both perspectives (see Table 3 for a list of excluded items).

A re-examination of the CFAs – which were henceforth based on the reduced initial version of the GFI – yielded substantial, beneficial changes in the fit indices (see Table 2). The *factor loadings* of these CFAs are depicted in Figure 3. All factor loadings were above the conservative minimum of $\lambda = .60$ (Bagozzi & Yi, 1988). The loadings within the factors were more homogeneous. The *intercorrelations* of the factors are listed in Table 4. The intercorrelations of the factors were positive and high.

Table 4

Correlation Matrix of Group Flow, Motivational Climate and Performance Outcome (Study 1)

<<<insert *Table 3* here>>>

Analysis of Item Properties

Psychometric properties of the items of the reduced initial version are displayed in Table 4.

Table 5

Psychometric Item Properties of Study 1

<<<insert *Table 5* here>>>

Item difficulty and item dispersion. *Item difficulties* were moderate or moderate to high, as indicated by their mean values in the light of the methodically possible scale range from 0 to 5. The strongest differences in difficulty between items were found for the factors of state of mind. The *dispersion of scores within the items* was substantial. Each item had an empirical range of the scale of at least 1 to 5, many items even had an empirical range of 0 to 5. The standard deviation of the items was about one scale point each, with minor fluctuations around the value 1.

Item discrimination. The *item discrimination* varied between r_{id} = .50 and r_{id} = .76 for the first level factors and between r_{id} = .42 and r_{id} = .76 for the second level factors.

Item homogeneity and internal consistency. The *item homogeneity* was between *H* = .43 (*SD* < 0.01) and *H* = .67 (*SD* = 0.04) for the first level factors and between *H* = .37 (*SD* = 0.11) and *H* = .54 (*SD* = 0.12) for the second level factors. The *internal consistency* varied for both indicators Cronbach's Alpha and McDonald's Omega between α = .69 (ω = .69) and α = .86 (ω = .86) for the first level factors and between α = .84 (ω = .83) and α = .90 (ω = .90) for the second level factors.

Criterion Validation (Performance)

The association between group flow and performance outcome (as indicated by loss, draw or win) was positive. This was indicated by multiple highly significant, moderate (Cohen, 1992) Spearman rank correlations (ranging from *r* = .29, *p* < .001 to *r* = .46, *p* < .001) between the factors of group flow on the one hand and performance on the other hand (see Table 4). More than half of the participants has won with their team (56.6%), one third has lost (32.2%) and only a few has drawn (11.2%).

Construct Validation (Motivational Climate)

The association between group flow and the motivational climate of task orientation was positive. This was indicated by multiple (highly) significant Pearson correlations with small to large effects (Cohen, 1992) (ranging from $r = .20$, $p = .012$ to $r = .50$, $p < .001$) between the factors of group flow on the one hand and task orientation on the other hand (see Table 4). Exploratory comparisons (Hemmerich, 2017) showed that the correlations between the factors of the group-oriented perspective on group flow and task orientation were higher than the correlations between the factors of the self-oriented perspective and task orientation. Overall, only the correlation between secondary fit–skills (self-oriented perspective) was non-significant ($r = .14$, $p < .078$).

In contrast, there was no association between group flow and the motivational climate of ego orientation. All of the correlations between the factors of group flow on the one hand and ego orientation on the other hand were non-significant (see Table 4).

Discussion

Study 1 has provided substantial evidence for the appropriateness of the conception and for the validity of the initial version of the GFI. However, conceptually, it has also revealed some need for item adjustment; and in terms of validity, there is a need for an extension of the construct validity of the GFI.

Regarding the conception of the GFI, the ***factor structure*** could be confirmed after certain items had been removed. Taking into account established cut offs (cf. Hair et al., 2014; Tabachnick & Fidell, 2014), the *fit* indices were acceptable to satisfactory. The fact that some indices were no more than acceptable can be attributed to the correlation of error terms (which is plausible for theoretical reasons) and the complex two-level structure (Hair et al., 2014). The two-level structure would essentially require dynamic cut offs for fit indices (cf. recent criticism regarding the established fixed cut offs; McNeish &

Wolf, 2023) which do not yet exist reliably (McNeish & Manapat, 2023). As the factor structure could only be confirmed after an exclusion of certain items, these should not be included in a final version.

The excluded *items* were, with one exception, from the factor state of mind. On the one hand, their exclusion can be formally justified as an equal number of items per factor is intended. Statistically and in terms of content, however, their exclusion can also be justified as state of mind is generally a heterogeneous factor that includes the facets cognition, motivation and affect (American Psychological Association, 2024a). This heterogeneity basically represents potential for low and heterogeneous factor loadings. It was therefore necessary to select items that adequately represent the three facets as a whole, but at the same time have a comparable level of abstraction in terms of content.

The remaining 36 *items* show acceptable to satisfactory ***psychometric properties***. The items show sufficient *discrimination and dispersion* (Field, 2009). All items contribute appropriately to their respective factor and allow individuals with low, moderate, or high group flow duration to be discriminated. Overall, the *internal consistency* of all factors was good, which is particularly noteworthy in view of the low number of items (cf. Cortina, 1993; Cronbach, 1951) of the first-level factors (three items each). Only for the factor primary fit–state of mind the consistency was no more than just acceptable (cf. DeVellis & Thorpe, 2021; Field, 2009), probably because this factor, unlike the others, is multifaceted in nature with aspects of emotion, cognition, and motivation. The combination of *item homogeneity* and *item difficulty* was basically appropriate, but could still be improved. In principle, it is desirable for a questionnaire assessing group flow – in contrast to a performance test – to have items that have a low item homogeneity and a similar item difficulty within their respective factors (cf. Lienert, 1989). This combination of low item homogeneity and similar item difficulty means that the items of a factor capture different facets of the factor, but the items equally reflect the existing level of the

construct (i.e., similar difficulty). This is exactly what is necessary for group flow from a theoretical perspective (cf. Pels & Kleinert, 2023b), since it can be assumed that during group flow all facets of the factors (e.g., all facets of state of mind) are equally developed. Despite the strengths, minor modifications should be made to the remaining 36 items. This should be done in particular with a view to sufficiently reflect all facets of group flow as theoretically comprehensively as possible in order to achieve a low level of item homogeneity while optimally maintaining the existing level of difficulty.

In terms of the **empirical *validation*** of the initial version of the GFI, there is support for criterion and construct validity. *Criterion validity* was confirmed using the performance outcome as a criterion. Performance outcome was positively correlated with group flow with a moderate effect. In line with our hypothesis, this can be explained theoretically by the notion that group flow involves a perfectly fitting handling of a group task (Pels & Kleinert, 2023b) which facilitates positive, manifest performance outcomes (see also findings on individual flow; Harris et al., 2021). However, performance was measured at the group level and, thus, strictly speaking, multi-level analyses would have been necessary which was not possible due to the ordinal data level ("win", "draw" or " loss"). *Construct validity* was partially empirically demonstrated for the construct motivational climate. As expected, a positive correlation was found for task orientation and group flow with small to large effects. According to the derivation of our hypothesis, task orientation promotes group flow because it encourages all group members to try to contribute to a group action in the best possible way (see also findings on individual flow; Çağlar et al., 2017). Interestingly, with only one exception – the correlations between the factors of the group-oriented perspective on group flow and task orientation were higher than the correlations between the factors of the self-oriented perspective and task orientation. This can be explained by the fact that, although each member of a group is surrounded by the motivational climate in the same way

as all others, not every group member feels or is equally involved in the overall group action (e.g., there are substitutes in sports who actively participate in only part of a game). In general, the reliable, small to large effects found between task orientation and group flow are worth noting, since a contextual factor (domain-specific motivational climate in the indoor hockey teams in general) was correlated with a situational factor (group flow experienced during the game) which could result in lower correlations (cf. Vallerand, 1997). For ego orientation, contrary to our hypothesis, no negative correlation with group flow was found. This can be explained by the specifics of the sample and the activity studied: Indoor hockey players who had just played a match were surveyed, but those members of a team who had not actively participated in the match were not. Thus, it is conceivable that only those played who had asserted their position before within an ego-oriented climate in training and gave their all in the match to assert themselves competing with those who did not play. The consideration of such moderator variables is also indicated by studies on individual flow (Çağlar et al., 2017; González-Cutre et al., 2009).

Although Study 1 provides support for the GFI, in addition to the need for revision already mentioned, two methodological limitations and associated consequences must be considered. First, the sample size was rather low for CFAs with more than 20 items, although still meeting the recommended absolute minimum of 150 participants (Tabachnick & Fidell, 2014). Therefore, it is necessary to examine the revision of the GFI (final reduction of item number, variation of item content with a particular consideration of automation of occurrence and maintenance of fit during group flow (IGFT; Pels & Kleinert, 2023b)) on a larger sample. Second, a construct validation is necessary that takes into account correlates and characteristics of state of mind, behavior and skills, which according to the IGFT (Pels & Kleinert, 2022) are the central psychological functions of group action during group flow.

Study 2: Psychometric Evaluation of the Final GFI-version

Introduction

Based on the discussion of the results of Study 1, the aim of Study 2 was to establish a final version of the GFI. For this purpose, first, the initial version of the GFI was slightly revised according to the consequences derived in Study 1 with additional consideration of linguistic aspects that were noticed. Second, the revised version of the GFI was to be psychometrically evaluated on a large sample, while confirming criterion and extending construct validity.

For the revision of the GFI, the items were edited in several ways. First, items of the initial version of the GFI that had been excluded during Study 1 were still excluded. With 18 items included per perspective, there were three items per factor. Second, the content of one item per factor was slightly expanded in order to capture group flow even more comprehensively and to evoke the desired combination of low item homogeneity and similar item difficulty: In these items, the phrase "automatically" was added to reflect that the occurrence and maintenance of fit during group action is as if automated (i.e., fit appears and continues "automatically"). This is in line with the IGFT (Pels & Kleinert, 2022), which in this respect also corresponds to the basic conceptualization of individual flow according to Csikszentmihalyi (1975, 1985, 2000). Questionnaires for the assessment of individual flow also use such wordings (S. A. Jackson & Marsh, 1996). Third, it was ensured for secondary fit that of the three items per first-level factor, one item contains the term “group task”, one item the term “demands of the group task”, and one item the term “challenges of the group task”. This was intended to ensure a comprehensive consideration of the facets of the group task. Fourth, minor linguistic inconsistencies were corrected in some items. For example, the wording "the behavior of our group is [...] aligned with each other" was changed to "the behavior of the members of our group [...] is aligned with each other", since the behavior of a single group cannot be aligned with each other, whereas the behavior of *multiple*

group members can. Finally, the order of the items was intermixed. While in the initial version of the GFI the items of a factor were listed one after the other, now items were intermixed as this prevents an overestimation of the results of the CFA and the internal consistency (Lam et al., 2002; Podsakoff et al., 2003), and sharpens the respondents' attention which enhances the validity of the data gained. Despite this intermixing, however, care was still taken to strictly separate the items of the self-oriented and the group-oriented perspectives, which means that the GFI still consists of two parts. For an overview of the final items of Study 2 and for a comparison of the items of Study 1 and Study 2, see Table 1 (Appendix).

For the psychometric evaluation of the revised GFI, a large sample was acquired in order to empirically test the questionnaire with respect to its inherent properties and its validity. The investigation of inherent properties included an analysis of the factor structure and item statistics as in Study 1. For validation, performance outcome was again tested as a criterion (assumption of a positive relationship with group flow). In addition, perceived contextual intrateam communication and individual situational mood right after the group task under investigation (sport match) were used for construct validation. With regard to contextual intrateam communication, a positive relationship to group flow was assumed because positive intrateam communication facilitates the solution-oriented coordination of the group members among each other (e.g., Eccles & Tenenbaum, 2007). Accordingly, the existing theoretical approaches also considered intrateam communication to positively influence group flow (Duff et al., 2014; Pels & Kleinert, 2023b; Sawyer, 2006; van den Hout et al., 2018). This relationship has been already confirmed both by initial study results on group flow (Aust et al., 2023; Kaye, 2016) and studies on individual flow in group settings (Swann et al., 2012). For individual situational mood right after the group task, also a positive relationship to group flow was assumed. It can be expected that group flow positively influences mood because it is an extremely positive group experience. Initial study

results on group flow confirm this (Paez et al., 2015; Zumeta et al., 2016), general findings on positive group experiences from social psychology (e.g., Barsade & Knight, 2015) as well as findings from research on individual flow (e.g., Peifer et al., 2022) further support this assumption.

Method

Sample

The sample consisted of 486 active athletes aged 16 to 64 years (M = 23.23, SD = 7.58), with most participants (97.1%) under 40 years old (13.4% female, 84.8% male, 0.6% diverse, 0.6% with refusal of information). Athletes were from one of the following team sports: football (78.1 %), handball (13.2 %), volleyball (5.8 %), basketball (2.9 %). In total, players from 42 different teams were surveyed, taking part in the German league competition at the lowest amateur (District League) to the highest professional level (National League). Players had just completed a game with their team. Per team, between two and 20 players were surveyed. Each of the teams was homogeneous in terms of sex.

Measures

Group Flow. Group flow was measured using the final version of GFI with the characteristics as described above (for an overview of all items, see Table 1 (Appendix)).

Performance outcome. The performance outcome measured was the result of the game (loss, draw or win), after which the participants were asked about their group flow.

Intrateam communication. Contextual intrateam communication (i.e., domain-specific intrateam communication of the respective sport team in general) was measured using the Scale for Effective Communication in Team Sports (SECTS-2; Sullivan & Short, 2011). As this questionnaire has so far only been available in English, it was translated into German for the present study in collaboration with a native speaker. The instruction asks participants to indicate how the players on the team

normally communicate when they interact with each other, not only during games or practices. They are asked to relate their answers to the team as a whole. Following the item stem "When our team communicates, we..." a total of 15 items assessed the four factors acceptance (i.e., mutual acceptance; four items; e.g., "… communicate our feelings honestly."; α = .74, distinctiveness (i.e., distinctiveness from other social entities; three items; e.g., "… use slang that only team members would understand."; α = .62), positive conflict (i.e., constructive conflict dealing with disagreements; four items; e.g., "… get all problems out in the open"; α = .74) and negative conflict (i.e., personal confrontations expressing disagreement; four items; e.g., "… show that we lose our temper."; α = .80). The response scale ranged from 1 (= almost never) to 7 (= almost always). Internal consistency was acceptable and similar to the English-language original (cf. Sullivan & Short, 2011), indicating the appropriateness of the translation. In order to keep the length of the entire survey questionnaire battery economical and thus acceptable for the participants, only a quarter of all participants (*n* = 130) completed the SECTS-2 in addition to the GFI, the remaining part of the sample completed the questionnaire on mood (see below).

Mood. Situational mood right after the match was measured using German language "Stimmungs- und Befindensskalen" [*Mood and Well-being Scales*] (SBS; Hackfort & Schlattmann, 1995). The instruction asks the participants to indicate their momentary mood and mental states. There is a total of eight items, each of which consists of a triad of adjectives, representing a similar facet of mood and mental states. The eight items can be combined into four each to form a positive factor and a negative factor (positive mood: e.g., "happy/satisfied/cheerful", α = .71; negative mood: "angry/peevish/annoyed", α = .71). In order to keep the length of the entire survey questionnaire battery economical and thus acceptable for the participants, a total of just three quarters of all

744 participants (*n* = 356) completed the SBS in addition to the GFI, the remaining part of the sample
745 completed the questionnaire on intrateam communication (see above).

