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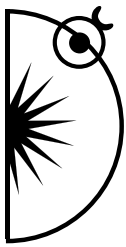

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Loneliness, Metaperception and Peer Network Position Among Early Adolescents

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Abstract
The relationship between position in a peer network (liking, disliking, popular, unpopular), its perception (metaperception), and loneliness were studied in a sample of 629 pupils (221 from grade 5 and 408 from grade 6 of primary school). The analyses conducted (Multiple Indicators, Multiple Causes Models – MIMIC - and SEM) first of all showed that among boys loneliness is mostly linked to unpopularity and among girls to disliking. These results prove the existence of cross-gender differences in the "location" of the source of stress that impacts loneliness: a fixed reputation of being unpopular among boys and negative dyadic relationships among girls. The second noteworthy result is that the negative assessment criteria of position in the peer network hierarchy are more important than the positive ones. This pattern holds with both, boys and girls. The third important result is that metaperception mediates between position in the network and loneliness. However, this relationship only appears in the case of the disliking criterion.

Keywords: loneliness, peer network, early adolescence.

Loneliness and position in the peer network among younger adolescents[1]

Loneliness is an unpleasant emotional state filled with sadness and anxiety caused by a lack of satisfying social relations (Asher & Weeks, 2013). In the public awareness, loneliness is a problem of the elderly but research demonstrates that it is also often experienced by younger people (Perlman & Landolt, 1999). Some studies show that loneliness is particularly intense in adolescence (Woodhouse at al., 2012), but also in the early phase of adolescence (Ladd & Ettekal, 2013). In fact up to 12% of schoolchildren have been reported to experience loneliness (Cassidy & Asher, 1992).

Schools contribute to the reduction of the role of parents and amplification of the significance of peer relationships. These relationships become the source of instrumental, social and emotional support, but a deficit in them leads to loneliness (Prinstein at al., 2009). However, an objective deficit of social relations is not equivalent to a sense of loneliness, either theoretically or empirically (Cacioppo at al., 2014). This is confirmed by the relatively low correlations between them found, i.e. not greater than 0,4 (Parker & Asher, 1993).

Multidimensionality of the peer network

An individual's position in their peer network has many dimensions, two of which are most often distinguished, i.e. liking and disliking. Another dimensions of peer relationships have been given more attention in recent times, among them popularity and unpopularity (Mayeux at al., 2011). Whereas (dis)liking is a dyadic construct, reflecting an individual's personal relationship with one of their peers, (un)popularity is a belief shared within a group (Gorman at al., 2011).

Evidence of the specificity of (dis)liking and (un)popularity is moderate correlations between them, ranging from 0.25 (Dawes & Xie, 2017) to 0.72 (Litwack at al., 2012). They also differ in their stability over time – (un)popularity as a measure is almost twice as stable (Mayeux & Cillessen, 2008). These dimensions of peer status have also different correlates. The "liked" children are usually pro-social and non-aggressive, whereas popular pupils combine positive and negative characteristics (Schwartz at al., 2006); they are pro-social

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but use anti-social strategies to gain a position in a group in early adolescence (Sandstrom & Cillessen, 2006).

Similarly to liking and disliking, popularity and unpopularity are not the two ends of a continuum (Cillessen & Marks, 2011). This is confirmed by low correlations between these two measures, in the case of primary school children ranging from 0.05 (Gorman et al., 2011) to 0.45 (Lease at al., 2002).

There are reasons for thinking that loneliness is more sensitive to negative social information than to positive. Behavioural studies suggest that lonely individuals show greater sensitivity to negative social signals (Egidi at al., 2008). Similar conclusions have also been reached by studies using functional magnetic resonance imaging (fMRI) (Cacioppo at al., 2015) and eye-tracking research (Lodder at al., 2016). Previous studies – in line with the concept of positive-negative asymmetry – consistently show that negative information is more intensely processed and contributes more strongly to final individual perceptions and social judgments than positive information. Generally, negative events are stronger determinants of mood and emotions than positive events (Taylor, 1991).

