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Effect of Contextual Motivation in Sports on the Evolution of Situational Intrinsic Motivation

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Abstract: The purpose of this study was to examine the evolution of participants' situational motivation in physical activity. From a sample of 194 individuals, the 20 most self-determined, the 20 moderately self-determined, and the 20 least self-determined in sports were selected to participate in the research protocols. These 60 subjects performed a putting task with a golf club on a 1.50 m mat. Immediately afterward, they had to self-assess using the mouse paradigm software in order to measure their intrinsic situational motivation throughout the task. We used multilevel growth curve analyses (MGCAs) to explore the trajectories of students' situational intrinsic motivation during the experimental task. The results revealed a significant positive linear and cubic effect of time and a significant negative quadratic effect of time on situational motivation for highly self-determined students. Our study shows that situational intrinsic motivation is dynamic, and the most self-determined subjects experience a positive evolution in their intrinsic motivation in a specific physical activity.

Keywords: self-determination theory; hierarchical model; sport motivation; mouse paradigm; multilevel analysis

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1. Introduction

According to the World Health Organization [1], more than a quarter of the world's adult population are insufficiently active. Moreover, insufficient activity increased by 5% in high-income countries between 2001 and 2016 [1]. Recently, several publications have tried to explain why many individuals intending to be physically active fail to turn these intentions into action [2]. These scientific considerations raise the question of motivations, that is, the reasons why individuals would agree to engage sustainably in an active lifestyle. Practicing sport or physical activity regularly is not so easy for a large number of citizens, while physical activity has significant health benefits for hearts, bodies, and minds [1]. Therefore, the question of motivations for sport and physical activity is a major issue.

Over the past twenty years, the theory of self-determination (SDT) [3], an emerging field of study in the 2000s, has become a key concept in understanding the behavior of individuals and its consequences. This organismic theory assumes that individuals have an inherent tendency to psychological growth, and individuals would be proactive in the search to learn more, to develop harmoniously, and to connect with others [3]. However, for these human tendencies to be effective, Ryan and Deci [4] emphasize the need for individuals to meet their basic psychological needs for autonomy, competence, and relatedness. These innate tendencies to harmonious development are not automatic

but require supportive conditions to be robust. Autonomy concerns the sense of initiative and the fact of feeling at the origin of these actions. This need is met when individuals are treated as responsible agents, with the ability to make choices within reason [4]. The need for competence refers to the feeling of mastery and achievement and is best met in well-structured environments that offer optimal challenges, positive feedback, and opportunities for growth [4]. The need for relatedness refers to social belonging, which is the perception of feeling recognized and connected. This need is facilitated by a climate of respect and benevolence [4]. The satisfaction of three needs feeds this integrative and proactive tendency of the individual to develop harmoniously. The prototypical expression of this trend is intrinsic motivation (IM). An individual is intrinsically motivated when they perform an activity for their own sake, for the pleasure and satisfaction that it gives them [5]. Intrinsically motivated behaviors do not depend on external incentives or pressures but rather are the result of personal satisfaction in completing a task. Intrinsic motivation is certainly responsible for the human preponderance to learn throughout one's life, unlike learning instrumentalized by an external injunction [6]. Intrinsic motivation has been found to predict higher learning, well-being, and psychological functioning [4].

