Original Article

The effectiveness of direct corners in high level soccer depending on the type and the zone of delivery

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Abstract
Sports analytics and performance analysis in general have a great contribution to improving the performance of soccer players and teams. The efficiency in corners is crucial for the final result of a soccer game. For this reason, the corners are widely studied by both team analysts and researchers. This study analyzed the corners that were executed directly (i.e., corners that were not executed with a short pass) in the Greek Super League 2020–21. The sample consisted of 1709 direct corners that were performed during the championship (N = 240 games). Statistical analyses were performed and employed log–linear analysis and the chi-square test. The obtained results showed that the percentage of out-swinging corners ending in a final effort was statistically significantly higher than the percentage of in-swinging corners, but there was no statistically significant difference in the respective percentages of corners that ended in goals. The results also showed that the percentage of counterattacks was statistically significantly higher for the corners executed in the goalkeeping (Gk) zone compared to the corners executed in the 1st post (nearest to the corner kick). In addition, the percentage of final attempts in the 2nd post and the penalty zone were significantly higher than the percentage of final attempts in the 1st post, while the percentage of final attempts in the penalty zone was significantly higher than the corresponding percentage in the Gk zone. The research findings can be used by coaches to improve the efficiency of their team while executing corners, both during the defense and in the attack phase.
Keywords: football; set pieces; performance analysis; performance indicators; in-swinging; out-swinging.

Introduction
        Studies show that successful - winning teams take more corners than unsuccessful - losing ones (Evangelos et al., 2014; Sgro et al., 2016; Stafylidis et al., 2022). The effectiveness of corners in football depends on many factors. 82% of corners are executed directly (Casal, 2015) and this method leads to the most goals (Sánchez-Flores, 2012). Goals scored from a corner have been shown to play an important role in the final result. Specifically, between 69% and 76% of the goals resulting from corners have contributed to a winning result or points to the teams (Maneiro, 2021; Strafford, 2019 & Casal, 2015). Therefore, examining the effectiveness of direct corners depending on the type and the zone of delivery could provide important information to the coaches.
Performance analysis is now widely used in many sports (Bailey, 2011). Performance in ball games is much more difficult to assess than in individual sports (Carling, 2005). As mentioned by Carling (2005), match analysis is the objective recording and examination of events that occur during the game. When analyzing a match, this is done through the analysis of the 5 "phases/ key moments" of the game, which are considered the organized attack, the defensive transition, the organized defense, the offensive transition, and the set pieces (Hewitt, 2016). Set pieces are referring to all restarts that take place in the match and are as follows: kick-off, goal kick, throw-in, free kick, corner kick, and penalty kick. 32-40% of goals are scored in matches awarded from set pieces (Molina, 2018; Kubayi, 2020), while 29% of them are awarded from corners (FC Barcelona Analysis Department, 2021).
        In recent years, there has been an increase in the number of studies conducted on the analysis of football matches (Bondia, 2017; Plakias, 2022). According to the relevant literature, in each match an average of about 10 corners are performed (Sánchez-Flores, 2012; Strafford, 2019). 82% of corners are executed directly (Casal, 2015). Although indirect executions result in more final efforts, direct executions lead to more goals (Sánchez-Flores, 2012). About corners that result in a final attempt, there is a big discrepancy in the literature, since the percentage ranges from 9.9% to 30% (Strafford, 2019; Barca Innovation Hub 2021). 1.3% to 3.3% of the corners end up in

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goals (Carling, 2005; Schmicker, 2013; Casal, 2015; Strafford, 2019; Barca Innovation Hub 2021), while 5 to 15% of them end up in counterattacks for the opponent team (Carling, 2005; Sánchez-Flores, 2012; De Baranda, 2012). The majority of the existing research shows that the direct corner kicks are roughly split or there is a slight advantage (55 vs. 45%) of in-swinging over out-swinging corner kicks. (Casal, 2015; De Baranda, 2012). In terms of efficiency based on this factor, research shows that more final attempts are made if corner kicks are executed from the right and the left corner using the right and left foot, respectively and are considered as a result out-swinging corner kicks (Barca Innovation Hub 2021; Casal, 2015; Kubayi, 2019). There are different views on the goals scored as Carling (2005), Casal (2015), and Kubayi (2019) claim that in-swinging corners give more goals (without finding a statistically significant difference), while Barca Innovation Hub (2021) gives a small lead in the out-swinging corners (without a statistically significant difference as well). Regarding the opponents' counterattacks, Carling (2005) argues that they are more after executions with the opposite foot (i.e. left and right foot from the right and left corner, respectively) and considers that this is the price paid in the effort to increase the chances of scoring a goal.