The constructs described above capture various aspects of the network, so it is worth including them in the analysis as complementary. To the authors' best knowledge only one such study has been conducted to date (Gorman et al., 2011).

Gender as a moderator of relationship between peer network and loneliness

The results of the research do not clearly prove the existence of gender differences in the level of loneliness. A meta-analysis conducted by the Mahon team (2006) demonstrated that of the 31 analyses they conducted, as many as 19 did not show any statistically significant differences between boys and girls.

But gender may be a factor moderating between the various relations occurring between position in a multi-dimensionally interpreted peer network and loneliness. Research shows that girls are prone to creating more dyadic relationships, whereas boys build broader networks (Rose & Rudolph, 2006); emotional support is important for girls, shared activity for boys (Ko at al., 2015). It can therefore be assumed that in the loneliness of girls the dimension of liking is important, and in the loneliness of boys, popularity.

Metaperception as a mediator of the relationship between a position in a social network and loneliness

Social studies differentiate between actual network position and perceived position in a group. The latter refers to "a person's sense of place within a hierarchy, which may or may not agree with objective status" (Sweeting at al., 2011, p. 493). This distinction is particularly important in the studies of early adolescents because their ability to perceive their position in the social network may be limited (Cillessen & Bellmore, 2011). So, the metaperception of liking/disliking or popularity/unpopularity may be an important mediator between objective network measures and loneliness.

The relationship between metaperception and loneliness has been studied by few researchers (Cillessen & Bellmore, 1999; Vanhalst at al., 2013; Putarek & Keresteš, 2016). As expected, the relationship between meta-perception and loneliness was stronger than for more objective measures of a position in a social network.

Limitations of previous studies

Most studies of the relationship between position in a social network and loneliness include only one measure of position in the social hierarchy, usually "liking". Only a few studies to date have considered liking and disliking as independent factors (Cassidy & Asher, 1992; London et al., 2007; Grygiel et al., 2011; 2019), although none of them investigated the network determinants of loneliness as their main goal; hence the results are of limited use. Their main drawbacks are (1) no net impact estimates; (2) no estimates of the differences in the force of impact of positive and negative measures on loneliness; (3) only one previous study (Cassidy & Asher, 1992) has considered gender. It is therefore hard to establish any possible differences in the force of the influence of one's position in positive or negative networks on loneliness.

Hypotheses

The literature review helped us identify some weak points of previous research on the network determinants of loneliness among younger adolescents, which led us to defining our research problem in terms of three basic hypotheses:

1. Among girls, loneliness may be related to liking/disliking, whereas among boys loneliness would be associated with popularity/unpopularity.
2. Loneliness may be more strongly associated with negative than positive aspects of a peer network. In connection with the first hypothesis this

allows us to suppose that in loneliness among girls disliking is more important, while in loneliness among boys unpopularity would be more important.

3. The relationship between a position in the peer network and loneliness may be mediated by metaperception.

For the purpose of verifying the hypotheses the optimal solution would be: (1) ensuring cross-gender invariance of loneliness in the measurement part of the model, and (2) including various aspects of the position in peer networks (liking/disliking, popularity/unpopularity, positive and negative metaperception) in the structural part of it.

Method

Participants and procedure

629 pupils (221 from grade 5 and 408 from grade 6 of primary school) participated in the study. These were selected from 49 different classes in 13 schools, from both municipal and rural areas. The mean age of the respondents was 11.61 (SD = 0.55) in grade 5, and 12.56 (SD = 0.65) in grade 6. Data was collected in the spring of 2017. Written consent was obtained from the children's parents or legal guardians. Data was collected using Computer-Assisted Web Interview (CAWI).