746 *Procedure*

747 After the study was approved by the ethics committee of the German Sport University Cologne
748 (approval no. 036/23), teams were contacted and informed about the possibility of voluntary study
749 participation. The teams that agreed to participate were visited by an investigator on a match day.
750 Approximately 10 minutes after the end of the match, the players were given the complete
751 questionnaire (collecting socio-demographic information, GFI (situational group flow), SECTS-2
752 (contextual intrateam communication), SBS (situational mood). In addition, the investigator noted the
753 teams' respective performance outcome of the match. Data were collected in 2023 and 2024.

754 *Data analysis*

755 In preparation for the analyses, the data were treated as in Study 1. There were no more than
756 eleven missing values (< 2.5%) per item. Therefore, the missings were not treated with an imputation
757 procedure. Seventeen multivariate outliers were identified for the items of the self-oriented perspective
758 and 24 for the group-oriented perspective, each of which were excluded only for the respective CFA.

759 Also the analytical procedure for the evaluation of the GFI was the same as in Study 1. There
760 was only one notable difference: Because the initial CFA for the self-oriented perspective tended to
761 show insufficient loading of one item below the conservative minimum of λ = .60 (Bagozzi & Yi, 1988),
762 the CFA for the self-oriented perspective was repeated with this item excluded so that the results could
763 be compared with and without this item.

764 ***Results***

765 **Analysis of Factor Structure**

The fit indices of the factor structure under investigation in the CFAs are shown in Table 6. The fit indices were good to excellent. The related *factor loadings* of these CFAs are depicted in Figure 4. There was one item with a loading of λ = .58 (item #14; factor primary fit–state of mind for the self-oriented perspective) which is lower than the conservative minimum of λ = .60 (Bagozzi & Yi, 1988). Another CFA for the self-oriented perspective, excluding this item, showed almost no change in the fit indices, only a slight increase in the CMIN/df parameter.

Table 6

Fit Indices of the Confirmatory Factor Analyses of Study 2

<<<insert *Table 6* here>>>

Figure 4

Factor Loadings of Confirmatory Factor Analyses (Study 2)

<<<insert *Figure 4* here>>>

The *intercorrelations* of the factors were positive and high (see Table 7).

Table 7

Correlation Matrix of Group Flow, Intrateam Communication, Individual Mood and Performance Outcome (Study 2)

<<<insert *Table 7* here>>>

788 **Analysis of Item Properties**

789 Psychometric properties of the items of the revised version of the GFI are displayed in Table 8.

790

791 **Table 8**

792 *Psychometric Item Properties of Study 2*

793 <<<insert *Table 8* here>>>

794

795 ***Item difficulty and item dispersion.*** *Item difficulties* were moderate or moderate to high, as
796 indicated by their mean values in the light of the methodically possible scale range from 0 to 5. In
797 general, the item difficulties within factors were relatively similar. The strongest differences in difficulty
798 between items were found within the factors of state of mind. The *dispersion of scores within the items*
799 was substantial. Each item had an empirical range of the scale of at least 1 to 5, many items even had an
800 empirical range of 0 to 5. The standard deviation of the items was about one scale point each, with
801 minor fluctuations around the value 1.

802 ***Item discrimination.*** The *item discrimination* varied between r_{id} = .44 and r_{id} = .63 for the first
803 level factors and between r_{id} = .54 and r_{id} = .72 for the second level factors.

804 ***Item homogeneity and internal consistency.*** The *item homogeneity* (as indicated by mean inter-
805 item correlations (Bühner, 2021) based on Fishers' Z-transformation) was between *H* = .40 (*SD* = 0.05)
806 and *H* = .54 (*SD* = 0.04) for the first level factors and between *H* = .43 (*SD* = 0.07) and *H* = .52 (*SD* = 0.05)
807 for the second level factors. The *internal consistency* varied for both indicators Cronbach's Alpha and
808 McDonald's Omega between α = .67 (ω = .67) and α = .78 (ω = .78) for the first level factors and
809 between α = .87 (ω = .87) and α = .91 (ω = .91) for the second level factors.

Criterion Validation (Performance)

The association between group flow and performance outcome was positive. This was indicated by multiple highly significant, small (Cohen, 1992) Spearman rank correlations (ranging from $r = .11$, $p = .007$ to $r = .24$, $p < .001$; see Table 7) between the factors of group flow on the one hand and performance on the other hand (see Table 7). Almost three quarters of the participants have won with their team (73.7%), about one quarter has lost (23.2%) and only a few have drawn (3.1%).

Construct Validation

Intrateam communication. The association between group flow and intrateam communication differed depending on the factor of intrateam communication considered (see Table 7). For the factors acceptance and positive conflict of intrateam communication there were highly significant, moderate associations with group flow (ranging from $r = .32$, $p < .001$ to $r = .48$, $p < .001$ for acceptance and from $r = .39$, $p < .001$ to $r = .52$, $p < .001$ for positive conflict). For the factors distinctiveness and negative conflict there were predominantly no significant correlations with group flow, there were only a few positive correlations between distinctiveness and group flow and negative correlations between positive conflict and group flow (ranging from $r = -.01$, $p = .447$ to $r = .18$, $p = .023$ for acceptance and from $r = -.15$, $p = .046$ to $r = .02$, $p = .420$ for positive conflict).

Mood. There was an association between group flow and the construct of mood (see Table 7). This was indicated by multiple highly significant, positive Pearson correlations with moderate effects (Cohen, 1992) between the factors of group flow on the one hand, and positive mood on the other hand (ranging from $r = .29$, $p < .001$ to $r = .41$, $p < .001$). Analogously, there were multiple (highly) significant, negative Pearson correlations with small effects (Cohen, 1992) between the factors of group flow on the one hand, and negative mood on the other hand (ranging from $r = -.10$, $p = .040$ to $r = .18$, $p < .001$).

832 ***Discussion***

833 The overall aim of Study 2 was to establish a final GFI version. After having implemented the
834 necessary revisions (reduction of the number of items to three per first-level factor, slight changes in the
835 item content based on theoretical and linguistic considerations, mixing of the item order), the GFI
836 conception was confirmed and extended on a large sample. This is reflected in the improved, excellent
837 factor structure fit, partly improved and still acceptable to satisfactory psychometric item statistics, and
838 empirically repeatedly confirmed criterion validity as well as extended construct validity.

839 The ***factor structure*** was confirmed also after the slight revision of the questionnaire. The *fit*
840 parameters are excellent, and (partly substantially) better than in Study 1. This concerns both absolute
841 (RMSEA, SRMR) and incremental parameters (TLI, CFI) (Hair et al., 2014). The parameters are particularly
842 remarkable because they could be achieved despite a mixing of the content of the item order (Podsakoff
843 et al., 2003). Reasons for this improvement are presumably the changed item contents which represent
844 the different facets of group flow more precisely, and the larger sample size (Hair et al., 2014).

845 It must be noted that one item had a relatively low factor loading. Item #14 ("…that my mood
846 exactly/perfectly/precisely matches the mood of the others in our group"; factor state of mind–primary
847 fit of the self-oriented perspective) had a loading of only $\lambda = .58$. With a liberal view (Hair et al., 2014),
848 the value is still generally acceptable. The low loading of this item can be explained by the fact that it is a
849 component of the conceptually heterogeneous factor state of mind (cf. the concept of state of mind;
850 American Psychological Association, 2024a; cf. IGFT; Pels & Kleinert, 2023b). Since the questionnaire
851 structure and the remaining factor loadings did not change (and if at all, tended to worsen) after an
852 exploratory exclusion of this item, the item should remain in the GFI in order to maintain comprehensive

content validity. Nevertheless, the item should be monitored critically in future applications of the GFI; it might make sense to include an additional, alternative item in a further application of the questionnaire.

Regarding the ***psychometric properties*** of *discrimination*, *internal consistency*, *homogeneity* and *difficulty*, the items are acceptable to satisfactory. In the light of the revisions made to the questionnaire, item homogeneity and item difficulty require special consideration. Compared to the initial version of the GFI (Study 1), the slight reduction in item homogeneity was achieved while it was also achieved that the similarity of item difficulty within factors remains at least the same: item homogeneity has decreased in almost all factors (in some cases substantially) and the range of item difficulties within the factors is even smaller. This reflects the desired circumstance that the GFI is supposed to assess different facets of group flow in its factors, but that the items – at the same time – assess a coherent quantitative level of the facets of group flow. In other words, after minor linguistic revisions were made and, even more important, after the phrase "as if by itself" was added to one item per first level factor in the revised version to reflect the IGFT statement (Pels & Kleinert, 2023b) that the occurrence and maintenance of fit during group action is as if automated (e.g., "… that the behavior of our group is as if by itself exactly/perfectly/precisely aligned to our group task"), homogeneity decreased slightly but item difficulty remained similar or became even more similar. Thus, in the revised (and final) version of the GFI, all facets of group flow are represented, which is evident in a consideration of the content of the items (content validity), but also in a statistical consideration of the item homogeneity, and yet the item difficulties are similar per factor.

Regarding ***empirical validation***, the results for *criterion validity* were consistent with the hypothesis. As in Study 1, there was a positive correlation between performance outcome and group flow. The fact that the correlations found were smaller in effect than in Study 1 can be explained by the

variance of one of the two variables (performance outcome) being smaller in Study 2 than in Study 1 which limits the statistical potential for detecting a stronger relationship (Winship & Mare, 1992).

In terms of *construct validation*, the relationship between group flow and intrateam communication largely conformed to the hypothesis and to existing findings (Aust et al., 2023; Kaye, 2016). Acceptance and positive conflict – as two of four factors of intrateam communication – were positively related to group flow, which can be explained by the fact that groups can better cope with a task together if the group members inform each other about their respective situation in a mutually accepted manner and communicate in a solution-oriented way (for overviews, see Eckardt & Tamminen, 2023; Lüdemann & Kleinert, 2023). For the factor negative conflict, there were predominantly no associations with group flow, and if there were, they were negative. Thus, negative communication within a team does not have to be destructive in any case for group flow, but it can be in some cases (e.g., if the negative communication evokes interpersonal conflicts). This is consistent with studies showing that negative conflict communication is only partly associated with (dys-)functional states of groups or its members (for an overview, see Lüdemann & Kleinert, 2023). For the factor distinctiveness, there are predominantly no associations with group flow, and if there are, then positive associations. This can be explained by the fact that distinctiveness includes aspects that have little to do with the immediate group task accomplishment (e.g., use of nicknames) but only with outgroup distinctiveness. The two significant positive associations (small effects) may be due to a general tendency in responses (Podsakoff et al., 2012) or due to an alpha error artifact in multiple correlation analyses.

In accordance with the hypothesis, there was a positive relationship between group flow and positive aspects of mood (e.g., satisfaction), and a negative relationship between group flow and negative aspects (e.g., anger) of mood (each measured as momentary mood after the activity). In

general, this can be explained by the fact that group flow can be regarded as a positive group experience that evokes beneficial states (Zumeta et al., 2016) – not only during the activity itself, but also afterwards. Positive mood can be expected after a group flow activity, arising from a combination of (a) the initial positive experience of group flow during the activity, which persists (albeit weaker) after the activity, and (b) new positive experiences that emerge after the activity (e.g., the emotion of pride) when group members reflect on their shared experience and activity (Lavoie et al., 2024). Interestingly, the positive relationship between group flow and positive aspects of mood was stronger than the negative relationship found for negative aspects of mood. This can be explained from a theoretical and a methodological perspective. In theoretical terms, the presence of positive mood does not necessarily mean the exact contrary absence of facets of negative mood (Watson & Tellegen, 1985). For group flow, this means that group flow as a positive construct is associated with positive experience content (e.g., positive mood); at the same time, this does not necessarily mean that the absence of group flow is associated with negative experience content, since the absence of group flow per se does not have to be a state with negative experience content (e.g., aversive, negative mood). In methodological terms, positive constructs in questionnaire data are more strongly related to other positive constructs than to other negative constructs as respondents strive for consistency in their answers (Podsakoff et al., 2003).

General Discussion

The purpose of this work was to elaborate a questionnaire assessing group flow in research settings. The systematically constructed, theory-based Group Flow Inventory (GFI) can fulfill this purpose: In two studies, the appropriateness of the items and factor structure was psychometrically proven, and reliability and validity of the GFI were demonstrated. The range of values and the psychometric item statistics show that group flow – although it is a rare experience (Łucznik & May,

2021) – can be measured by the GFI. Thus, it is necessary to discuss the possible applications and limitations of the GFI as well as the implications and benefits of this work for (group) flow research.

General Results

Overall, the concept of the GFI was confirmed: One half of the questionnaire assesses group flow from the self-oriented perspective, the other from the group-oriented perspective of the individual surveyed. Both perspectives take into account primary and secondary fit of group flow at a higher factor level and first-level factors of group flow at the lower level, each representing a function of group action. This factor structure basically confirms the assumption of the IGFT (Pels & Kleinert, 2022) that primary and secondary fit of group flow each have the components of behavior, state of mind and skills.

However, the high correlations between the factors should be noted critically. From a psychometric perspective, this raises the question of whether there is an over-factorization (i.e., there are several factors where fewer would also be appropriate for measurement), which, in turn, from a research perspective raises the question of what added value a separate assessment of the factors would have in future studies. At first glance, the high intercorrelations could indicate a missing distinctiveness of the elements of the IGFT. However, the cause of the intercorrelations is probably less a missing distinctiveness of the elements (each of which is clearly conceptualized in the IGFT and in the GFI), but rather the fact that group flow involves all system functions of an acting group system being in harmony when the group is in group flow (Pels & Kleinert, 2023b). Therefore, the reason for this could be the phenomenon of group flow itself rather than a problem of measurement. Despite the high intercorrelation of the factors, it is recommended that the subdivision into the various factors is maintained, as this allows specific processes to be identified: For example, an analysis of the specific

dynamics of group flow, which has yet to be conducted, could investigate whether group flow spreads in its development from an initial fit in state of mind to a perfect fit that also includes behavior and skills.

Furthermore, the studies have provided various evidence for the construct and criterion validity of the GFI. The results provided plausible correlations of group flow with domain-specific motivational climate and intrateam communication, as well as with situational mood and performance.

Application Possibilities in Research Settings

The existing form of the GFI offers various application possibilities in research settings. First, due to its compact length, the questionnaire can be used simply and with few resources, either paper-pencil or online based. Second, the items are formulated in a context-unspecific way. This means that the GFI can be used in different groups and domains (e.g., work, music, sport) simply by adapting the instruction. Third, the GFI distinguishes between a self-oriented (me in our team) and a group-oriented (we as a team) perspective, which can be applied separately. Depending on the purpose, future studies can flexibly consider both or only one of the perspectives (cf. research on group cohesion; Carron et al., 2002). For example, studies that examine group outcomes (e.g., collective efficacy; Salanova et al., 2014) of group flow could primarily draw on the group-oriented perspective, and studies that examine individual outcomes (e.g., well-being; Zumeta et al., 2016) could primarily draw on the self-oriented perspective. Fourth, the GFI contains first (i.e., the primary and secondary fit of behavior, state of mind and skills, respectively) and second level (i.e., primary fit as a whole, secondary fit as a whole) factors, which can also be evaluated separately as required. While the evaluation of the second-level factors is more reliable due to the higher number of items, the evaluation of the first-level factors allows for taking a closer look at specific facets of group flow (behavior, state of mind, skills separately). Such a separation into higher and lower level factors is also recommended in other areas of psychological

research (cf. coping research; Schwarzer & Schwarzer, 1996). In summary, the wide range of possible applications shows that the GFI – in addition to the major goodness criteria of objectivity, reliability and validity – also meets the minor goodness criteria of practicality (i.e., whether the questionnaire is easily applicable and economically feasible), utility (i.e., whether the questionnaire provides valuable information) and fairness (i.e., whether the questionnaire is impartial to all respondents regardless of their background or group membership) (Coaley, 2014). Overall, this offers the opportunity to advance group flow research – which to date has had little clear focus (Pels & Kleinert, 2023a; Pels et al., 2018) – including the comparison of different theoretical approaches (Pels & Kleinert, 2023b; van den Hout et al., 2018), for each of which a questionnaire exists (i.e., GFI; TFM, van den Hout et al., 2019).