Another variable that has been examined in terms of its effectiveness is the area of the football field where the corners are executed. Kubayi (2019) argues that most corners with the best percentages in final attempts as well as the most goals being scored are executed on the 1st post and in the middle of the goal. According to Schmicker (2013), only the space in the center of the box brought higher goal percentages than expected while Pulling (2013) found that more final attempts were made from the 1st post and followed the center of the box. To the best of our knowledge, no research to date has correlated the zone of delivery with the possibility of counterattack by opponents. Also, we found only one study that examined the interaction of zone of delivery and type of execution in the effectiveness of corners (Fernández-Hermógenes, 2021).

To address the identified research gap, this study aimed to investigate whether the type of execution and the zone in which a direct corner was executed in the Greek Super league 2020-21 affected its effectiveness by answering the following research questions: to what extent the type and the point of execution of the corners (independently or their interaction) affect 1) the achievement of a goal, 2) the realization of the final effort (with or without the achievement of a goal) and 3) the ability of the defending team to counterattack.

Material and Methods
Sample
          The sample used for the present study was the total of corners executed directly in the Greek Super League in the 2020-2021 season (regular time and play-off / play-out), i.e. 1709 corners from 240 games (182 in the regular season and 58 in play-off / play-out). 192 from these were excluded either because neither out-swinging nor in-swinging corners were performed, or because the ball was not directed to any of the zones examined after the corner execution, or because both these conditions were not met during the execution of the same corner kick. Thus the final sample consisted of 1517 corner kicks.
Procedure
          Data were obtained from the analysis platform Instatscout (section set pieces & crosses) with an appropriate selection of competition, teams, and variables that were necessary for the study. According to previous research, the reliability of the indicators obtained by Instatscout is very high (K values 0.90 to 0.98) (Casal et al., 2019; Castellano & Echeazarra, 2019; Gómez et al., 2018). Ethics committee approval of the current study was given from the local university.
Variables-Definitions

Table 1. Variables, definitions, and acronyms

Direct corner		The ball is sent to the shot zone with just one touch (Casal et al., 2015)
Delivery type (HOW) (figure 1)	In-swinging (INS)	The ball is spinning/curling towards the goal (Strafford et al., 2019)
	Out-swinging (OUTS)	The ball is spinning/curling away from the goal (Strafford et al., 2019)
Delivery zones (WHERE) (figure 2)	1st post (1post)	According to the zones that Instatscout divides the shot zone
	2nd post (2post)	
	GK zone (Gkz)	
	Penalty zone (Pz)	
Outcome	Goal	
	Final attempt without goal (FAWG)	
	Final attempt with & without goal (ATTEMPT)	
	Counterattack (C/A)	
	No final attempt & no counterattack (NA&NC)	

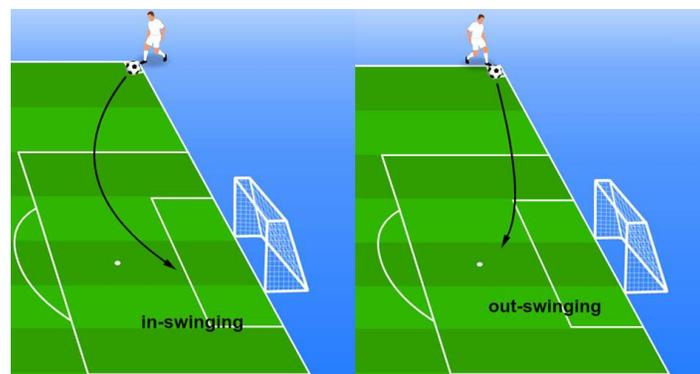

Figure 1. Delivery type

Figure 2. Delivery zones

Statistical Analyses

        Data were analyzed using the statistical package SPSS (IBM, Version 25). Loglinear analysis was used to study the interaction between the three categorical variables (Vermunt, 2005; Wickramasinghe, 2009). Chi-square (x^2) analysis was then used to examine whether there were statistically significant differences between the variables in pairs (Franke, 2012; McHugh, 2013). Specifically, the following interactions were examined:

- Delivery type (In-swinging, Out-swinging) and execution zone (1st post, 2nd post, GK zone, penalty zone).
- Delivery Type (In-swinging, Out-swinging) and Outcome (goal, no goal).
- Delivery Type (In-swinging, Out-swinging) and final effort (attempted, not attempted) regardless of whether they scored a goal or not.
- Delivery Type (In-swinging, Out-swinging) and counterattack (C/A, NO C/A).
- Execution zone (1st post, 2nd post, GK zone, penalty zone) and Outcome (goal, no goal)
- Execution zone (1st post, 2nd post, GK zone, penalty zone) and final attempt (attempted, not attempted) regardless of whether they scored a goal.
- Execution zone (1st post, 2nd post, GK zone, penalty zone) and counterattack (C/A, NO C/A).

        When a statistically significant difference ($p < 0.05$) was found in the Chi-Square Tests, in cases where one of the two variables had more than two categories, the categories were examined in pairs to find between which of them there was a statistically significant difference (McHugh, 2013). The values of the cells expected were 5 or more in at least 80% of the cells, and no cell had an expected of less than one. These conditions are necessary for applying Chi-Square analysis (McHugh, 2013). Descriptive Statistics Frequencies were calculated for the selected variables.

Results

Descriptive Statistics

The frequencies of the variables investigated are reported in Table 2.

Table 2. Derived frequencies for the execution method (HOW), the execution zone (WHERE), and the result of the corners (OUTCOME).

HOW			WHERE			OUTCOME		
	Frequency	Percent		Frequency	Percent		Frequency	Percent
INS	768	50,6	1post	642	42,3	GOAL	39	2,6
OUTS	749	49,4	2post	161	10,6	FAWG	362	23,9
Total	1517	100	Gkz	394	26	C/A	160	10,5
			Pz	320	21,1	NA&NC	956	63
			Total	1517	100	Total	1517	100

Loglinear Analysis

The loglinear analysis results are presented in Tables 3 and 4. In Table 3 we observe that the effect of the individual variables (K = 1) on the model was statistically significant (Sig. < 0.001). Also, the bilateral interactions between the variables had a significant effect on the model (Sig. < 0.001). In contrast, the tripartite interaction of the variables was not significant (Sig. = 0.243).

Table 3. K-Way and Higher-Order Effects from loglinear analysis.

							Number of Iterations
K-Way and Higher-Order Effects							
			Likelihood Ratio		Pearson		
	K	df	Chi-Square	Sig.	Chi-Square	Sig.	
K-way and Higher Order Effects[a]	1	31	1775,349	,000	2271,846	,000	0
	2	24	173,291	,000	172,610	,000	2
	3	9	12,554	,184	11,500	,243	4
K-way Effects[b]	1	7	1602,057	,000	2099,236	,000	0
	2	15	160,737	,000	161,111	,000	0
	3	9	12,554	,184	11,500	,243	0

Table 4. Results for absolute and relative frequencies from loglinear analysis.