However, when basic psychological needs are not met, individuals become more involved for extrinsic reasons. Extrinsic motivation concerns behaviors practiced not because the activity is interesting or pleasant but because the activity is instrumental. There are many reasons to engage in an activity to benefit from it. This is why SDT proposes four subtypes of extrinsic regulation. External regulation (ER) refers to externally induced behaviors in order to receive a reward or avoid punishment, whereas introjected regulation (InR) is more internalized as the behavior is induced by pressures no longer external but internal [4]. These two types of regulation represent the controlled forms of motivation. Extrinsic motivation can also be more autonomous. In the identified regulation (IR), the individual personally approves of the commitment and attaches great importance to it, whereas in integrated regulation, the individual recognizes the importance of commitment, but they also believe that this commitment is in accordance with their values, with a certain part of their identity. Conversely, at the lowest level of autonomous behavior is amotivation. An amotivated (AM) person no longer perceives reasons to commit and no longer makes a link between their behavior and the results of the latter [4]. In sport, the more self-determined an athlete, the more persistent they are, and the more they report intentions for future engagement with sport [7]. Vallerand [8] proposed that intrinsic and extrinsic motivation are represented at three hierarchical levels of generality: global, contextual, and situational levels. Global motivation is the highest hierarchical level. They refer to a general motivational orientation to interact with the environment. Global motivation can be related to a personality trait [8]. Contextual motivation refers to specific motivation about distinct sphere of human activity [9]. This level of generality is very important because it explains that an individual can be intrinsically motivated toward sport but extrinsically motivated toward education. The last level of generality is situational motivation. This level refers to the here and now of motivation. It is motivation experienced when individuals are currently engaging in an activity [10]. Consequently, this situational motivation is very interesting to understand the present behavior. A student may have an intrinsic motivation toward a fun activity in sport but extrinsic when graded. Vallerand [8] also indicates that bottom-up and top-down effects are present between situational and contextual level. In sport, Blanchard and al. [11] explain that contextual motivation determines situational motivation (e.g., top-down effect) and how this motivation influences subsequent contextual motivation (e.g., bottom-up effect). The more self-determined an athlete is in sport, the more likely they are to have intrinsic situational motivations. Also, the more an athlete experiences intrinsic situational motivations in sport activity, the more they will strengthen their self-determined

motivation in sport. The situational level is thus essential to a better understanding of people's lives [8]. But very few studies have focused on measuring potential changes in situational motivation within the same situation. We can think that this situational motivation is dynamic [12] and that it is interesting to analyze it to understand the changes in the behavior of individuals. Since situational and contextual motivations have reciprocal effects, do the different degrees of self-determination of motivation in sport have an effect on the evolution of participants' situational motivation?

In line with recent studies [13], this research aimed to develop and implement an innovative technique to explore how psychological processes (i.e., intrinsic motivation) evolve in a particular physical activity situation. Specifically, this study examined the trajectories of situational intrinsic motivation associated with successes or failures in a putting task. In addition, this study also examined whether the evolution of situational intrinsic motivation in this task could be impacted by the level of contextual self-determined motivation in sport.

2. Materials and Methods

A total of 194 French subjects (boys = 68%, Mage = 13.55, SD = 1.23, and girls = 32%, Mage = 13.34, SD = 1.17) voluntarily participated in the present study. They were aged between 11 and 15 years. A total of 106 of them were practicing a sporting activity in a club at the time of the study. The participants completed the French version of the Sports Motivation Scale (SMS) [14] to assess their contextual motivation in sports. The SMS is composed of seven subscales assessed by four items each. Three types of intrinsic motivation were assessed: intrinsic motivation to know (e.g., "Because I experience pleasure and satisfaction while learning new things"), to accomplish (e.g., "For the pleasure I get when i hone my skills"), and to stimulate (e.g., "For the intense emotions I feel doing sports"). Three types of extrinsic motivation were assessed: identified regulation (e.g., "Because it is one of the good ways, I have chosen in order to develop other aspects of my person"), introjected regulation (e.g., "Because I would feel bad if I didn't take the time to do sports"), and external regulation (e.g., "To show others how good I am at sports"). The last subscale was amotivation (e.g., "I don't know. I don't see what it brings to me"). Participants responded to each item on a 7-point Likert scale ranging from 1 (do not correspond at all) to 7 (very strongly correspond). For each subject, we calculated the self-determination index in sports (index = (2IM + IR) − (2AM+ ((ER + InR)/2))).

2.1. Selection of Three Experimental Groups

We then ranked these 194 subjects from the most self-determined to the least self-determined in sports. Based on this ranking, we formed three groups of 20 subjects. We selected the 20 volunteers with the lowest self-determination in sports (AD− group, index < 4.38; 6 girls and 14 boys; Mage = 13.4, SD = 1.14), the 20 volunteers with a self-determination level equal to or close to the average self-determination in sports of the 194 subjects (AD= group, 8.58 < index < 4.46; 6 girls and 14 boys; Mage = 13.20, SD = 1.06), and the 20 volunteers with the highest self-determination in sports (AD+ group, index > 8.58; 5 girls and 15 boys; Mage = 13.33, SD = 1.15). These three groups' self-determination index levels (AD−, M = 1.75, range = −5.92_4.38; AD=, M = 6.47, range = 4.46_7.79; AD+, M = 10.4, range = 8.58_13.1) were significantly different: $F(2,52) = 91.3$, $p < 0.001$. The Power in Two-level design software was used to perform a priori power analysis, which was designed to estimate standard errors of regression coefficients in multilevel analysis for power calculations [15]. If α was chosen at 0.05, a medium effect size of 0.50 was what we expected, and a power of 0.90 was desired, then a sample of 12 participants with 20 measurement points was required. Nevertheless, due