Limitations

Despite these versatile application possibilities, there are also limitations of the GFI. These can be found in the *status of the empirical testing of the GFI* to date, which requires further research. First, the GFI has so far only been studied in the context of sport, which – strictly speaking – requires an empirical investigation in other contexts (e.g., work, music) even though the items are context-unspecific and the instruction can be adapted flexibly. Second, it would be helpful to expand criterion and construct validity in two regards: (a) Methodologically, it would be appropriate to use at least prospective designs when there are assumptions about causal, sequential links between variables (e.g., group flow on performance or motivational climate on group flow). In the two validation studies on the GFI, a cross-sectional design had to be used for practical reasons (e.g., prohibited measurement of group flow possible during a league game). The cross-sectional measurement of multiple variables could have caused a bias because the respondents might have striven for consistency in their answers across constructs. However, such a bias could be ruled out at least for some constructs, as otherwise there

would have had to be a positive relation between, for example, distinctiveness (as one factor of intrateam communication) and group flow. In addition, the cross-sectional relationships examined are each based on a theoretical foundation that at least allows an approximation to causalities (Savitz & Wellenius, 2023). Moreover, the question arises as to whether and to what extent outcomes of group flow can be reasonably investigated when group flow is measured during the activity (and the outcomes afterwards), since the survey during the activity could interrupt (group) flow (Peifer & Engeser, 2021b). (b) On the construct level, it would be reasonable to relate further constructs to group, for example by correlating the GFI with an established questionnaire that measures individual flow (e.g., Flow State Scale; S. A. Jackson & Marsh, 1996). Based on the theoretical considerations of the IGFT (Pels & Kleinert, 2023b), one would expect small to moderate positive correlations between group flow and individual flow, since the presence of group flow does not necessarily imply the presence of individual flow (and vice versa), but the harmonious interaction in a group during group flow can facilitate individual flow. Moderate or even high correlations would also not be expected because group flow has special emergent qualities that differ from individual flow (Pels & Kleinert, 2023b). Third, a cross-correlation of the GFI with an instrument of another measurement approach (e.g., movement badges as objective behavioral indicators; Gloor et al., 2013) would be desirable. This would be helpful to examine the extent to which the GFI and other measurement approaches can meaningfully complement or replace each other and, in turn, expand the minor goodness criterion of utility (Coaley, 2014) of the GFI.

Furthermore, limitations can be found in the *chosen construction of the GFI*. In principle, every questionnaire construction has both advantages and disadvantages, and the decision for or against a certain construction approach automatically entails limitations. The construction limitations of the GFI should therefore not be understood as substantial, content-related shortcomings, but rather as aspects

of how future developments of self-report instruments for group flow can complement the GFI. A first aspect worth considering concerns the cognitive complexity of the questionnaire. Due to the precise consideration of the IGFT (Pels & Kleinert, 2023b) and the targeted use in research settings, the items are cognitively complex, although implicit processes are not completely disregarded, but included by the instruction ("respond intuitively", "without extensive thinking") and the item stem ("I had the impression"). Future further developments to complement the GFI could attempt to make the item content more feeling-based (e.g., with specific adjectives). Such a further development of item formulation would also facilitate the use of a group flow questionnaire in practical settings.

Benefits and Implications for Future Work on (Group) Flow

The aim of the present work was to elaborate a questionnaire that allows for assessing group flow particularly in research settings. However, the steps taken have also yielded various benefits and implications for further work on (group) flow research. First, the two validation studies have slightly *expanded the relatively limited findings on group flow* to date and, thereby, lend further support for the IGFT (Pels & Kleinert, 2023b). In more detail, the studies provide initial indications – to be interpreted with caution due to the cross-sectional design – that a mastery-oriented motivational climate and positive intrateam communication could promote group flow. Moreover, both studies provide initial indications – also to be interpreted with caution – that group flow could lead to a positive performance outcome at the group level; the second study also indicates that group flow could lead to or is at least associated with positive mood among the individual group members involved. However, longitudinal and (field) experimental studies are necessary to test the causality of the relationships.

Second, *new research questions have arisen* for the investigation of the phenomenon group flow. Future studies should, for example, investigate the dynamics of group flow. This includes

investigating whether it is more favorable for the outcomes to have one long phase of group flow than several shorter phases with the same overall length as the long phase (cf. Peifer & Engeser, 2021b).

Third, there remain *questions and work concerning the assessment of group flow*. Regarding self-report assessment of group flow, a potential memory bias should be investigated since it can be assumed that the memory of a group flow experience becomes less valid the longer the experience lies in the past, as the experience can be retrieved less accurately (Podsakoff et al., 2012). Specifically, it should be examined at what time interval from the group task the questionnaire should be completed so that a bias can be avoided or its extent can be estimated. In the two studies so far, the GFI was completed approximately 10 minutes after the group task, but it should be checked in the future whether it would be better to apply the questionnaire during the group task itself (if an interruption is possible) or whether it is even possible to apply it after a somewhat greater time interval from the group task. Another aspect worth considering concerns the response scale. While from a theoretical perspective (cf. IGFT; Pels & Kleinert, 2023b) the developed response scale (assessment of the relative duration of the item content) should – to date – preferably be retained, it would also be interesting to investigate whether there are different perceptible intensities of fit underlying group flow from the perspective of the respondents. Up to now, there have been controversial discussions on the perceptibility of intensity in research on individual flow (cf. Peifer & Engeser, 2021b). Finally, the extent to which group flow questionnaires (such as the GFI) can be used in practice should also be investigated. This requires studies on the practical relevance of questionnaire values (e.g., norming) to indicate when a group or group leaders should introduce interventions. This also requires evidence as to whether a questionnaire is sensitive enough to detect changes caused by interventions. For the practicability, the length of the questionnaire should also be checked (e.g., by validly reducing it to marker items).

Fourth, the questionnaire developed and the underlying IGFT (Pels & Kleinert, 2023b) can also be *stimulating for research on individual flow* in two respects. In theoretical terms, constructs (state of mind, behaviour, skills) were identified, named and linked during the development of the IGFT (Pels & Kleinert, 2023b) that could also be relevant for further development of the individual flow concept and, thereby, represent a solution to the call (Swann et al., 2018) to create an explanatory theory of individual flow; from a methodological point of view, a questionnaire was created that can capture these constructs and can also be adapted for individual flow through its instructions and item descriptions (e.g., adaptation to individual task). For the questionnaires assessing individual flow, it is recommended that the relative duration and not just the intensity should also be taken into account in response scales: Our considerations regarding the response scale can overcome limitations that have existed so far as the assessment of individual flow duration has not been part of the existing questionnaires and has left research gaps (Abuhamdeh, 2020; Peifer & Engeser, 2021a).

Appendix

Table 1

Items of the GFI

<<<insert *Table 1* here>>>

References

Abuhamdeh, S. (2020). Investigating the "flow" experience: Key conceptual and operational issues. *Frontiers in Psychology*, *11*, 158. https://doi.org/10.3389/fpsyg.2020.00158

American Psychological Association. (2024a). Mind. In American Psychological Association (Ed.), *APA Dictionary of Psychology.* American Psychological Association. https://dictionary.apa.org/mind

American Psychological Association. (2024b). preconscious (Pcs). In American Psychological Association (Ed.), *APA Dictionary of Psychology.* American Psychological Association. https://dictionary.apa.org/preconscious

Ames, C. A. (1992). Achievement goals, motivational climate, and motivational processes. In G. C. Roberts (Ed.), *Motivation in Sport and Exercise* (pp. 161–176). Human Kinetics.

Aust, F., Heinemann, L., Holtz, M., Hagemann, V., & Peifer, C. (2023). Team flow among firefighters: associations with collective orientation, teamwork-related stressors, and resources. *International Journal of Applied Positive Psychology.* Advance online publication. https://doi.org/10.1007/s41042-023-00093-7

Bagozzi, R., & Yi, Y. (1988). On the evaluation of structural equation models. *Journal of the Acadamy of Marketing Science*(16), 74–94.

Bakker, A. B. (2008). The work-related flow inventory: Construction and initial validation of the WOLF. *Journal of Vocational Behavior*, *72*(3), 400–414. https://doi.org/10.1016/j.jvb.2007.11.007

Barsade, S. G., & Knight, A. P. (2015). Group affect. *Annual Review of Organizational Psychology and Organizational Behavior*, *2*(1), 21–46. https://doi.org/10.1146/annurev-orgpsych-032414-111316

1088 Biocca, F., & Harms, C. (2011). *Guide to the Networked Minds Social Presence Inventory (Version 1.2): Measures of co-presence, social presence, subjective symmetry, and intersubjective symmetry*. http://cogprints.org/6743/

1091 Boudreau, P., Mackenzie, S. H., & Hodge, K. (2020). Flow states in adventure recreation: A systematic review and thematic synthesis. *Psychology of Sport and Exercise*, *46*, 101611. https://doi.org/10.1016/j.psychsport.2019.101611

1094 Bühner, M. (2021). *Einführung in die Test- und Fragebogenkonstruktion* (4th ed.). Pearson.

1095 Çağlar, E., Aşçi, F. H., & Uygurtaş, M. (2017). Roles of perceived motivational climates created by coach, peer, and parent on the dispositional flow in the young athletes. *Perceptual and Motor Skills*, *124*(2), 462–476. https://doi.org/10.1177/0031512516689404

1098 Carron, A. V., Brawley, L. R., & Widmeyer, N. W. (2002). *The Group Environment Questionnaire: Test Manual*. Fitness Information Technology.

1100 Carron, A. V., Widmeyer, W. N., & Brawley, L. R. (1985). The development of an instrument to assess cohesion in sport teams: The Group Environment Questionnaire. *Journal of Sport Psychology*, *7*, 244–266. https://doi.org/10.1177/104649640003100105

1103 Chirico, A., Serino, S., Cipresso, P., Gaggioli, A., & Riva, G. (2015). When music "flows". State and trait in musical performance, composition and listening: A systematic review. *Frontiers in Psychology*, *6*, 906. https://doi.org/10.3389/fpsyg.2015.00906

1106 Chyung, S. Y. Y., Roberts, K., Swanson, I., & Hankinson, A. (2017). Evidence-based survey design: The use of a midpoint on the Likert scale. *Performance Improvement*, *56*(10), 15–23. https://doi.org/10.1002/pfi.21727

1109 Coaley, K. (2014). *An introduction to psychological assessment & psychometrics* (2nd edition). Sage.

1110 Cohen, J. (1992). A power primer. *Psychological Bulletin*, *112*, 155–159. https://doi.org/10.1037/0033-
1111 2909.112.1.155
1112 Cortina, J. M. (1993). What is coefficient alpha? An examination of theory and applications. *Journal of*
1113 *Applied Psychology*, *78*(1), 98–104. https://doi.org/10.1037/0021-9010.78.1.98
1114 Cranach, M., Ochsmann, G., & Valach, L. (1986). The group as a self-active system: Outline of a theory of
1115 group action. *European Journal of Social Psychology*, *16*, 193–229.
1116 Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika*, *16*(3), 297–
1117 334.
1118 Csikszentmihalyi, M. (1975). *Beyond boredom and anxiety*. Jossey-Bass.
1119 Csikszentmihalyi, M. (1985). Emergent motivation and the evolution of the self. In D. A. Kleiber & M. L.
1120 Maehr (Eds.), *Advances in motivation and achievement* (pp. 93–119). JAI Press.
1121 Csikszentmihalyi, M. (1990). *Flow - The Psychology of optimal experience*. Harper.
1122 Csikszentmihalyi, M. (2000). The contribution of flow to Positive Psychology. In M. E. P. Seligman & J.
1123 Gillham (Eds.), *The science of optimism and hope* (pp. 387–395). Templeton Foundation Press.
1124 DeVellis, R. F., & Thorpe, C. T. (2021). *Scale development: Theory and applications*. Sage.
1125 DiStefano, C., & Motl, R. W. (2006). Further investigating method effects associated with negatively
1126 worded items on self-report surveys. *Structural Equation Modeling: A Multidisciplinary Journal*,
1127 *13*(3), 440–464. https://doi.org/10.1207/s15328007sem1303_6
1128 Duda, J. L., & Balaguer, I. (2007). Coach-created motivational climate. In S. Jowett & D. Lavallee (Eds.),
1129 *Social psychology in sport* (pp. 117–130). Human Kinetics.
1130 Duff, S. N., Giudice, K. D., Johnston, M., Flint, J., & Kudrick, B. (2014). A systems approach to diagnosing
1131 and measuring teamwork in complex sociotechnical organizations. *Proceedings of the Human*

Factors and Ergonomics Society Annual Meeting, *58*(1), 573–577. https://doi.org/10.1177/1541931214581121

Eccles, D. W., & Tenenbaum, G. (2007). A social cognitive perspective on team funtioning in sport. In G. Tenenbaum & R. C. Eklund (Eds.), *Handbook of Sport Psychology* (3rd, pp. 264–283). Wiley & Sons.

Eckardt, V. C., & Tamminen, K. A. (2023). A scoping review on interpersonal coping in sports. *International Review of Sport and Exercise Psychology*, 1–27. https://doi.org/10.1080/1750984X.2023.2251137

Elbe, A.-M., Strahler, K., Krustrup, P., Wikman, J., & Stelter, R. (2010). Experiencing flow in different types of physical activity intervention programs: Three randomized studies. *Scandinavian Journal of Medicine & Science in Sports*, *20*(1), 111–117. https://doi.org/10.1111/j.1600-0838.2010.01112.x

Feng, X., Han, P., & Long, T. (2024). Teams' stressors and flow experience: An energy-based perspective and the role of team mindfulness. *Journal of Business Research*, *183*, 114860. https://doi.org/10.1016/j.jbusres.2024.114860

Field, A. P. (2009). *Discovering statistics using SPSS* (3. ed.). Sage.

Gloor, P. A., Oster, D., & Fischbach, K. (2013). JazzFlow - Analyzing "group flow" among jazz musicians through "honest signals". *KI - Künstliche Intelligenz*, *27*(1), 37–43. https://doi.org/10.1007/s13218-012-0230-3

González-Cutre, D., Sicilia, Á., Moreno, J. A., & Fernández-Balboa, J. M. (2009). Dispositional flow in physical education: Relationships with motivational climate, social goals, and perceived

competence. *Journal of Teaching in Physical Education*, *28*(4), 422–440. https://doi.org/10.1123/jtpe.28.4.422

Hackert, B., Lumma, A.-L., Raettig, T., Berger, B., & Weger, U. (2022). Towards a re-conceptualization of flow in social contexts. *Journal for the Theory of Social Behaviour*, Article jtsb.12362. Advance online publication. https://doi.org/10.1111/jtsb.12362

Hackfort, D. (2019). Psyche. In D. Hackfort, R. Schinke, & B. Strauss (Eds.), *Dictionary of sport psychology: Sport, exercise, and performing arts* (p. 228). Elsevier.

Hackfort, D., & Schlattmann, A. (1995). *Die Stimmungs- und Befindensskalen (SBS)*. *Arbeitsinformation Sportwissenschaft: Vol. 7*. Institut für Sportwissenschaft und Sport.

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2014). *Multivariate data analysis* (Seventh edition, Pearson new international edition). Pearson Education Limited.

Harris, D. J., Allen, K. L., Vine, S. J., & Wilson, M. R. (2021). A systematic review and meta-analysis of the relationship between flow states and performance. *International Review of Sport and Exercise Psychology*, 1–29. https://doi.org/10.1080/1750984X.2021.1929402

Hemmerich, W. (2017). *StatistikGuru* [Computer software]. Hemmerich, W. https://statistikguru.de/rechner/korrelationen-vergleichen.html

Jackson, S. A., & Roberts, G. (1992). Positive Performance States of Athletes - Toward a Conceptual Understanding of peak performance. *The Sport Psychologist*(6), 156–171.