HOW	WHERE	OUTCOME	Observed Count	Observed %	Expected Count	Expected %	Residuals	Std. Residuals
Cell Counts and Residuals								
INS	1post	GOAL	7	0,5%	8,748	0,6%	-1,748	-0,591
		FAWG	74	4,9%	69,435	4,6%	4,565	0,548
		C/A	31	2,0%	27,336	1,8%	3,664	0,701
		NA&NC	239	15,8%	245,481	16,2%	-6,481	-0,414
	2post	GOAL	4	0,3%	3,801	0,3%	0,199	0,102
		FAWG	29	1,9%	28,509	1,9%	0,491	0,092
		C/A	15	1,0%	12,037	0,8%	2,963	0,854
		NA&NC	54	3,6%	57,652	3,8%	-3,652	-0,481
	Gkz	GOAL	5	0,3%	6,589	0,4%	-1,589	-0,619
		FAWG	41	2,7%	51,513	3,4%	-10,513	-1,465
		C/A	38	2,5%	32,944	2,2%	5,056	0,881
		NA&NC	152	10,0%	144,954	9,6%	7,046	0,585
	Pz	GOAL	0	0,0%	1,481	0,1%	-1,481	-1,217
		FAWG	26	1,7%	25,675	1,7%	0,325	0,064
		C/A	8	0,5%	8,888	0,6%	-0,887	-0,298
		NA&NC	45	3,0%	42,956	2,8%	2,044	0,312
OUTS	1post	GOAL	9	0,6%	7,252	0,5%	1,748	0,649
		FAWG	53	3,5%	57,565	3,8%	-4,565	-0,602
		C/A	19	1,3%	22,664	1,5%	-3,664	-0,770
		NA&NC	210	13,8%	203,519	13,4%	6,481	0,454
	2post	GOAL	2	0,1%	2,199	0,1%	-0,199	-0,134
		FAWG	16	1,1%	16,491	1,1%	-0,491	-0,121
		C/A	4	0,3%	6,963	0,5%	-2,963	-1,123
		NA&NC	37	2,4%	33,348	2,2%	3,652	0,632
	Gkz	GOAL	6	0,4%	4,411	0,3%	1,589	0,756
		FAWG	45	3,0%	34,487	2,3%	10,513	1,790
		C/A	17	1,1%	22,056	1,5%	-5,056	-1,077
		NA&NC	90	5,9%	97,046	6,4%	-7,046	-0,715
	Pz	GOAL	6	0,4%	4,519	0,3%	1,481	0,697
		FAWG	78	5,1%	78,325	5,2%	-0,325	-0,037
		C/A	28	1,8%	27,113	1,8%	0,887	0,170
		NA&NC	129	8,5%	131,044	8,6%	-2,044	-0,179

Chi-Square Analysis

The results from the Chi-Square Tests performed are presented in Table 5 and 6. It can be seen that out-swing corners more often result in a final attempt compared to in-swing corners (p = 0.048), but without a statistically significant difference in the goals scored (p = 0.224). These two types of execution lead to attempts in different zones (p < 0.001). In addition, the corner kick zone appears to influence the probability of a final attempt

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($p < 0.001$) and the probability of a counter-attack by the defending team ($p = 0.015$), but not the success of a goal ($p = 0.666$). In particular, executions in the Gkz seem to be more associated with counterattacks by opponents (14%), while executions in the Pz seem to result more often in a final attempt (34.4%)

Table 5. Chi-Square Tests

VARIABLE	CRITERION	Value	df	Asymptotic Significance (2-sided)
GOAL - NO GOAL	HOW (INS - OUTS)	1,476[a]	1	0,224
ATTEMPT - NO ATTEMPT	HOW (INS - OUTS)	3,924[a]	1	0,048
C/A - NO C/A	HOW (INS - OUTS)	3,381[a]	1	0,066
HOW (INS - OUTS)	WHERE	114,326[a]	3	0,000
HOW (INS - OUTS)	1post - 2post	3,945[a]	1	0,047
HOW (INS - OUTS)	2post - Gkz	,573[a]	1	0,449
HOW (INS - OUTS)	1post - Gkz	2,715[a]	1	0,099
HOW (INS - OUTS)	1post - Pz	77,678[a]	1	0,000
HOW (INS - OUTS)	2post - Pz	68,233[a]	1	0,000
HOW (INS - OUTS)	Gkz - Pz	88,801[a]	1	0,000
GOAL - NO GOAL	WHERE	1,570[a]	3	0,666
ATTEMPT - NO ATTEMPT	WHERE	19,033[a]	3	0,000
ATTEMPT - NO ATTEMPT	1post - 2post	6,211[a]	1	0,013
ATTEMPT - NO ATTEMPT	2post - Gkz	2,911[a]	1	0,088
ATTEMPT - NO ATTEMPT	1post - Gkz	,754[a]	1	0,385
ATTEMPT - NO ATTEMPT	1post - Pz	16,133[a]	1	0,000
ATTEMPT - NO ATTEMPT	2post - Pz	,350[a]	1	0,554
ATTEMPT - NO ATTEMPT	Gkz - Pz	8,164[a]	1	0,004
C/A - NO C/A	WHERE	10,478[a]	3	0,015
C/A - NO C/A	1post - 2post	2,639[a]	1	0,104
C/A - NO C/A	2post - Gkz	,461[a]	1	0,497
C/A - NO C/A	1post - Gkz	10,209[a]	1	0,001
C/A - NO C/A	1post - Pz	3,144[a]	1	0,076
C/A - NO C/A	2post - Pz	,032[a]	1	0,858
C/A - NO C/A	Gkz - Pz	1,166[a]	1	0,280