to the risk of dropout inherent to the longitudinal study, 20 participants were included in each group in the present study.

2.2. Presentation of the Experimental Task

All participants performed a putting task in golf. This situation was easily reproducible in various indoor spaces. We installed a putting kit with a flat surface without obstacles indoors. The motor task was to use a putter to send a ball into a hole located 1.50 m away (see Figure 1).

Figure 1. The putting task.

The subject had 20 tries to complete this task as many times as possible. This task corresponded to a sports situation as it involved achieving a sports performance that required physical activity. A try was successful when the ball arrived directly into the hole. After each putt, they had to write their score on a table tennis mark. They indicated the number of successes on the number of moves played.

2.3. Use and Presentation of the Mouse Paradigm

This experimental task was recorded by a digital camcorder (JVC Everio GZ-MG 130, Angers, France) mounted on tripod in front of the player. Immediately after this task, the participant was placed in front of a computer in order to view the video recording of their performance. We invited them to use the mouse paradigm method [16,17]. This records the movements of the computer mouse represented by a cursor on the screen every two hundred milliseconds, five measurements per second. The intent of this software was to obtain time series allowing us to measure the evolution of data over time. We asked the subject, recalling the feeling experienced at each moment of the situation, to continuously indicate to us their degree of agreement with the following statement: "at this time, I continue the activity because I find it interesting and pleasant" at the same time as they watched their performance. This item was representative of intrinsic motivation's definition. Indeed, intrinsic motivation pertains to activities done for their inherent and enjoyment [4]. To answer the item, the more the subject moved the mouse to the left, the more they indicated the importance of their disagreement with the statement. The more they moved it to the right, the more they affirmed their agreement with the statement. The mouse's movements were recorded by the software every 200 ms on a scale ranging from -0- "strongly disagree" (i.e., mouse on the far left) to -640- "strongly agree" (i.e., mouse on the far right) see Figure 2. This methodology was used to continuously measure hypothetical constructs [16]. For our study, it allowed us to better highlight the here and now of situational motivation [8].

Scores from 0 to 640 recorded by the software were not displayed on the screen. The participants took between 3 min 26 s and 6 min 52 s to complete their 20 trials. We recorded 1033 data for the subject who spent the least time in the putting task and 2061 data for the subject who spent the most time in the activity.

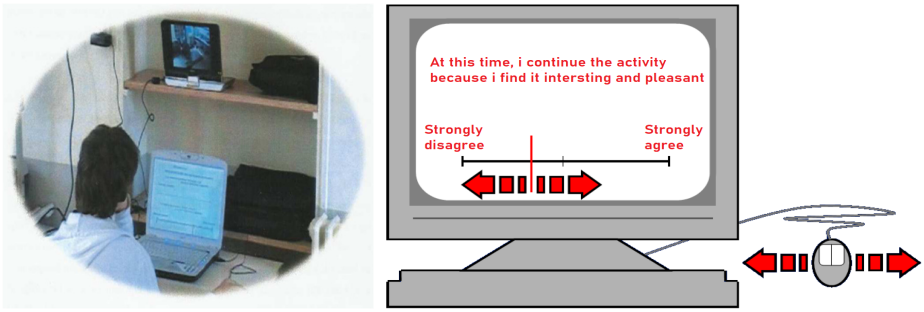

Figure 2. Mouse paradigm.