Jackson, S. A., & Marsh, H. W. (1996). Development and validation of a scale to measure optimal experience: The Flow State Scale. *Journal of Sport & Exercise Psychology*, *18*(1), 17–35. https://doi.org/10.1123/jsep.18.1.17

Kaye, L. K. (2016). Exploring flow experiences in cooperative digital gaming contexts. *Computers in Human Behavior*, *55*, 286–291. https://doi.org/10.1016/j.chb.2015.09.023

Lam, T. C. M., Green, K. E., & Bordignon, C. (2002). Effects of item grouping and position of the "Don't know" option on questionnaire response. *Field Methods*, *14*(4), 418–432. https://doi.org/10.1177/152582202237730

Lampitt Adey, K. (2018). Understanding why women knit: Finding creativity and "flow". *TEXTILE*, *16*(1), 84–97. https://doi.org/10.1080/14759756.2017.1362748

Lavoie, R., Baer, M., & Rouse, E. D. (2024). Group flow: A theory of group member interactions in the moment and over time. *Academy of Management Review*, Article amr.2021.0458. Advance online publication. https://doi.org/10.5465/amr.2021.0458

Leineweber, H., & Ohlert, J. (2010). Motivationales Klima bei Jugendlichen: Übersetzung und Validierung des Fragebogens zum peerinduzierten motivationalen Klima (FPMK). In G. Amesberger, T. Finkenzeller, & S. Würth (Eds.), *Schriften der Deutschen Vereinigung für Sportwissenschaft: Vol. 201. Psychophysiologie im Sport - zwischen Experiment und Handlungsoptimierung. 42. Jahrestagung der Arbeitsgemeinschaft für Sportpsychologie (asp) vom 13.-15. Mai 2010 in Salzburg* (p. 126). Feldhaus Verlag, Edition Czwalina.

Lienert, G. A. (1989). *Testaufbau und Testanalyse*. 4. neu ausgestattete Aufl (4th ed.).

Łucznik, K., & May, J. (2021). Measuring individual and group flow in collaborative improvisational dance. *Thinking Skills and Creativity*, *40*(5), 100847. https://doi.org/10.1016/j.tsc.2021.100847

Lüdemann, J., & Kleinert, J. (2023). Intragroup conflict in sports: a scoping review. *International Review of Sport and Exercise Psychology*, 1–43. https://doi.org/10.1080/1750984X.2023.2278135

1195 Mazzola, G. B., & Cherlin, P. B. (2009). *Flow, gesture, and spaces in free jazz: Towards a theory of*
1196 *collaboration*. *Computational Music Science, v. 1: v.v. 1*. Springer.
1197 McNeish, D., & Manapat, P. D. (2023). Dynamic fit index cutoffs for hierarchical and second-order factor
1198 models. *PsyArXiv*, 1–47. https://doi.org/10.31234/osf.io/sm6az
1199 McNeish, D., & Wolf, M. G. (2023). Dynamic fit index cutoffs for confirmatory factor analysis models.
1200 *Psychological Methods*, *28*(1), 61–88. https://doi.org/10.1037/met0000425
1201 Moreno Murcia, J. A., Cervelló Gimeno, E., & González-Cutre Coll, D. (2008). Relationships among goal
1202 orientations, motivational climate and flow in adolescent athletes: Differences by gender. *The*
1203 *Spanish Journal of Psychology*, *11*(1), 181–191. https://doi.org/10.1017/s1138741600004224
1204 Muchinsky, P. M., & Monahan, C. J. (1987). What is person-environment congruence? Supplementary
1205 versus complementary models of fit. *Journal of Vocational Behavior*, *31*(3), 268–277.
1206 https://doi.org/10.1016/0001-8791(87)90043-1
1207 Nitsch, J. R., & Hackfort, D. (2016). Theoretical framework of performance psychology: An action theory
1208 perspective. In M. Raab, B. Lobinger, S. Hoffmann, A. Pizzera, & S. Laborde (Eds.), *Performance*
1209 *Psychology: Perception, Action, Cognition, and Emotion* (pp. 11–29). Elsevier.
1210 https://doi.org/10.1016/B978-0-12-803377-7.00002-8
1211 Ntoumanis, N., & Vazou, S. (2005). Peer motivational climate in youth sport: Measurement development
1212 and validation. *Journal of Sport & Exercise Psychology*, *27*(4), 432–455.
1213 Paez, D., Rime, B., Basabe, N., Wlodarczyk, A., & Zumeta, L. (2015). Psychosocial effects of perceived
1214 emotional synchrony in collective gatherings, *108*(5), 711–729.
1215 https://doi.org/10.1037/pspi0000014
1216 Peifer, C., & Engeser, S. (Eds.). (2021a). *Advances in flow research*. Springer.

Peifer, C., & Engeser, S. (2021b). Theoretical integration and future lines of flow research. In C. Peifer & S. Engeser (Eds.), *Advances in flow research* (pp. 417–439). Springer.

Peifer, C., & Tan, J [J.]. (2021). The psychophysiology of flow experience. In C. Peifer & S. Engeser (Eds.), *Advances in flow research* (pp. 191–230). Springer.

Peifer, C., & Wolters, G. (2021). Flow in the context of work. In C. Peifer & S. Engeser (Eds.), *Advances in flow research* (pp. 287–321). Springer.

Peifer, C., Wolters, G., Harmat, L., Heutte, J., Tan, J [Jasmine], Freire, T., Tavares, D., Fonte, C., Andersen, F. O., van den Hout, J., Šimleša, M., Pola, L., Ceja, L., & Triberti, S. (2022). A scoping review of flow research. *Frontiers in Psychology*, *13*, 815665. https://doi.org/10.3389/fpsyg.2022.815665

Pels, F., & Kleinert, J. (2023a). "There is nothing as practical as a good theory" – A position paper on the development of group flow research. *European Journal of Applied Positive Psychology*, *7*(1), 1–5. https://www.nationalwellbeingservice.org/volumes/volume-7-2023/volume-7-article-7/

Pels, F., & Kleinert, J. (2023b). Perspectives on group flow: Existing theoretical approaches and the development of the Integrative Group Flow Theory. *Group Dynamics: Theory, Research, and Practice*, *27*(4), 276-294. https://doi.org/10.1037/gdn0000194

Pels, F., Kleinert, J., & Mennigen, F. (2018). Group flow: A scoping review of definitions, theoretical approaches, measures and findings. *PLOS ONE*, *13*(12), e0210117. https://doi.org/10.1371/journal.pone.0210117

Perttula, A., Kiili, K., Lindstedt, A., & Tuomi, P. (2017). Flow experience in game based learning – a systematic literature review. *International Journal of Serious Games*, *4*(1). https://doi.org/10.17083/ijsg.v4i1.151

1239 Podsakoff, P. M., MacKenzie, S. B., Lee, J.-Y., & Podsakoff, N. P. (2003). Common method biases in
1240 behavioral research: A critical review of the literature and recommended remedies. *Journal of*
1241 *Applied Psychology*, *88*(5), 879–903. https://doi.org/10.1037/0021-9010.88.5.879
1242 Podsakoff, P. M., MacKenzie, S. B., & Podsakoff, N. P. (2012). Sources of method bias in social science
1243 research and recommendations on how to control it. *Annual Review of Psychology*, *63*, 539–569.
1244 https://doi.org/10.1146/annurev-psych-120710-100452
1245 Primus, D. J., & Sonnenburg, S. (2018). Flow experience in design thinking and practical synergies with
1246 lego serious play. *Creativity Research Journal*, *30*(1), 104–112.
1247 https://doi.org/10.1080/10400419.2018.1411574
1248 Salanova, M., Rodriguez-Sanchez, A. M., Schaufeli, W. B., & Cifre, E. (2014). Flowing together: A
1249 longitudinal study of collective efficacy and collective flow among workgroups. *The Journal of*
1250 *Psychology*, *148*(4), 435–455. https://doi.org/10.1080/00223980.2013.806290
1251 Saris, W. E., & Gallhofer, I. N. (2014). *Design, Evaluation, and Analysis of Questionnaires for Survey*
1252 *Research* (4th ed.). John Wiley & Sons, Inc. https://doi.org/10.1002/9780470165195
1253 Savitz, D. A., & Wellenius, G. A. (2023). Can cross-sectional studies contribute to causal inference? It
1254 depends. *American Journal of Epidemiology*, *192*(4), 514–516.
1255 https://doi.org/10.1093/aje/kwac037
1256 Sawyer, R. K. (2003). *Group creativity: Music, theater, collaboration*. Lawrence Erlbaum Associates.
1257 Sawyer, R. K. (2006). Group creativity: Musical performance and collaboration. *Psychology of Music*,
1258 *34*(2), 148–165. https://doi.org/10.1177/0305735606061850
1259 Sawyer, R. K. (2007). *Group genius: The creative power of collaboration*. Basic Books Press.

Schwarzer, R., & Schwarzer, C. (1996). A critical survey of coping instruments. In M. Zeidner & N. S. Endler (Eds.), *Handbook of coping: Theory, research, applications* (pp. 107–132). John Wiley & Sons.

Sullivan, P. J., & Short, S. (2011). Further Operationalization of Intra-Team Communication in Sports: An Updated Version of the Scale of Effective Communication in Team Sports (SECTS2). *Journal of Applied Social Psychology*, *41*(2), 471–487. https://doi.org/10.1111/j.1559-1816.2010.00722.x

Swann, C., Keegan, R. J., Piggott, D., & Crust, L. (2012). A systematic review of the experience, occurrence, and controllability of flow states in elite sport. *Psychology of Sport and Exercise*, *13*(6), 807–819. https://doi.org/10.1016/j.psychsport.2012.05.006

Swann, C., Piggott, D., Schweickle, M., & Vella, S. A. (2018). A review of scientific progress in flow in sport and exercise: Normal science, crisis, and a progressive shift. *Journal of Applied Sport Psychology*, *30*(3), 249–271. https://doi.org/10.1080/10413200.2018.1443525

Tabachnick, B. G., & Fidell, L. S. (2014). *Using multivariate statistics* (6. ed., Pearson new internat. ed.). *Always learning*. Pearson.

Vallerand, R. J. (1997). Toward a hierarchical model of intrinsic and extrinsic motivation. In M. P. Zanna (Ed.), *Advances in experimental social psychology* (Vol. 29, pp. 271–360). Academic Press. https://doi.org/10.1016/S0065-2601(08)60019-2

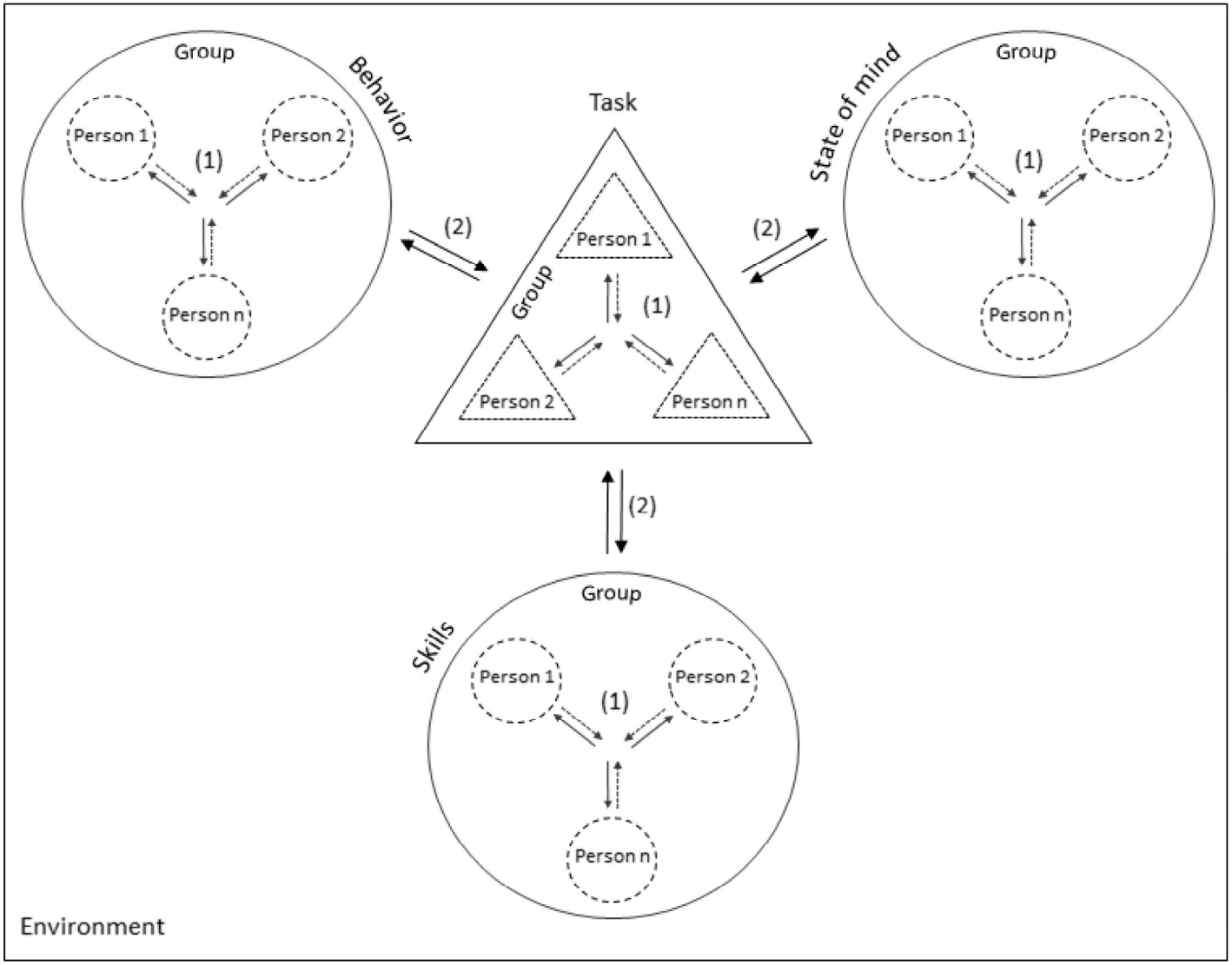
van den Hout, J. J. J., Davis, O. C., & Weggeman, M. C. D. P. (2018). The conceptualization of team flow. *The Journal of Psychology*, *152*(6), 388–423. https://doi.org/10.1080/00223980.2018.1449729

van den Hout, J. J. J., Gevers, J. M., Davis, O. C., Weggeman, M. C. D. P., & Wakefield, J. (2019). Developing and testing the team flow monitor (TFM). *Cogent Psychology*, *6*(1). https://doi.org/10.1080/23311908.2019.1643962

1282 van Oortmerssen, L. A., Caniëls, M. C. J., Stynen, D., & van Ritbergen, A. (2022). Boosting team flow
1283 through collective efficacy beliefs: A multilevel study in real-life organizational teams. *Journal of*
1284 *Applied Social Psychology*, *52*(10), 1030–1044. https://doi.org/10.1111/jasp.12910
1285 Watson, D., & Tellegen, A. (1985). Toward a consensual structure of mood. *Psychological Bulletin*(98),
1286 219–235.
1287 Winship, C., & Mare, R. D. (1992). Models for sample selection bias. *Annual Review of Sociology*, *18*(1),
1288 327–350. https://doi.org/10.1146/ANNUREV.SO.18.080192.001551
1289 Zepp, C., & Kleinert, J. (2015). Homogeneity of prototypical attributes in soccer teams. *SAGE Open*, *5*(3),
1290 1–10. https://doi.org/10.1177/2158244015602517
1291 Zumeta, L., Basabe, N., Wlodarczyk, A., Bobowik, M., & Paez, D. (2016). Shared flow and positive
1292 collective gatherings. *Anales De Psicología*, *32*(3), 717–727.
1293 https://doi.org/10.6018/analesps.32.3.261651

Figure 1

Model of the Structure of Group Flow According to the IGFT



Note.
(1) = primary fit.
(2) = secondary fit.
The figure includes the three action theoretical components of group action: the acting group system (with two levels (individual level and group level) and three functions (behavior, state of mind, skills)); the task of group action; the environment of group action.