Table 6. Descriptive statistics from the Chi-Square Tests

	HOW		WHERE			
	INS	OUT	1post	2post	Gkz	Pz
GOAL	2,1%	3,1%	41,0%	15,4%	28,2%	15,4%
NO GOAL	97,9%	96,9%	42,4%	10,5%	25,9%	21,2%
ATTEMPT	24,2%	28,7%	22,3%	31,7%	24,6%	34,4%
NO ATTEMPT	75,8%	71,3%	77,7%	68,3%	75,4%	65,6%
C/A	12,0%	9,1%	7,8%	11,8%	14,0%	11,3%
NO C/A	88,0%	90,9%	92,2%	88,2%	86,0%	88,8%
INS			54,7%	63,4%	59,9%	24,7%
OUTS			45,3%	36,6%	40,1%	75,3%

Discussion

The present study revealed statistically interactions between the how, where and outcome variables. Specifically, in the where-outcome interaction, it appeared that the percentage of final attempts in the penalty area (34.4%) was significantly higher than the percentage of final attempts in the 1st post (22.3%) and in the goalkeeper zone (24.6%), while the percentage of final attempts in the 2nd post (31.7%) was significantly higher than the respective attempts in the 1st post (22.3%). Regarding the counterattacks of the defending team, the percentage when the ball went to the goalkeeper zone (14%) was statistically significantly higher than the corresponding percentage when the ball went to the 1st post (7.8%). The how-outcome interaction showed that the percentage of final attempts made with out-swinging execution (28.7%) was statistically significantly higher than the percentage of final attempts made with in-swinging execution (24.2%). Finally, in the how-where interaction, it was observed

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that the in-swinging executions send the ball to the zones that are close to the goal (1st post, Gk zone, 2nd post), while the out-swinging in the penalty zone.

The descriptive statistics of the variables examined are consistent with the existing literature. Previous studies reported that 1.3% to 3.3% of the corners end up in goals (Carling, 2005; Schmicker, 2013; Casal, 2015; Strafford, 2019; Barca Innovation Hub 2021) and 5 to 15% of corners end up in counter-attacks of the defending team (Carling, 2005; Sánchez-Flores, 2012; De Baranda, 2012). The corresponding values in our research were 2.6% and 10.5% for the corners that end up in goals and counter-attacks, respectively. Regarding the corners that end in a final attempt, there is a big discrepancy in the literature, since the percentage ranges from 9.9% to 30% (Strafford, 2019; Barca Innovation Hub 2021). In our research, a percentage of 26.4% was found, which indicates that about 1 of 4 corners that are executed directly end up in a final attempt of the attacking team. Also, most research shows that the delivery type of direct corners is approximately split or there is a slight superiority (55 vs. 45%) of the corners that are executed with the opposite foot (i.e. In-swinging) in relation to the corners that are executed with the same foot (i.e. out-swinging) (Casal, 2015; De Baranda, 2012). In our research, this superiority was even smaller (50.6% vs 49.4%). Finally, Kubayi (2019) argues that most corners are executed on the 1st crossbar with a rate of 42.3%. In our research, we found a similar percentage, although the zones of the shooting area were defined differently compared to Kubayi (2019).

The novelty of the present research lies in the results concerning bilateral interactions of the examined variables (i.e. how, where and outcome). To date, there have been no available data in the literature regarding interactions between the area where a corner is taken and the possibility of a counterattack by the defending team. We found that the percentage of counterattacks when the ball went to the goalkeeper zone (14%) was statistically significantly higher than the corresponding percentage when the ball went to the 1st post (7.8%). If we take into account the fact that goalkeepers usually take a position between the middle of the goal and the 2nd post during corners' executions, it seems that the role of the goalkeeper in counterattack is very important.