Measures

Loneliness – De Jong Gierveld Loneliness Scale. The DJGLS (de Jong Gierveld & Kamphuls, 1985; Polish adaptation: Grygiel at al., 2013) consists of 11 statements, to which interviewees respond using a 4-point scale, ranging from 1 (yes) to 4 (no). The higher total score the higher level of loneliness. The scale is reliable and valid for research on younger adolescents (Grygiel et al., 2019).

Network measures. Students were asked to nominate an unlimited number of classmates in six categories: likeability (Like), unlikeability (DisLike), popularity (Pop), unpopularity (UnPop), positive metaperception (PosMet) and negative metaperception (NegMet). The exact wording of the questions is presented in Table 1. The analysis used the in-degree for popularity, unpopularity, liking and disliking and out-degree for the metaperception of liking and disliking (Freeman, 1978). In-degree centrality was given as the ratio of the sum of nominations received by a child to the number of all possible nominations that could be received. Out-degree centrality is, by analogy, the ratio of the sum of nominations given by a child to the number of all peers in the classroom minus 1. The in-degree and out-degree values range from 0 to 1.

Table 1. The exact wording of the questions used in the sociometric nominations procedure

Measure	Question
Likeability	Mark the people from your class that you like most, with whom you would like to spend the most time
Unlikeability	Mark the people from your class that you dislike most, with whom you would like to spend the least time
Popularity	Who in your class is well liked? Who is the person with whom others want to spend time, have fun? Who is popular?
Unpopularity	Who in your class is not liked? Who is the person with whom others do not want to spend time, have fun? Who is unpopular?
Positive metaperception	Who do you think likes you most in your class? Who would want to spend the most time with you?
Negative metaperception	Who do you think likes you least in your class? Who would want to spend the least time with you?

Source: Authors' research.

Models of statistical analysis

Factor Structure Model of the DJGLS. The preliminary analyses included a confirmatory factor analysis (CFA), carried out to confirm the factor structure of the loneliness measure (i.e., DJGLS). Although DJGLS was developed as a unidimensional tool, the analysis of its structure shows a better fit in the case of bifactor rather than two- or single-factor models (Grygiel et al., 2013; 2019). This structure indicates the existence of three uncorrelated dimensions: the general factor, explaining the majority of the variance between the scale items (i.e. measuring loneliness *per se*) and two subfactors. Importantly, once the general factor is taken into consideration, both subfactors explain only a negligible part of the position variance. The first consists in the statements referring to, according to Weiss' (1973) terminology, the "emotional" dimension of loneliness, and also "negative" statements (example: "I miss having a really close friend"), whereas the second comprises positive statements referring to the "social aspect of loneliness" (example: "There are many people I can trust completely").

Checking the factor structure of the DJGLS for the purposes of this article involved the testing of several confirmatory models: single-factor, two-factor and a bi-factor. The following measures were used to compare the fit of the tested models: (1) root mean square error of approximation (RMSEA), (2) Tucker-Lewis index (TLI), and (3) comparative fit index (CFI). According to the rules accepted (Marsh at al., 2005) we assume that a model that is adequately fitted to data should be characterized by RMSEA values that are equal to or lower than .06, and values of CFI and TLI higher than .90. When

comparing the models we were guided by the principle that the model with the better fit shows lower values of RMSEA and higher values of CFI and TLI.

The single-factor model fits the data badly (RMSEA = 0.089, CFI = 0.970, TLI = 0.962). The two-factor model fits it well (RMSEA = 0.051, CFI = 0.990, TLI = 0.988), but the bi-factor fits even better (RMSEA = 0.048, CFI = 0.993, TLI = 0.989). Unfortunately, in this model four out of five positions' loadings were statistically insignificant on the negative subfactor, which might indicate a misspecification. This is why we have also tested the incomplete bi-factor model, in which only the positive subfactor (PSF) was tested. This was proven to be the best model of those tested (RMSEA = 0.046, CFI = 0.993, TLI = 0.990), with the fit measures being satisfactory both for the subsamples of girls (RMSEA = 0.054, CFI = 0.994, TLI = 0.991) and boys (RMSEA = 0.054, CFI = 0.988, TLI = 0.983).