Figure 2

Theoretical Factor Structure

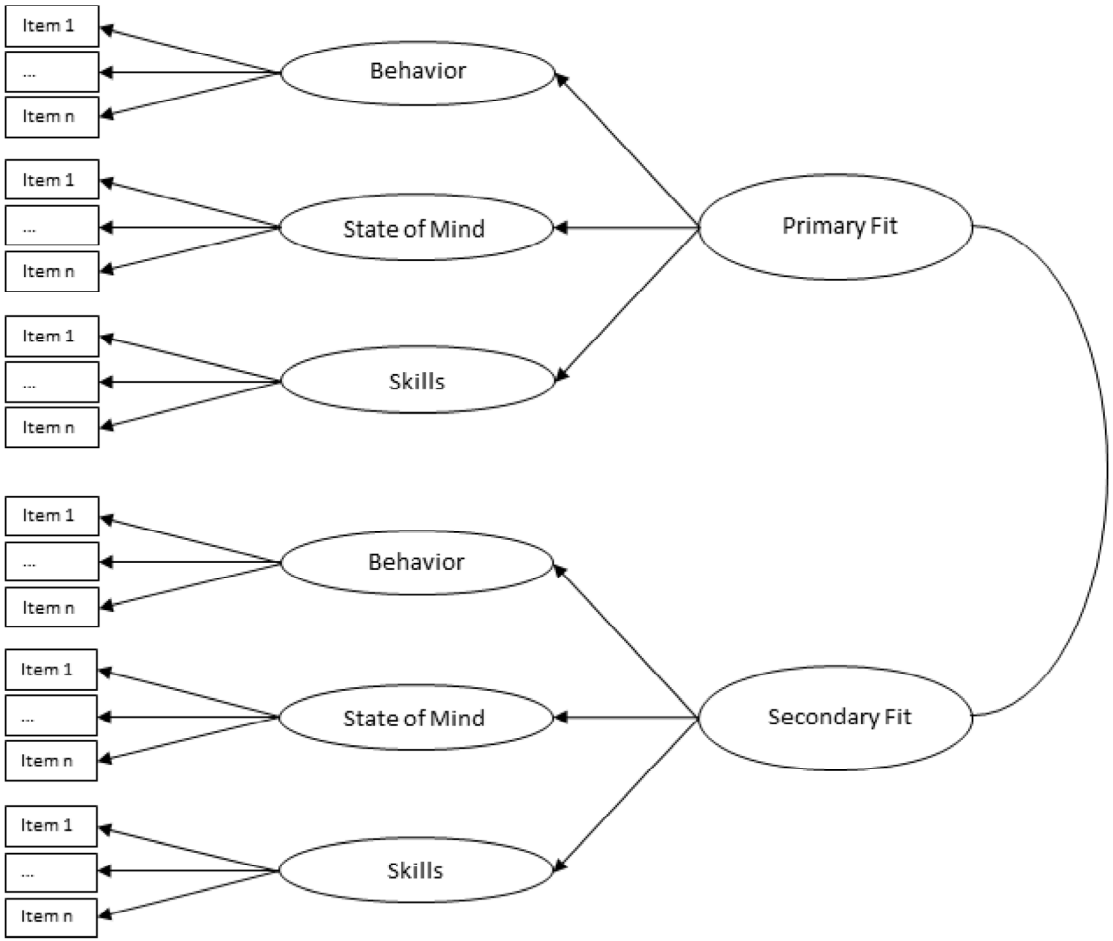
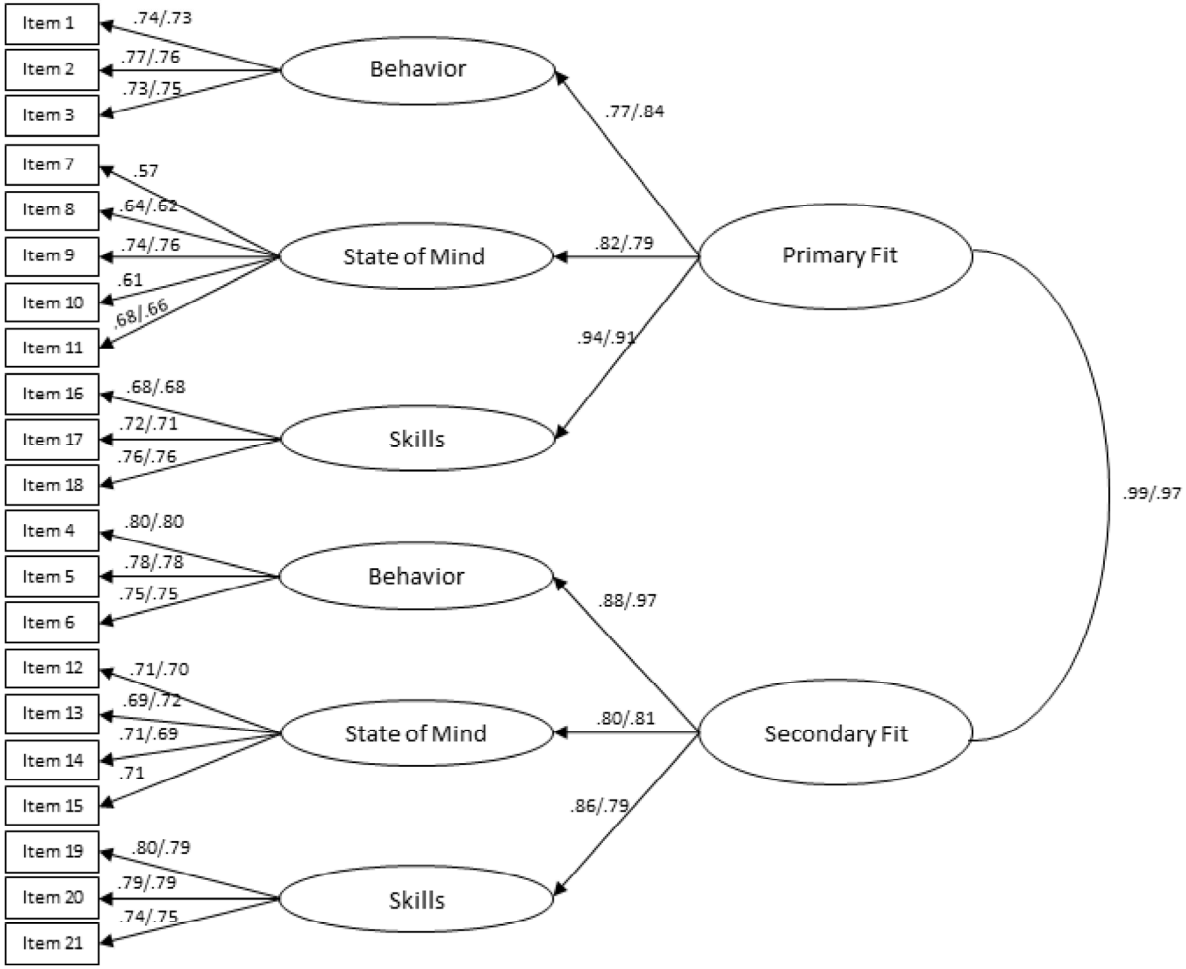


Figure 3

Factor Loadings of Confirmatory Factor Analyses (Study 1)

Figure 3a

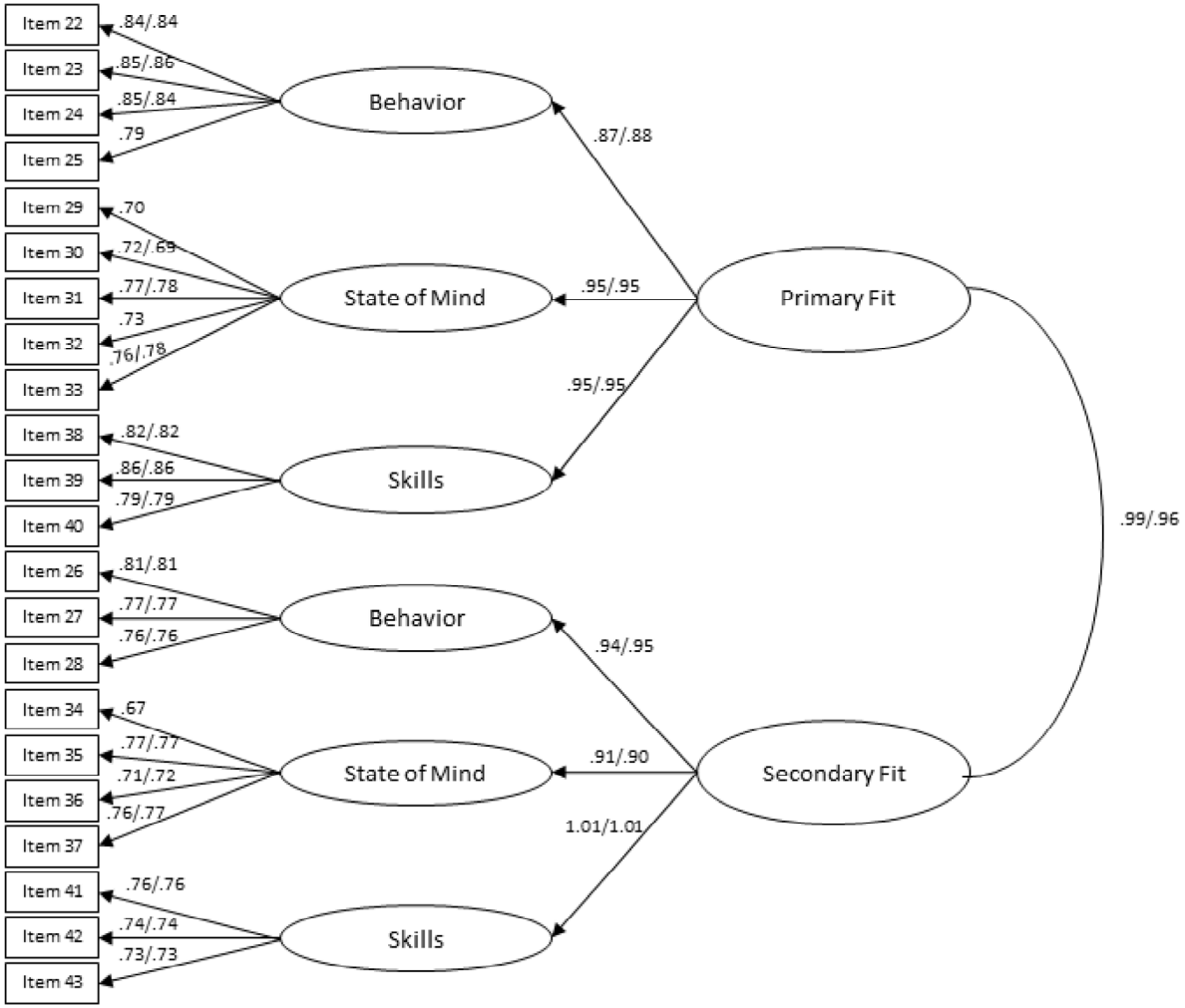
Factor Loadings of Confirmatory Factor Analyses (Self-oriented Perspective; Study 1)



Note. Values to the left of the slash refer to the full initial version, values to the right of the slash refer to the reduced initial version.

Figure 3b

Factor Loadings of Confirmatory Factor Analyses (Group-oriented Perspective; Study 1)



Note. Values to the left of the slash refer to the full initial version, values to the right of the slash refer to the reduced initial version.

Table 2

Perspective	Version	χ^2	*df*	*p*	CMIN/df	TLI	CFI	RMSEA	SRMR
Self-oriented	1	369.58	182	< .001	2.03	.85	.87	.09	.07
	2	213.09	125	< .001	1.71	.91	.93	.07	.06
Group-oriented	1	350.51	199	< .001	1.76	.91	.93	.07	.05
	2	215.06	125	< .001	1.72	.94	.95	.07	.04

Fit Indices of the Confirmatory Factor Analyses of Study 1

Note. Version 1 = full initial version of the GFI; Version 2 = reduced initial version of the GFI based on excluded items.

Table 3

List of Excluded Items (Study 1)

#	Reason for exclusion
7	Factor loading of λ = .57 which is lower than the recommended minimum of λ = .60 (Bagozzi & Yi, 1988)
10	low factor loading of λ = .61 that was substantially different from two of the three remaining factor loadings of the factor; item content clearly different from the other items of the factor in terms of level of abstraction
15	item content clearly different from the other items of the factor in terms of level of abstraction
25	factor loading differed substantially from the loadings of the other items of the respective factor
29	item content was clearly different from the other items of the factor in terms of level of abstraction
32	item content was clearly different from the other items of the factor in terms of level of abstraction
34	factor loading differed substantially from the loadings of the other items of the respective factor

Table 4

Correlation Matrix of Group Flow, Motivational Climate and Performance Outcome (Study 1)

		(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)
	Group flow (self-oriented perspective)																		
(1)	Primary fit (overall)	.82***	.80***	.83***	.80***	.70***	.62***	.68***	.79***	.67***	.70***	.74***	.80***	.70***	.68***	.75***	.10	.37***[1]	.46***
(2)	Behavior		.52***	.52***	.58***	.61***	.42***	.42***	.60***	.59***	.47***	.54***	.58***	.56***	.46***	.54***	.11	.30***	.41***
(3)	State of mind			.49***	.65***	.51***	.61***	.50***	.76***	.63***	.74***	.68***	.76***	.66***	.65***	.72***	-.03	.41***	.31***
(4)	Skills				.74***	.60***	.50***	.73***	.59***	.44***	.51***	.61***	.62***	.52***	.56***	.60***	.14*	.20*[2]	.43***
(5)	Secondary fit (overall)					.86***	.82***	.82***	.75***	.59***	.70***	.73***	.81***	.72***	.70***	.73***	.04	.34***[3]	.44***
(6)	Behavior						.58***	.55***	.62***	.54***	.56***	.57***	.68***	.64***	.59***	.58***	.04	.29***[4]	.38***
(7)	State of mind							.48***	.71***	.57***	.68***	.66***	.73***	.66***	.60***	.68***	-.10	.43***	.29***
(8)	Skills								.56***	.39***	.51***	.60***	.62***	.51***	.55***	.59***	.11	.14*[5]	.42***
	Group flow (group-oriented perspective)																		
(9)	Primary fit (overall)									.88***	.88***	.91***	.87***	.80***	.73***	.81***	.02	.50***[1]	.39***
(10)	Behavior										.64***	.72***	.71***	.71***	.54***	.66***	.04	.43***	.38***
(11)	State of mind											.72***	.81***	.70***	.73***	.73***	-.02	.44***	.32***
(12)	Skills												.82***	.72***	.68***	.79***	.04	.47***[2]	.34***
(13)	Secondary fit (overall)													.89***	.88***	.90***	<.01	.45***[3]	.42***
(14)	Behavior														.65***	.71***	.02	.47***[4]	.37***
(15)	State of mind															.70***	-.05	.35***	.38***
(16)	Skills																.04	.37***[5]	.37***
	Motivational climate																		
(17)	Ego orientation																	-.32***	.12
(18)	Task orientation																		.10
(19)	Performance Outcome																		

Note. * $p < .05$, ** $p < .01$, *** $p < .001$.