By catching the ball, the goalkeeper gains the advantage to perform an accurate pass to a teammate and initiate an efficient counter-attack, compared to intercepting the ball first from any other defender. Perhaps for this reason, the teams that are ahead in the scoreline avoid taking the corners towards the middle of the goal and on the contrary, their main preference is the execution towards the 1st post (De Baranda, 2012). We also did not find in the literature any study that examnined the interaction of the execution type with zone where the ball is directed. In our investigation, it appeared that the in-swinging executions send the ball to the zones that are close to the goal (1st post, Gk zone, 2nd post), while the out-swinging in the penalty zone. This seems logical as in in-swinging corners the ball takes a trajectory toward the goal while in out-swinging away from it. Moreover, if the curve of the trajectory in an out-swinging corner is large, then for the ball to reach the zones near the goal, it is required first to travel outside the lines of the playing field.

In terms of effectiveness based on the type of delivery, research shows that most final attempts are made after corner kicks with the same foot (i.e. corner kicks are executed from the right and the left corner using the right and left foot, respectively) (Barca Innovation Hub 2021; Casal, 2015; Kubayi, 2019) which our research agrees with since we found a statistically significant higher percentage of final attempts after out-swinging executions compared to in-swinging executions.

The fact that out-swinging executions bring the ball toward the attackers seems to play an important role in this result. For the goals scored depending on the type of delivery, our research agrees with the Barca innovation Hub (2021) as it gives a small lead to the out-swinging corners, but without having a statistically significant difference compared to in-swinging corners (3.1% vs. 2.1%) and disagrees with the previous studies (Carling, 2005; Casal, 2015; Kubayi 2019) that gave a small lead without a statistically significant difference in in-swinging corners. The fact that the differences are not statistically significant in all studies may be due to differences in the level of competition in these studies. Finally regarding the opponents' counterattacks, Carling (2005) claims that they are more after executions with the opposite foot (i.e. in-swinging), a finding which is in agreement with our research, but without observing statistically significant differences (opposite foot 12% vs. same foot 9.1%).

While examining the corner type and zone of delivery interaction in the outcome, Fernández-Hermógenes (2021) reported more final attempts with out-swinging corners in the penalty area and in-swinging corners in the first post. This is in line with the findings of our research, but without statistically significant differences in the

HOW-WHERE-OUTCOME interaction.

The observations made in the present study are based on data collected from a specific league and as a result cannot be generalized for different competitions, especially in those where knock-out games are required and the players' way of thinking is probably different.

Therefore, further research is needed in different leagues and levels of competition. Additionally, more variables should be examined, given that the outcome of the corners can be influenced by other factors, such as the ranking of the teams, the scoreline of the match at the time of execution as well as the number and position of defenders and attackers.

Conclusions

To conclude, the present study revealed statistically interactions between the how, where and outcome variables. Particularly, in the where-outcome interaction, it appeared that the percentage of final attempts in the penalty area was higher than the percentage of final attempts in the 1st post and in the goalkeeper zone, while the percentage of final attempts in the 2nd post was higher than the respective attempts in the 1st post. Regarding the counterattacks of the defending team, the percentage when the ball went to the goalkeeper zone was higher than the corresponding percentage when the ball went to the 1st post. The how-outcome interaction showed that final attempts made after out-swinging execution were more frequent than final attempts made after in-swinging execution. Furthermore, in the how-where interaction, it was observed that the in-swinging executions send the ball to the zones that are close to the goal (1st post, Gk zone, 2nd post), while the out-swinging in the penalty zone. Therefore, our research provides new insights into the effect that the type of execution of the corners can have on the zone where the ball is delivered as well as into the combined effect of the corner type and zone of delivery on the outcome. The practical significance of the results of the HOW-WHERE interaction is that the defenders may have to adjust their position farther from the goal when they see that the player who will perform the corner is preparing for out-swinging execution, relative to the position they should have in in-swinging executions. Also, because out-swinging executions lead to statistically significantly more final attempts, but this does not apply to goals scored, it may indicate that coaching staffs need to place more emphasis on practicing the successful completion of such actions. Finally, coaches should advise their players to avoid sending the ball close to the goalkeeper, if they are ahead in the scoreline and want to reduce the chance of a counterattack by the opposing team.

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