2.4. Data Analysis Method

To investigate the trajectories of the participants' situational intrinsic motivation throughout the experimental task [18], we employed multilevel growth curve analyses (MGCAs). Multilevel models enabled the extension of multiple regressions to nested data (i.e., data that were hierarchically structured). In this study, the data were collected repeatedly using the mouse paradigm. Specifically, all measurements obtained with the mouse paradigm (5 measures per second) were aggregated across the tests (putts) performed by the participants, resulting in 20 measurement times. Longitudinal data, derived from repeated measures for each subject (level 1 units, inter-individual level) within individuals (level 2 units, intra-individual level), could be analyzed using a multilevel approach. With these multilevel models, we could measure inter-individual differences in intra-individual changes over time. Thus, MGCAs allowed into account the hierarchical structure of the longitudinal data [18].

We conducted separate analyses for each of the sub-samples using the R package (version 1.1.36) labeled lme4 [19]. Specifically, the sample of the present study (i.e., 60 participants) was divided into three sub-samples of 20 participants based on the self-determination index computed using the SMS [14] scores. Thus, the analyses were conducted on the total, low self-determined, moderate self-determined, and high self-determined groups. We examined the intra-class correlation of participants' situational intrinsic motivation (i.e., systematic within- and between-individual variance) by computing the null models [20] before testing the hypotheses. Then, we measured the average and individual differences in each trajectory using a two-level model. We specified time (linear trajectory) as a predictor to calculate the average intercept ($\beta 0$) and the average linear growth ($\beta 1$) at level 1. Since the time variable was centered in the first measurement time (T1), we interpreted the intercept as a reliable measure of situational intrinsic motivation during the first putt of the experimental task. To add the estimation of average quadratic growth ($\beta 2$) and average cubic growth ($\beta 3$), we included the squared time (quadratic trajectory) and the cubic time (cubic trajectory) in the initial models. The MGCA models with the linear parameters were first compared with their respective models with both linear and quadratic parameters and then to models with linear, quadratic, and cubic parameters. In line with the view of parsimony, when chi-square tests revealed a significant improvement of fit [20], we added quadratic and/or cubic functions to the MGCA models. Finally, the random parameters of intercept and linear, quadratic, and cubic slopes were included within the several models.

3. Results

3.1. Null Models

To explore the variance in level 1 residuals (σ^2), we calculated the null models for the dependent variables. The results of the null models are presented in Table 1. The intraclass correlations (ICC = $\tau 00/(\tau 00 + \sigma^2)$) indicated the percentage of between-individual and within-individual variance on the total variance of the dependent variable. The obtained

results indicated that 41.20 to 56.79 percent of the total variance of participants' situational intrinsic motivation for the three groups was represented by between-individual variance The within-individual variation accounted for 43.21 to 58.80 percent of the total variance. Therefore, the results of the null models demonstrated the value of adopting a multi-level approach for analyzing these data.

Table 1. Parameter estimates and variance components of the null models.

Samples	Fixed Effect γ_{00} (SE)	Random Effects σ^2 (SD)	Random Effects τ_{00} (SD)	−2*log Likelihood
Total sample	416.69 *** (12.64)	7026 (83.82)	9235 (96.10)	14,220.9
High self-determined	455.35 *** (19.99)	7808 (88.36)	7599 (87.17)	4780.7
Moderate self-determined	402.14 *** (22.06)	9368 (96.79)	7346 (85.71)	4761.4
Low self-determined	392.58 *** (20.91)	8451 (91.93)	5921 (76.95)	4665.8

Notes: SE = standard errors; SD = standard deviations; γ_{00} is the group mean of situational intrinsic motivation; σ^2 = var(rij) variance in level 1 residual (i.e., variance in rij); τ_{00} = var(U0j) variance in level 2 residual (i.e., variance in U0j). *** $p < 0.001$.

3.2. Over-Time Trajectories of Intrinsic Motivation

Then, the models incorporating only the linear parameter of the trajectories were compared with their respective versions including both linear and quadratic functions, as well as those integrating linear, quadratic, and cubic versions. The results of chi-square tests revealed a significant improvement of fit with the quadratic and cubic parameters for the high self-determined group. In line with the view of parsimony, the model with the linear, quadratic, and cubic parameters was used for the high self-determined group, whereas only the linear parameter was used for the total, low, and moderate self-determined groups. The results of the MGCAs are presented in Table 2.

Table 2. Unstandardized parameter estimates of the growth curve models of participants' situational intrinsic motivation.