Exploratory comparisons of correlations: Superscript numbers in column 18 indicate a significant difference between correlations of the group flow factors (self-oriented perspective) and the motivation climate of task orientation on the one hand and the correlations of the group flow factors (group-oriented perspective) and the motivation climate of task orientation on the other hand (calculated based on Hemmerich, 2017). For ego orientation, there were no significant differences (column 17).

All data are based on the reduced initial version of the GFI.

Table 5

Psychometric Item Properties of Study 1

Self-oriented Perspective																									
	Primary Fit													Secondary Fit											
	First Level Factors									Second-level Factors				First Level Factors								Second-level Factors			
Factor	*Item*	*M*	*SD*	Min	Max	r_{id}	H *(SD)*	*α*	ω	r_{id}	H *(SD)*	*α*	ω	Item	*M*	*SD*	Min	Max	r_{id}	H *(SD)*	*α*	ω	r_{id}	H *(SD)*	*α*	ω
Behavior	1	3.52	0.85	1	5	.56	.52 (0.07)	.76	.76	.60	.37 (0.11)	.84	.83	4	3.59	0.92	1	5	.71	.60 (0.08)	.82	.82	.59	.44 (0.13)	.87	.87
	2	3.38	0.91	1	5	.64				.54				5	3.52	0.97	0	5	.66				.67			
	3	3.27	0.91	1	5	.58				.60				6	3.54	0.94	1	5	.63				.64			
State of Mind	7	3.60	0.94	1	5	.51	.43 (< 0.01)	.69	.69	.42				12	3.82	1.02	1	5	.60	.49 (0.05)	.74	.74	.56			
	9	3.58	1.10	0	5	.51				.57				13	3.62	0.91	1	5	.58				.58			
	11	3.26	0.86	1	5	.51				.57				14	3.72	1.04	1	5	.50				.61			
Skills	16	3.47	1.00	1	5	.62	.49 (0.08)	.74	.74	.51				19	3.61	0.99	0	5	.68	.60 (0.14)	.81	.82	.58			
	17	3.49	1.00	1	5	.56				.56				20	3.66	0.97	0	5	.72				.58			
	18	3.61	1.10	0	5	.52				.59				21	3.54	1.05	0	5	.59				.55			
Group-oriented Perspective																									
	Primary Fit													Secondary Fit											
	First-level factors									Second-level Factors				First-level factors								Second-level Factors			
Factor	*Item*	*M*	*SD*	Min	Max	r_{id}	*H (SD)*	*α*	ω	r_{id}	*H (SD)*	*α*	ω	Item	*M*	*SD*	Min	Max	r_{id}	*H (SD)*	*α*	ω	r_{id}	*H (SD)*	*α*	ω
Behavior	22	3.41	0.94	1	5	.73	.67 (0.04)	.86	.86	.74	.54 (0.12)	.91	.91	26	3.44	1.07	0	5	.71	.59 (0.11)	.81	.82	.55	.50 (0.09)	.90	.90
	23	3.37	0.95	1	5	.76				.73				27	3.49	0.97	1	5	.67				.65			

	24	3.48	0.96	1	5	.72				.71	28	3.50	0.95	1	5	.60				.65
State of Mind	30	3.79	1.04	0	5	.53				.57	35	3.75	1.01	1	5	.63				.55
	31	3.61	1.09	1	5	.70	.47 (0.16)	.75	.78	.68	36	3.36	1.02	0	5	.58	.54 (0.04)	.78	.78	.61
	33	3.36	1.03	1	5	.52				.65	37	3.54	1.00	0	5	.62				.57
Skills	38	3.51	1.01	1	5	.69				.72	41	3.54	0.96	1	5	.57				.60
	39	3.40	0.98	1	5	.74	.63 (0.08)	.83	.84	.76	42	3.62	0.97	1	5	.59	.51 (0.03)	.76	.76	.54
	40	3.60	0.88	1	5	.66				.72	43	3.69	0.93	1	5	.60				.66

Note. r_{id} = item discrimination; *H* = item homogeneity; α = internal consistency, ω = internal consistency.
All data are based on the reduced initial version of the GFI.

Table 6

Perspective	Version	χ^2	*df*	*p*	CMIN/df	TLI	CFI	RMSEA	SRMR
Self-oriented	1	273.29	125	< .001	2.19	.95	.96	.05	.03
	2	247.04	109	< .001	2.27	.95	.96	.05	.03
Group-oriented	1	201.41	125	< .001	1.61	.98	.98	.04	.03

Fit Indices of the Confirmatory Factor Analyses of Study 2

Note. Version 1 = full revised version of the GFI; Version 2 = reduced revised version of the GFI excluding item #14 of the self-oriented perspective.

Figure 4

Factor Loadings of Confirmatory Factor Analyses (Study 2)

Figure 4a

Factor Loadings of Confirmatory Factor Analyses (Self-oriented Perspective; Study 2)

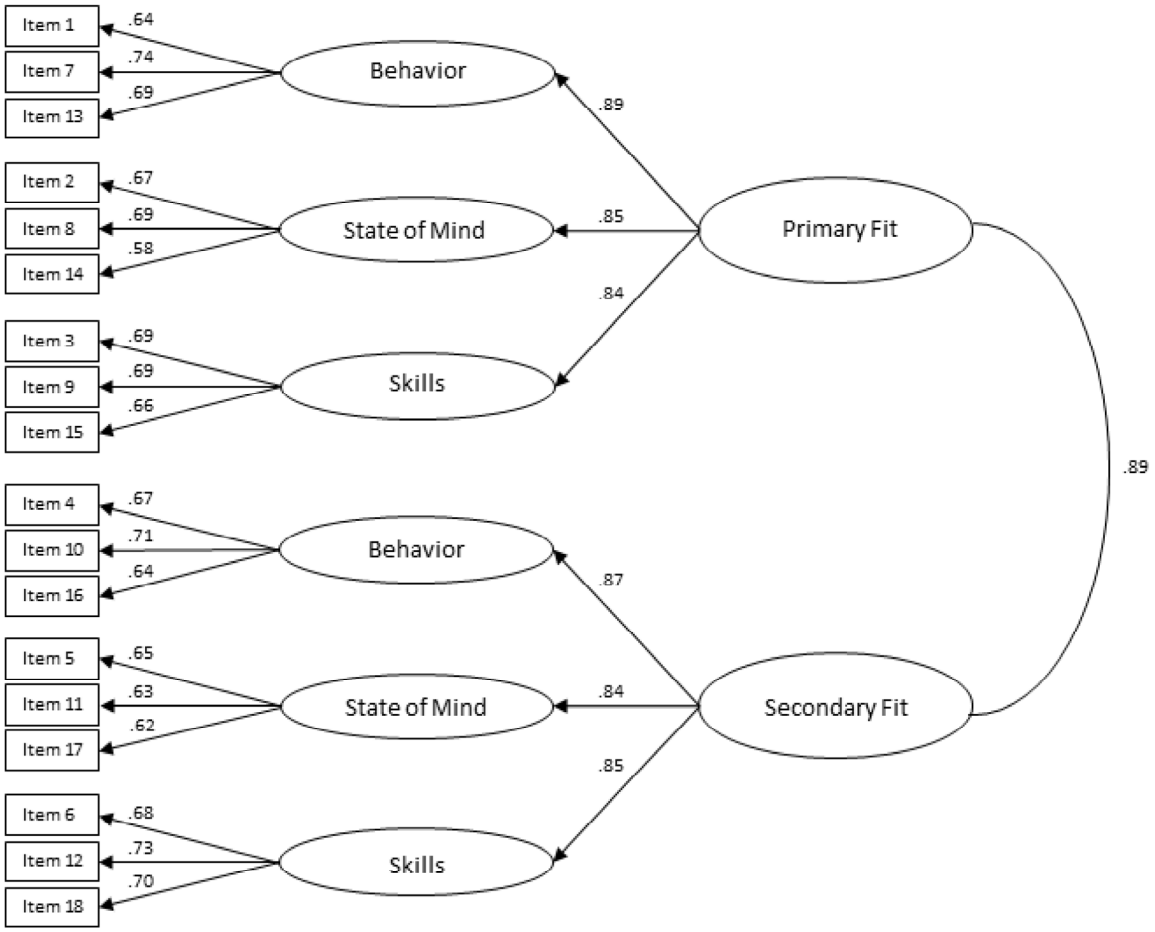


Figure 4b

Factor Loadings of Confirmatory Factor Analyses (Group-oriented Perspective; Study 2)

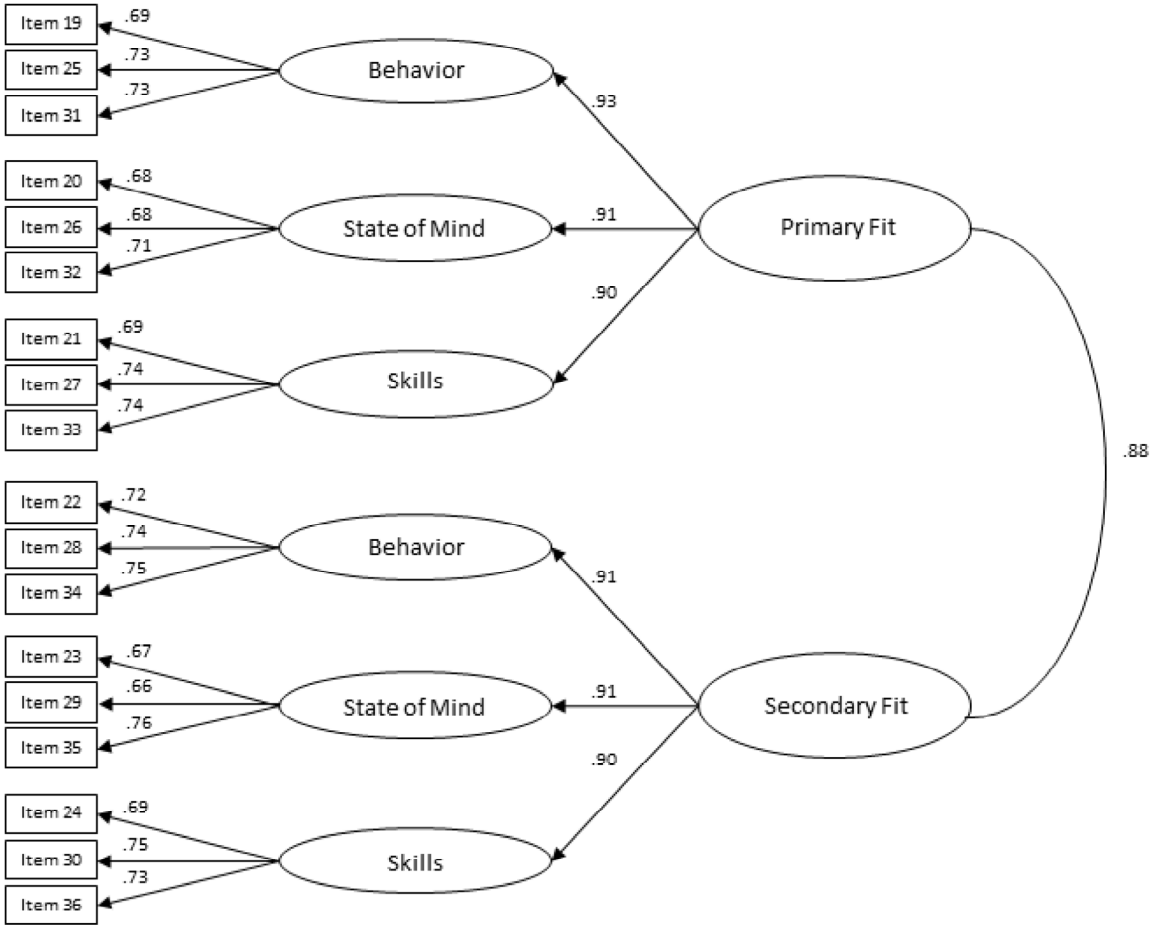


Table 7

Correlation Matrix of Group Flow, Intrateam Communication, Mood and Performance Outcome (Study 2)

		(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)
	Self-oriented perspective																						
(1)	Primary Fit	.90***	.89***	.85***	.84***	.79***	.62***	.76***	.75***	.69***	.67***	.69***	.77***	.70***	.71***	.68***	.48***	.10	.51***	-.0	.45***	-.13**	.18***
(2)	Behavior		.71***	.66***	76***	.74***	.57***	.67***	.67***	.62***	.61***	.61***	.68***	.62***	.62***	.61***	.38***	.11	.41***	.02	.40***	-.10*	.12***
(3)	State of mind			.60***	.70***	.66***	.55***	59***	.72***	.67***	.67***	.65***	.74***	.68***	.68***	.64***	.47***	.15*	.49***	-.02	.47***	-.14**	.22***
(4)	Skills				.75***	.70***	.52***	.73***	.57***	.52***	.49***	.57***	.61***	.55***	.56***	.54***	.44***	-.01	.57***	-.09	.29***	-.10*	.12***
(5)	Secondary Fit					.87***	.84***	.85***	.69***	.62***	62***	.65***	.70***	.61***	.64***	.64***	.39***	.06	.46***	-.04	.41***	-.16**	.18***
(6)	Behavior						.56***	.72***	.65***	.58***	.60***	.60***	.67***	.59***	.63***	.61***	.35***	.03	.42***	-.03	.39***	-.15**	.15***
(7)	State of mind							.52***	.53***	.50***	.47***	.49***	.53***	.47***	.50***	.48***	.32***	.04	.39***	-.06	.31***	-.14**	.18***
(8)	Skills								.61***	.52***	.54***	.60***	.60***	.52***	.54***	.57***	.38***	.11	.43***	-.01	.34***	-.12*	.15***
	Group perspective																						
(9)	Primary Fit									.93***	.91***	.90***	.87***	.80***	.79***	.78***	.46***	.13	.49***	-.08	.48***	-.18***	.23***
(10)	Behavior										.79***	.75***	.82***	.75***	.74***	.73***	.39***	.18*	.43***	-.04	.45***	-.15**	.20***
(11)	State of mind											.71***	.79***	.75***	.70***	.70***	.43***	.14	.43***	-.04	.46***	-.15**	.22***
(12)	Skills												.78***	.70***	.72***	.72***	.47***	.05	.51***	-.15*	.39***	-.18***	.22***
(13)	Secondary Fit													.91***	.91***	.90***	.44***	.13	.52***	-.05	.51***	-.15**	.22***
(14)	Behavior														.73***	.73***	.34***	.11	.44***	-.09	.47***	-.13*	.20***
(15)	State of mind															.73***	.45***	.12	.49***	-.06	.46***	-.15**	.20***
(16)	Skills																.42***	.12	.49***	.01	.46***	-.14**	.21***
	Intrateam Communication																						
(17)	Acceptance																	.18*	.79***	-.02	---	---	.06
(18)	Distinctiveness																		.16*	.57***	---	---	-.16*
(19)	Positive conflict																			.03	---	---	.04
(20)	Negative Conflict																				---	---	-.26
	Mood																						
(21)	Positive																					-.19***	.23***
(22)	Negative																						-.34***
(23)	Performance outcome																						

Note. * $p < .05$, ** $p < .01$, *** $p < .001$.

The correlations between intrateam communication and mood were not calculated, as each respondent received either the questionnaire on intrateam communication or on mood, but not on both.

Table 8

Psychometric Item Properties of Study 2

Self-oriented Perspective																									
Primary Fit														Secondary Fit											
						First Level Factors				Second-level Factors									First Level Factors				Second-level Factors			
Factor	*Item*	*M*	*SD*	Min	Max	r_{id}	H *(SD)*	*α*	ω	r_{id}	H *(SD)*	*α*	ω	Item	*M*	*SD*	Min	Max	r_{id}	H *(SD)*	*α*	ω	r_{id}	H *(SD)*	*α*	ω
Behavior	1	3.41	0.98	0	5	.53	.47 (0.05)	.73	.73	.63	.43 (0.07)	.87	.87	4	3.39	1.03	0	5	.49	.45 (0.06)	.71	.71	.63	.45 (0.07)	.88	.88
	7	3.41	0.96	0	5	.58				.69				10	3.55	0.94	0	5	.56				.68			
	13	3.55	0.93	1	5	.55				.63				16	3.60	0.92	1	5	.54				.62			
State of Mind	2	3.63	0.96	0	5	.51	.42 (0.04)	.69	.69	.63				5	3.66	1.01	1	5	.48	.40 (0.05)	.67	.67	.59			
	8	3.35	1.08	0	5	.52				.61				11	3.45	0.97	1	5	.51				.58			
	14	3.51	1.11	0	5	.48				.54				17	3.59	1.05	0	5	.44				.59			
Skills	3	3.46	0.95	0	5	.57	.46 (0.06)	.72	.72	.63				6	3.63	0.94	0	5	.54	.49 (0.05)	.74	.74	.61			
	9	3.45	0.98	0	5	.55				.59				12	3.54	0.92	1	5	.59				.69			
	15	3.55	0.95	1	5	.50				.56				18	3.63	0.92	0	5	.57				.63			

Group-oriented Perspective																									
Primary Fit														Secondary Fit											
						First-level factors				Second-level Factors									First-level factors				Second-level Factors			
Factor	*Item*	*M*	*SD*	Min	Max	r_{id}	*H (SD)*	*α*	ω	r_{id}	*H (SD)*	*α*	ω	Item	*M*	*SD*	Min	Max	r_{id}	*H (SD)*	*α*	ω	r_{id}	*H (SD)*	*α*	ω
Behavior	19	3.32	0.97	0	5	.53	.51 (0.08)	.76	.76	.66	.52 (0.05)	.91	.91	22	3.41	1.00	0	5	.60	.54 (0.04)	.78	.78	.67	.52 (0.06)	.91	.91
	25	3.38	1.03	0	5	.61				.71				28	3.51	0.97	0	5	.62				.71			

	31	3.49	0.96	0	5	.62				.71	34	3.53	0.95	0	5	.64				.72
State of Mind	20	3.58	0.96	0	5	.56	.48 (0.03)	.73	.73	.65	23	3.56	0.95	0	5	.57	.48 (0.02)	.74	.74	.64
	26	3.58	1.04	0	5	.53				.66	29	3.57	1.00	0	5	.55				.63
	32	3.31	1.03	0	5	.57				.68	35	3.42	1.00	0	5	.57				.72
Skills	21	3.47	0.92	0	5	.55	.53 (0.08)	.77	.77	.67	24	3.48	0.93	0	5	.56	.52 (0.06)	.77	.77	.66
	27	3.43	0.96	0	5	.63				.70	30	3.49	0.98	0	5	.61				.71
	33	3.41	0.97	0	5	.62				.68	36	3.57	0.98	0	5	.62				.70

Note. r_{id} = item discrimination; *H* = item homogeneity; α = internal consistency, ω = internal consistency.

Appendix

Table 1

Items of the GFI

Table 1a

Self-oriented perspective (German)

		Item # Study 1	Item # Study 2	Items (Stem: Ich hatte das Gefühl, …)
primary fit	Behavior	1		dass mein Verhalten exakt/perfekt/genau auf das Verhalten der anderen aus unserer Gruppe abgestimmt ist
			1	dass mein Verhalten exakt/perfekt/genau auf das Verhalten der anderen aus unserer Gruppe abgestimmt ist
		2		dass sich mein Handeln exakt/perfekt/genau mit dem Handeln der anderen aus unserer Gruppe ergänzt
			7	dass sich mein Handeln exakt/perfekt/genau mit dem Handeln der anderen aus unserer Gruppe ergänzt
		3		dass mein Verhalten wie von selbst exakt/perfekt/genau zum Verhalten der anderen aus unserer Gruppe passt
			13	dass mein Verhalten wie von selbst exakt/perfekt/genau zum Verhalten der anderen aus unserer Gruppe passt
	State of mind	7		dass meine Ziele exakt/perfekt/genau zu den Zielen der anderen aus unserer Gruppe passen
			2 (r)	dass sich meine Ziele exakt/perfekt/genau mit den Zielen der anderen aus unserer Gruppe ergänzen.
		8		dass meine Vorstellung davon, was wir zu machen haben, exakt/perfekt/genau zu den Vorstellungen der anderen aus unserer Gruppe passt
			8 (r)	dass meine Vorstellung davon, was wir zu machen haben, wie von allein exakt/perfekt/genau mit den Vorstellungen der anderen aus unserer Gruppe abgestimmt ist
		9		dass meine Stimmung exakt/perfekt/genau zu der Stimmung der anderen aus unserer Gruppe passt
			14	dass meine Stimmung exakt/perfekt/genau zu der Stimmung der anderen aus unserer Gruppe passt
		10		dass mein Aufmerksamkeitsfokus exakt/perfekt/genau zum Aufmerksamkeitsfokus der anderen aus unserer Gruppe passt
			X	
		11		dass meine Überlegungen exakt/perfekt/genau zu den Überlegungen der anderen aus unserer Gruppe passen
			X	

	Skills	16		dass meine Fähigkeiten exakt/perfekt/genau die Fähigkeiten der anderen aus unserer Gruppe ergänzen
			3	dass meine Fähigkeiten exakt/perfekt/genau die Fähigkeiten der anderen aus unserer Gruppe ergänzen
		17		dass meine Kompetenzen exakt/perfekt/genau zu den Kompetenzen der anderen aus unserer Gruppe passen
			9	dass meine Kompetenzen exakt/perfekt/genau zu den Kompetenzen der anderen aus unserer Gruppe passen
		18		dass ich meine Fähigkeiten exakt/perfekt/genau passend in unsere Gruppe einbringe
			15 (r)	dass ich meine Fähigkeiten wie von selbst exakt/perfekt/genau abgestimmt in unsere Gruppe einbringe
Secondary fit	Behavior	4		dass mein Verhalten exakt/perfekt/genau auf unsere Gruppenaufgabe abgestimmt ist
			4 (r)	dass mein Verhalten wie von allein exakt/perfekt/genau auf unsere Gruppenaufgabe abgestimmt ist
		5		dass mein Handeln exakt/perfekt/genau zu den Herausforderungen unserer Gruppenaufgabe passt
			10	dass mein Handeln exakt/perfekt/genau zu den Herausforderungen unserer Gruppenaufgabe passt
		6		dass mein Verhalten exakt/perfekt/genau auf die Anforderungen unserer Gruppenaufgabe abgestimmt ist
			16 (r)	dass mein Verhalten exakt/perfekt/genau mit den Anforderungen unserer Gruppenaufgabe vereinbar ist
	State of mind	12		dass meine Ziele exakt/perfekt/genau zu unserer Gruppenaufgabe passen
			5	dass meine Ziele exakt/perfekt/genau zu unserer Gruppenaufgabe passen
		13		dass meine Vorstellung davon, was wir zu machen haben, exakt/perfekt/genau zu den Anforderungen unserer Gruppenaufgabe passt
			11 (r)	dass meine Vorstellung davon, was wir zu machen haben, wie von selbst exakt/perfekt/genau an die Anforderungen unserer Gruppenaufgabe angepasst ist
		14		dass meine Stimmung exakt/perfekt/genau zu unserer Gruppenaufgabe passt
			17 (r)	dass meine Stimmung exakt/perfekt/genau mit den Herausforderungen unserer Gruppenaufgabe vereinbar ist.
		15		dass mein Aufmerksamkeitsfokus exakt/perfekt/genau zu den Herausforderungen unserer Gruppenaufgabe passt
			x	
	Skills	19		dass meine Fähigkeiten exakt/perfekt/genau zu unserer Gruppenaufgabe passen
			6	dass meine Fähigkeiten exakt/perfekt/genau zu unserer Gruppenaufgabe passen

20		dass meine Kompetenzen exakt/perfekt/genau zu den Herausforderungen unserer Gruppenaufgabe passen
	12 (r)	dass meine Kompetenzen exakt/perfekt/genau mit den Herausforderungen unserer Gruppenaufgabe in Einklang sind
21		dass ich meine Fähigkeiten exakt/perfekt/genau passend für die Anforderungen unserer Gruppenaufgabe einbringe
	18 (r)	dass ich meine Fähigkeiten wie von allein exakt/perfekt/genau abgestimmt für die Anforderungen unserer Gruppenaufgabe einbringe

Note. (r) after the item # indicates that the item has been revised as compared to Study 1. x as item # indicates that the item was no longer included in Study 2.

Table 1b

Self-oriented perspective (English)

		Item # Study 1	Item # Study 2	Items (Stem: I had the impression…)
primary fit	Behavior	1		that my behavior exactly/perfectly/precisely aligns with the behavior of the others in our group
			1	that my behavior exactly/perfectly/precisely aligns with the behavior of the others in our group
		2		that my actions exactly/perfectly/precisely add to the actions of the others in our group
			7	that my actions exactly/perfectly/precisely add to the actions of the others in our group
		3		that my behavior automatically exactly/perfectly/precisely matches the behavior of the others in our group
			13	that my behavior automatically exactly/perfectly/precisely matches the behavior of the others in our group
	State of mind	7		that my goals exactly/perfectly/precisely match the goals of the others in our group
			2 (r)	that my goals exactly/perfectly/precisely complement the goals of the others in our group
		8		that my ideas of what we have to do exactly/perfectly/precisely match the ideas of the others in our group
			8 (r)	that my idea of what we are required to do is exactly/perfectly/precisely and automatically aligned with the ideas of the others in our group
		9		that my mood exactly/perfectly/precisely matches the mood of the others in our group
			14	that my mood exactly/perfectly/precisely matches the mood of the others in our group
		10		that my attention focus exactly/perfectly/precisely matches the attention focus of the others in our group
			X	
		11		that my thoughts exactly/perfectly/precisely match the thoughts of the others in our group
			X	
	Skills	16		that my skills exactly/perfectly/precisely add to the skills of the others in our group
			3	that my skills exactly/perfectly/precisely add to the skills of the others in our group
		17		that my skills exactly/perfectly/precisely match the skills of the others in our group

			9	that my skills exactly/perfectly/precisely match the skills of the others in our group
		18		that I contribute my abilities exactly/perfect/precisely matching to our group
			15 (r)	that I automatically contribute my abilities to our group in an exactly/perfect/precisely coordinated way
		4		that my behavior exactly/perfectly/precisely aligns with our group task
			4 (r)	that my behavior automatically exactly/perfectly/precisely aligns with our group task
		5		that my actions exactly/perfectly/precisely match the challenges of our group task
	Behavior		10	that my actions exactly/perfectly/precisely match the challenges of our group task
		6		that my behavior exactly/perfectly/precisely aligns with the demands of our group task
			16 (r)	that my behavior is exactly/perfectly/precisely consistent with the requirements of our group task
		12		that my goals match our group task exactly/perfectly/precisely
			5	that my goals match our group task exactly/perfectly/precisely
		13		that my idea of what we have to do exactly/perfectly/precisely matches the demands of our group task
Secondary fit	State of mind		11 (r)	that my idea of what we are required to do is exactly/perfectly/precisely and automatically matched with the ideas of the others in our group
		14		that my mood matches our group task exactly/perfectly/precisely
			17 (r)	that my mood is exactly/perfectly/precisely compatible with our group task
		15		that my focus of attention exactly/perfectly/precisely matches the challenges of our group task
			x	
		19		that my skills match our group task exactly/perfectly/precisely
			6	that my skills match our group task exactly/perfectly/precisely
		20		that my competencies exactly/perfectly/precisely match the challenges of our group task
	Skills		12 (r)	that my skills are exactly/perfectly/precisely in line with the challenges of our group task
		21		that I contribute my skills exactly/perfectly/precisely matching the demands of our group task
			18 (r)	that I automatically contribute my skills exactly/perfectly/precisely as needed for the demands of our group task

Note. (r) after the item # indicates that the item has been revised as compared to Study 1. x as item # indicates that the item was no longer included in Study 2.

Table 1c

Group-oriented perspective (German)

		Item # Study 1	Item # Study 2	Items (Stem: Ich hatte das Gefühl, …)
primary fit	Behavior	22		dass das Verhalten unserer Gruppe exakt/perfekt/genau aufeinander abgestimmt ist
			19 (r)	dass das Verhalten der Mitglieder unserer Gruppe wie von selbst exakt/perfekt/genau aufeinander abgestimmt ist
		23		dass das Handeln unserer Gruppe exakt/perfekt/genau zueinander passt
			25 (r)	dass das Handeln der Mitglieder unserer Gruppe exakt/perfekt/genau zueinander passt
		24		dass sich unser Handeln in der Gruppe exakt/perfekt/genau ergänzt
			31	dass sich unser Handeln in der Gruppe exakt/perfekt/genau ergänzt
		25		dass unser Verhalten wie von selbst exakt/perfekt/genau zueinander passt
			x	
	State of mind	29		dass wir alle exakt/perfekt/genau wissen, was wir als Gruppe vorhaben
			x	
		30		dass unsere Ziele exakt/perfekt/genau zueinander passen
			20 (r)	dass sich die Ziele der Mitglieder unserer Gruppe exakt/perfekt/genau ergänzen
		31		dass unsere Stimmung exakt/perfekt/genau zueinander passt
			26 (r)	dass die Stimmung der Mitglieder unserer Gruppe exakt/perfekt/genau zueinander passt
		32		dass unser Aufmerksamkeitsfokus exakt/perfekt/genau zueinander passt
			x	
		33		dass unsere Gedanken exakt/perfekt/genau zueinander passen
			32 (r)	dass die Gedanken der Mitglieder unserer Gruppe wie von allein exakt/perfekt/genau abgestimmt sind
	Skills	38		dass sich unsere Fähigkeiten exakt/perfekt/genau in unserer Gruppe ergänzen
			21	dass sich unsere Fähigkeiten exakt/perfekt/genau in unserer Gruppe ergänzen
		39		dass unsere Kompetenzen exakt/perfekt/genau zu den Fähigkeiten der anderen aus unserer Gruppe passen
			27	dass unsere Kompetenzen exakt/perfekt/genau zu den Fähigkeiten der anderen aus unserer Gruppe passen
		40		dass wir unsere Kompetenzen exakt/perfekt/genau passend in unsere Gruppe einbringen können
			33 (r)	

				dass wir unsere Kompetenzen wie von selbst exakt/perfekt/genau passend in unsere Gruppe integrieren
Secondary fit	Behavior	26		dass das Verhalten unserer Gruppe als Ganzes exakt/perfekt/genau auf unsere Gruppenaufgabe abgestimmt ist
			22 (r)	dass das Verhalten unserer Gruppe als Ganzes wie von allein exakt/perfekt/genau auf unsere Gruppenaufgabe abgestimmt ist
		27		dass das Handeln unserer Gruppe als Ganzes exakt/perfekt/genau zu den Anforderungen unserer Gruppenaufgabe passt
			28	dass das Handeln unserer Gruppe als Ganzes exakt/perfekt/genau zu den Anforderungen unserer Gruppenaufgabe passt
		28		dass das Verhalten unserer Gruppe als Ganzes exakt/perfekt/genau auf die Herausforderungen unserer Gruppenaufgabe abgestimmt ist
			34 (r)	dass das Verhalten unserer Gruppe als Ganzes exakt/perfekt/genau mit den Herausforderungen unserer Gruppenaufgabe vereinbar ist
	State of mind	34		dass die Ziele unserer Gruppe als Ganzes exakt/perfekt/genau zu unserer Gruppenaufgabe passen
			23 (r)	dass die Ziele unserer Gruppe als Ganzes exakt/perfekt/genau zu den Herausforderungen unserer Gruppenaufgabe passen
		35		dass unsere Gruppenstimmung exakt/perfekt/genau zu unserer Gruppenaufgabe passt
			29 (r)	dass unsere Gruppenstimmung exakt/perfekt/genau mit unserer Gruppenaufgabe vereinbar ist
		36		dass unser Aufmerksamkeitsfokus exakt/perfekt/genau zu unserer Gruppenaufgabe passt
			x	
		37		dass unsere Überlegungen exakt/perfekt/genau auf unsere Gruppenaufgabe abgestimmt sind
			35 (r)	dass die Entscheidungen unserer Gruppe als Ganzes wie von selbst exakt/perfekt/genau auf die Anforderungen unserer Gruppenaufgabe abgestimmt sind
	Skills	41		dass unsere Fähigkeiten exakt/perfekt/genau zu unserer Gruppenaufgabe passen
			24 (r)	dass unsere Fähigkeiten als Gruppe exakt/perfekt/genau zu den Herausforderungen unserer Gruppenaufgabe passen
		42		dass wir unsere Fähigkeiten exakt/perfekt/genau passend für unsere Gruppenaufgabe einbringen
			30 (r)	dass wir die Fähigkeiten unserer Gruppe als Ganzes wie von selbst exakt/perfekt/genau passend für unsere Gruppenaufgabe einbringen
		43		dass wir unsere Kompetenzen exakt/perfekt/genau passend für unsere Gruppenaufgabe einbringen
			36 (r)	dass die Kompetenzen unserer Gruppe als Ganzes exakt/perfekt/genau den Anforderungen unserer Gruppenaufgabe entsprechen

Note. (r) after the item # indicates that the item has been revised as compared to Study 1. x as item # indicates that the item was no longer included in Study 2.