	Total Sample	High Self-Determined	Moderate Self-Determined	Low Self-Determined
Fixed effects—Estimates (Standard errors)				
Intercept	415.73 *** (13.42)	404.70 *** (26.61)	412.24 *** (27.95)	385.23 *** (19.51)
Time	0.10 (0.98)	25.28 ** (9.92)	−1.06 (1.88)	0.78 (1.24)
Time2	–	−2.77 ** (0.89)	–	–
Time3	–	0.08 *** (0.03)	–	–
Random effects—Variance (Standard deviation)				
Intercept	9827.74 (99.13)	1202 (109.63)	14,672.80 (121.13)	6662 (81.62)
Time	49.39 (7.03)	1498 (38.70)	62.97 (7.94)	23 (4.76)
Time2	–	8.64 (2.94)	–	–
Time3	–	0.005 (0.07)	–	–
Residual	5295.50 (72.77)	3815 (61.76)	5102.35 (71.43)	5094 (71.38)
−2*loglikelihood	14,012.3	4614.5	4667.3	4633.0

Notes. *** $p < 0.001$ ** $p < 0.01$; Time, linear time; Time2, square time; Time3, cubic time.

The results revealed a significant positive linear effect of time ($\beta = 25.28$, $p < 0.01$), a significant negative quadratic effect of time ($\beta = -2.77$, $p < 0.01$), and a significant positive cubic effect of time ($\beta = 0.08$, $p < 0.01$) on the situational motivation of subjects belonging to the high self-determined group. In contrast, the MGCAs conducted on the total sample, moderate, and low self-determined groups revealed no significant effect of time on participants' situational motivation (all ps > 0.05).

4. Discussion

In the present study, we aimed to evaluate intrinsic motivation evolution in sport activity. The strengths and novelties of our study were the use of mouse paradigm methodology in golf activity and specifically in the putter task to estimate intrinsic motivation evolution. The main results revealed that (i) only the most self-determined in sport could experience an increase in intrinsic motivation even in situation with little success, (ii) the participant's situational motivation was dynamic and evolved during the putting task [10], and (iii) this evolution was dependent on the contextual motivation. The more the contextual motivation was self-determined, the more the situational motivation increased.

The physical activity we proposed was a difficult situation causing many failures over a relatively short period of time. Indeed, on the 20 tests of this putting task, carried out in about 3 min, the three groups (AD−, AD=, and AD+) all had average scores between three and four successes. Thus, the participants were confronted with a task in which they had very few successes. It is interesting to note that there was an effect of time on the intrinsic motivation but only for the most self-determined group. Only subjects with highly contextual self-determined motivation experienced an increase in intrinsic situational motivation in experiences of failure or difficulty (i.e., the putting task). This result is all the more interesting as we know that the intrinsic motivation predicts engagement, which in turn predicts higher returns [21]. This present study showed that in difficult environments with high probability of failure, the most self-determined individuals would have more opportunity to continue to experience intrinsic situational motivation, even if they were not successful. For the other groups, which corresponded to subjects who were slightly or moderately self-determined in sports, it may not be appropriate to confront them with situations where success is limited. In such situations where failure was significant, these participants did not manage to experience or increase their intrinsic situational motivation during the task.

For the high self-determined group, situational motivation evolved over time [12]. The reasons for engagement changed over time for this group. Vallerand [10] stipulates that situational motivation is not as stable as contextual motivation and that motivations evolve within the same situation. Our results confirmed the literature on this point for the AD+ group. During the approximately 3 min of putting, athletes had different reasons to engage. More precisely, intrinsic motivation, the fact of carrying out the activity for itself, evolved. We can also consider that if these athletes were in a state of flow, resulting from intrinsic motivation, this state would evolve during the putting task. A subject who was highly self-determined in sports would be able, for example, to be completely absorbed by the task for two or three putts and then to become distracted, to get tired, to force himself, to continue, and to return to a significant absorption in the activity.

Situational motivation is dependent on contextual motivation, as specified within the top-down effect [10]. The results of the present study highlighted the top-down effect as the more athletes were self-determined, the more their situational motivation evolved positively over time. In other words, the subjects who had the highest level of contextual self-determination in sports also experienced the most important intrinsic motivation states.