Table 1d

Group-oriented perspective (English)

		Item # Study 1	Item # Study 2	Items (Stem: I had the impression…)
primary fit	Behavior	22		that the behavior of our group exactly/perfectly/precisely aligns with each other
			19 (r)	that the behavior of the members of our group is automatically exactly/perfectly/precisely aligned
		23		that the action of our group exactly/perfectly/precisely matches
			25 (r)	that the actions of the members of our group are exactly/perfectly/precisely matched
		24		that our actions in the group add to each other exactly/perfectly/precisely
			31	that our actions in the group add to each other exactly/perfectly/precisely
		25		that our behavior automatically matches exactly/perfectly/precisely
			x	
	State of mind	29		that we all know exactly/perfectly/precisely what we have to do as a group
			x	
		30		that our goals exactly/perfectly/precisely match each other
			20 (r)	that the goals of the members of our group complement each other exactly/perfectly/precisely
		31		that our mood matches each other exactly/perfectly/precisely
			26 (r)	that the mood of the members of our group is exactly/perfectly/precisely matched
		32		that our focus of attention exactly/perfectly/precisely matches
			x	
		33		that our thoughts are exactly/perfectly/precisely aligned
			32 (r)	that the thoughts of the members of our group are automatically exactly/perfectly/precisely aligned
	Skills	38		that the skills of the members of our group add to each other exactly/perfectly/precisely
			21	that the skills of the members of our group add to each other exactly/perfectly/precisely
		39		that our skills exactly/perfectly/precisely match the skills of the others in our group
			27	that our skills exactly/perfectly/precisely match the skills of the others in our group
		40		that we integrate our skills exactly/perfectly/precisely fitting into our group

			33 (r)	that we automatically integrate our skills exactly/perfectly/precisely fitting into our group
Secondary fit	Behavior	26		that the behavior of our group as a whole is exactly/perfectly/precisely aligned with our group task
			22 (r)	that the behavior of our group as a whole is automatically exactly/perfectly/precisely aligned with our group task
		27		that the action of our group as a whole exactly/perfectly/precisely match the requirements of our group task
			28	that the action of our group as a whole exactly/perfectly/precisely match the requirements of our group task
		28		that the behavior of our group as a whole is exactly/perfectly/precisely aligned with the challenges of our group task
			34 (r)	that the behavior of our group as a whole is exactly/perfectly/precisely compatible with the challenges of our group task
	State of mind	34		that the goals of our group as a whole exactly/perfectly/precisely matches our group task
			23 (r)	that the goals of our group as a whole exactly/perfectly/precisely match the challenges of our group task
		35		that our group mood exactly/perfectly/precisely matches our group task
			29 (r)	that our group mood is exactly/perfectly/precisely compatible with our group task
		36		that our attention focus exactly/perfectly/precisely matches our group task
			x	
		37		that our thoughts are exactly/perfectly/precisely aligned with our group task
			35 (r)	that the decisions made by our group as a whole are automatically exactly/perfectly/precisely aligned with the requirements our group task
	Skills	41		that our skills exactly/perfectly/precisely match our group task
			24 (r)	that our skills as a group exactly/perfectly/precisely match the challenges of our group task
		42		that we contribute our skills exactly/perfectly/precisely in line with our group task
			30 (r)	that we automatically contribute the skills of our group as a whole exactly/perfectly/precisely in line with our group task
		43		that we contribute our skills exactly/perfectly/precisely in line with our group task
			36 (r)	that the skills of our group as a whole exactly/perfectly/precisely correspond to the demands of our group task

Note. (r) after the item # indicates that the item has been revised as compared to Study 1. x as item # indicates that the item was no longer included in Study 2.

Supplement

Overview of Existing Questionnaires Assessing Group Flow

Reference	Context[1]	Theory	Factors	Items						Evaluation
				Instruction	Generation	#	Content Type	Perspective	Response scale	
Aust et al. (2023)	Unspecific	Individual Flow Concept (Csikszentmihalyi, 1975, 2000); Conceptualization of Team Flow (van den Hout et al., 2018)	One total factor	Participants were asked to indicate how often they experience group flow	individual compilation inspired by FKS (Rheinberg et al., 2003) and TFM (van den Hout et al., 2019)	12	Vague (metaphoric): e.g., "The teamwork was fluid and smooth"; concrete (thoughts/feelings/observations): e.g., "We knew that we could accomplish the task together."	Group	1 (never) to 6 ([almost] always)	Reliability (α = .93), validity (factor validity: indicated by CFA)
Kaye (2016)	Unspecific	Individual Flow Concept (Csikszentmihalyi, 1975, 2000)	One total factor	Participants asked to rate the extent to which they agreed to a series of statements about their experiences	Adaption of the FSS-SF (Jackson & Eklund, 2002) towards group flow and addition of five specific items based on previous study (Kaye & Bryce, 2012)	13	Abstract (theoretical constructs): e.g., "The task required complementary participation"; concrete (thoughts/feelings/observations): e.g., "We had a good idea while we were performing about how well we were doing"	Group	1 (strongly disagree) to 5 (strongly agree)	Reliability (α = .87)

Reference	Context[1]	Theory	Factors	Items						Evaluation
				Instruction	Generation	#	Content Type	Perspective	Response scale	
Primus and Sonnenburg (2018)	Unspecific	Group Flow Concept (Sawyer, 2003, 2006, 2007)	One total factor	Participants asked to describe the group during the activity	Theory-based (importance of activity to others on the group, continuous communication, listening to each other, equal participation, sense of unity, activity moving forward, full concentration)	8	Concrete (thoughts/feelings/observations): e.g., "Was there continuous communication among the team?"[2]	Group	0 (not at all) to 9 (very)	Reliability (α = .87), Validity (construct validity: discriminant to individual flow)
Salanova et al. (2014)	Unspecific	Individual Flow Concept (Csikszentmihalyi, 1975, 2000)	Group absorption, group task enjoyment, balance of challenges and skills	Not reported	Not reported	10	Concrete (thoughts/feelings): e.g., "The group members enjoy themselves while doing the task."	Group	0 (never) to 6 (all the time)	Not reported
van den Hout and Davis (2019) – Team Flow Monito	Unspecific	Conceptualization of Team Flow (van den Hout et al., 2018)	Two-level structure: team flow prerequisites on the second level comprising collective ambition, common goal, aligned personal goals, high skill integration, open communication, safety and mutual commitment on the first level; team flow characteristics on the second level comprising sense of unity, sense of joint progress, mutual trust and holistic focus on the first level	Participants were asked to indicate to what extent the statements apply to their team	Several iterations of expert group and panel group discussions	37	Vague (metaphoric): e.g., "Actions naturally flow in quick succession"; concrete (thoughts/feelings/observations): e.g., "We pay attention to each other's activities"	Group	1 (strongly disagree) to 7 (strongly agree)	Reliability (α = .80 to α = .95), validity (factor validity: indicated by CFA; construct validity: analyses for convergence at group level and discriminant validity with happiness; criterion validity: group performance, time in flow)

Reference	Context[1]	Theory	Factors	Items						Evaluation
				Instruction	Generation	#	Content Type	Perspective	Response scale	
van Oortmerssen et al. (2022)	Work	Individual Flow Concept (Csikszentmihalyi, 1975, 2000), Group Flow Concept (Sawyer, 2003, 2006, 2007)	First order factors: Team absorption, team enjoyment, team interaction; second order factor: total factor	Participants were asked to report their perception of what is going on in the group	Adaption of the WOLF (Bakker, 2008) towards group flow and addition of five specific items based on previous study (Kaye & Bryce, 2012)	16	Concrete (thoughts/feelings/observations): e.g., "We enjoy ourselves while working together"	Group	1 (never) to 7 (always)	Validity (factor validity: indicated by CFA)
Zumeta et al. (2016)	Unspecific	Individual Flow Concept (Csikszentmihalyi, 1975, 2000)	Two-level structure: Total factor on second order comprising the first order factors challenge- skill-balance, action-awareness merging, clear proximal goals, unambiguous feedback, focused concentration, sense of control, loss of self-consciousness, time transformation, autotelic experience	Not reported	Adaptation of the DFS (Jackson & Marsh, 1996) towards group flow	27	Concrete (thoughts/feelings): e.g., "We knew that our capabilities would enable us to face the challenge posed to us"	Group	1 (totally disagree) to 7 (totally agree)	Validity (factor validity: indicated by CFA; construct validity: discriminant to individual flow, group cohesion, collective efficacy)

Note. [1] = The context refers to the area in which the questionnaire can be used in the original version without any modifications. The context mentioned here is not necessarily the same one for which the questionnaire was originally developed. [2] = Citation of the sample item with the kind permission of D. J. Primus (personal communication, January 12, 2023).

CFA = confirmatory factor analysis

In addition to the questionnaires listed in this table, there are several studies (for an overview, see Pels et al., 2018) that purport to capture group flow by asking individual group members to report their individual flow, which is summed across all group members to produce a group value for group flow. However, contrary to the respective authors' claims, this is not a capture of group flow as an emergent state of a group. Instead, it is an assessment of social interactive flow, which is a form of individual flow (Hackert et al., 2022).

References

Aust, F., Heinemann, L., Holtz, M., Hagemann, V., & Peifer, C. (2023). Team flow among firefighters: associations with collective orientation, teamwork-related stressors, and resources. *International Journal of Applied Positive Psychology.* Advance online publication. https://doi.org/10.1007/s41042-023-00093-7

Bakker, A. B. (2008). The work-related flow inventory: Construction and initial validation of the WOLF. *Journal of Vocational Behavior*, *72*(3), 400–414. https://doi.org/10.1016/j.jvb.2007.11.007

Csikszentmihalyi, M. (1975). *Beyond boredom and anxiety*. Jossey-Bass.

Csikszentmihalyi, M. (2000). *Beyond boredom and anxiety*. Jossey-Bass.

Hackert, B., Lumma, A.-L., Raettig, T., Berger, B., & Weger, U. (2022). Towards a re-conceptualization of flow in social contexts. *Journal for the Theory of Social Behaviour*, Article jtsb.12362. Advance online publication. https://doi.org/10.1111/jtsb.12362

Jackson, S. A., & Eklund, R. C. (2002). Assessing flow in physical activity: The Flow State Scale–2 and Dispositional Flow Scale–2. *Journal of Sport & Exercise Psychology*, *24*(2), 133–150. https://doi.org/10.1123/jsep.24.2.133

Jackson, S. A., & Marsh, H. W. (1996). Development and validation of a scale to measure optimal experience: The Flow State Scale. *Journal of Sport & Exercise Psychology*, *18*(1), 17–35. https://doi.org/10.1123/jsep.18.1.17

Kaye, L. K. (2016). Exploring flow experiences in cooperative digital gaming contexts. *Computers in Human Behavior*, *55*, 286–291. https://doi.org/10.1016/j.chb.2015.09.023

Kaye, L. K., & Bryce, J. (2012). Putting the "fun factor" into gaming: The influence of social contexts on experiences of playing videogames. *International Journal of Internet Science*, *7*(1), 23–36.

Mosek, E. (2017). *Team flow: The missing piece in performance* [Dissertation]. Victoria University, Melbourne. http://vuir.vu.edu.au/35038/1/MOSEK%20Erez-Thesis__nosignatures.pdf

Pels, F., Kleinert, J., & Mennigen, F. (2018). Group flow: A scoping review of definitions, theoretical approaches, measures and findings. *PLOS ONE*, *13*(12), e0210117. https://doi.org/10.1371/journal.pone.0210117

Primus, D. J., & Sonnenburg, S. (2018). Flow experience in design thinking and practical synergies with lego serious play. *Creativity Research Journal*, *30*(1), 104–112. https://doi.org/10.1080/10400419.2018.1411574

Rheinberg, F., Vollmeyer, R., & Engeser, S. (2003). Die Erfassung des Flow-Erlebens. In J. Stiensmeier-Pelster & F. Rheinberg (Eds.), *Diagnostik von Motivation und Selbstkonzept* (pp. 261–279). Hogrefe.

Salanova, M., Rodriguez-Sanchez, A. M., Schaufeli, W. B., & Cifre, E. (2014). Flowing together: A longitudinal study of collective efficacy and collective flow among workgroups. *The Journal of Psychology*, *148*(4), 435–455. https://doi.org/10.1080/00223980.2013.806290

Sawyer, R. K. (2003). *Group creativity: Music, theater, collaboration*. Lawrence Erlbaum Associates.

Sawyer, R. K. (2006). Group creativity: Musical performance and collaboration. *Psychology of Music*, *34*(2), 148–165. https://doi.org/10.1177/0305735606061850

Sawyer, R. K. (2007). *Group genius: The creative power of collaboration*. Basic Books Press.

van den Hout, J. J. J., & Davis, O. C. (2019). *Team Flow: The psychology of optimal collaboration*. *SpringerBriefs in Well-Being and Quality of Life Research*. Springer.

van den Hout, J. J. J., Davis, O. C., & Weggeman, M. C. D. P. (2018). The conceptualization of team flow. *The Journal of Psychology*, *152*(6), 388–423. https://doi.org/10.1080/00223980.2018.1449729

van den Hout, J. J. J., Gevers, J. M., Davis, O. C., Weggeman, M. C. D. P., & Wakefield, J. (2019). Developing and testing the team flow monitor (TFM). *Cogent Psychology*, *6*(1). https://doi.org/10.1080/23311908.2019.1643962

van Oortmerssen, L. A., Caniëls, M. C. J., Stynen, D., & van Ritbergen, A. (2022). Boosting team flow through collective efficacy beliefs: A multilevel study in real-life organizational teams. *Journal of Applied Social Psychology*, *52*(10), 1030–1044. https://doi.org/10.1111/jasp.12910

Zumeta, L., Basabe, N., Wlodarczyk, A., Bobowik, M., & Paez, D. (2016). Shared flow and positive collective gatherings. *Anales De Psicología*, *32*(3), 717–727. https://doi.org/10.6018/analesps.32.3.261651