Our results indicated that in situations where the difficulty was important, only the self-determined individuals faced the situation by continuing to experience increasingly important situational intrinsic motivation. These results are particularly interesting in the sport context where confrontation with failure and difficulty is significant. In high-performance sport, repetitions are numerous and difficult, and injuries are frequent [22]. In the context of amateur sports or physical activity, we know that health recommendations alone are not enough to engage citizens in regular practice [2]. This involves emphasizing social nutrients to support self-determined contextual motivation. Whether by focusing

on the individual or on the environment we create, it seems essential to create climates that favor competence, autonomy, and social belonging [23]. Indicate, for example, in the situation that is globally failed what is on the other hand specifically successful. If the putt is not successful (cf. the ball in the hole), the trajectory of ball may have been good. Let the subject choose between different courses of action. For each putt, they place the ball where they want on the line. Finally, recognize the subjects in what they do. Our results also involve adapting of situations at the level of contextual motivation of the audience. When an individual is weakly self-determined in a life context, it is useless to confront them with difficult experiences where the probability of failure is high. On the other hand, a highly self-determined sporty individual may see their situational intrinsic motivation evolve positively over time in situations where they fail. However, we can rely on the bottom-up effect to increase the contextual motivation level of individuals. For example, a sporty individual who repeats an intrinsically motivating situation can by bottom-up effect increase their contextual motivation in sports and thus become more resilient in situations where they fail.

In this study we use the mouse paradigm [16,17], which is interesting with respect to the ecological context, the reality of the experience lived by the subject, and the gathering of time series data. Nevertheless, the retrospective side of the measure is debatable as the bias of distortion of events over time [24] and reliability of recalls [25] cannot completely be ruled out even if the data gathering occurred as soon as possible after the putting task. We could also have formed our groups based not on the self-determination index but on motivational profiles. Moreover, it would be interesting for future studies to assess the several dimensions postulated within the SDT (and not only intrinsic motivation) in order to explore the wide range of motivational states of individuals during the activity.

5. Conclusions

The present study highlighted the dynamic nature of situational intrinsic motivation during a putting task. Specifically, intrinsic motivation evolved positively during task realization, only for those who had high self-determined contextual motivation. The results would probably be different if the task allowed for more success. In this task of putting, many failures were experienced, and only the most self-determined in sports saw their intrinsic motivation increase. We can conclude that as long as the contextual motivation is not sufficiently autonomous, it is not appropriate to put individuals in difficult situations with many failures and hope to have a lasting or beneficial change in their behavior. These results are particularly relevant in contexts where failures are frequent. Sports are among these contexts, but they are not the only ones. Our results question all contexts where situations are difficult: parental education when it comes to teaching children to manage their frustration [26] and school education when it comes to learners transforming their behavior that is, for the moment, ineffective. To learn is to want to understand what we do not yet understand [27].

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Institutional Review Board Statement: All procedures performed in this study involving human participants were in accordance with the ethical standards set forth in the 1964 Helsinki Declaration and the 2004 Bioethics Law (Law No. 2004-800 of 6 August 2004). These principles include respect for human dignity (non-mandatory protocol, no right or wrong answers), informed consent (see Informed Consent Statement), and data protection (data were anonymized and used solely for this research).

Additionally, for our study, the Hurriet-Sérusclat Law (Law No. 88-1138 of 20 December 1988) applied. This law mainly concerned biomedical research. However, for non-interventional research, i.e., without risk or constraints, as is the case for our protocol, this law stipulated the following: "non-interventional research, that is, research that poses no risk or constraint to individuals, does not require approval from a protection committee." Therefore, at the time of this study, we did not need approval from an ethics committee. Nevertheless, for this publication, we consulted the research ethics committee of the Catholic University of the West. They recognized the implementation of a scientific approach respecting the ethical principles of research in the present research protocol (2024-01-000111).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study. Practitioners participated voluntarily in the study and were guaranteed that any information given would be treated confidentially. Verbal informed consent was obtained from children, and written informed consent was obtained from the parents of the children prior to data assessments.

Data Availability Statement: The data presented in this study are available on request from the corresponding author.

Conflicts of Interest: The authors have no relevant financial or non-financial interests to disclose.

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