Cross-gender measurement invariance of the DJGLS. In the next step, the cross-gender measurement invariance of the DJGLS was submitted to analyses. The aim of testing the measurement (configural, metric, scalar and strict) invariance was to verify the assumption that the observable result does not depend on belonging to a gender group but only on the level of the construct studied.

The measurement bias between the two groups occurs if the likelihood ratio χ^2 difference statistic between the two nested models is found to be significant. Results for configural invariance indicated that the fit of the model was satisfactory, χ^2 (78) = 149.2; p <0.01.

For metric invariance testing, a significant $\chi 2$ difference statistic was found ($\Delta\chi^2$ (12) = 28.1; p < 0.01), and equal factor loadings across gender were not assumed. The analysis of modification indices (MI) showed that improvement of the model fit could be achieved by releasing two loadings: item 10 (MI = 5.23) and item 11 (MI = 4.97) of the scale. For the modified model the χ^2 difference test is insignificant ($\Delta\chi^2$ (9) = 16.4; p = 0.06).

For scalar invariance, a significant χ^2 difference statistic ($\Delta\chi^2$ (18) = 38.6; p < 0.01), and equivalent item threshold were not assumed. The modification indices showed that the model fit would be improved by the release of the first (MI = 9.17) and the third (MI = 5.83) threshold of position 8. The modified model is characterized by good fit to data and the insignificant value χ^2 of the difference test ($\Delta\chi^2$ (16) = 26.0; p =0.05).

Additionally, the comparisons of strict and scalar invariance models yielded $\Delta\chi^2$ (9) = 32.4; p < 0.01, indicating that strict invariance did not emerge across gender. MI demonstrated that achieving a strict invariance requires the releasing of the residual variance for position 1 (MI = 39.83). Such a model is characterized by a good fit to data and – most importantly – a negligible value of the $\chi 2$ difference test ($\Delta\chi 2$ (8) = 12.9, p = 0.12). It can be assumed that the

measurement among boys and girls is characterized by partial strict measurement invariance.

All subsequent analyses were based on the last of the models described here.

Reliability and unidimensionality of the DJGLS. In order to investigate the reliability and unidimensionality of the DJGLS scale we used Cronbach's α, ω (omega), ω_H, ω_S, ω_{HS} and ECV (explained common variance) coefficients. Both the α coefficient and its equivalent for the latent general factor and subfactor (ω, ω_S) indicate that (for both genders) the DJGLS is reliable ($\alpha > 0.70$).

Multiple linear regression. Obtained partial strict measurement invariance was the starting point for conducting the main analyses, i.e. of the relationships between the various network measures and loneliness, separately for boys and girls (using a latent multi-group model). The effects of covariates on the incomplete bifactor model of the DJGLS was tested by the multigroup Multiple Indicators Multiple Causes (MIMIC) (Brown, 2006). In the MIMIC modelling the dependent variable is a latent construct based on multiple indicators with appropriate control for measurement error (Marsh at al., 2006). The model consists of two components: (1) the relations between the latent variable and its indicators (the measurement part), and (2) the relations between the predictors and the predicted latent variable (structural part). In our analyses, the covariates were added sequentially to the model order in the following way: (Model 1) Grade; (Model 2A) [Model 1 +] likeability and unlikeability; (Model 2B) [Model 1 +] popularity and unpopularity; (Model 3) [Model 1 +] likeability, unlikeability, popularity and unpopularity; (Model 4) [Model 3 +] positive and negative meta-perception. The models will be used to verify hypotheses H1 and H2.

Mediation model. In the final step, we tested the mediation model separately for boys and girls (also using a multi-group model). The model was used to verify mainly hypothesis H3, but also additionally H1 and H2. The bootstrapping procedure recommended by Preacher and Hayes (2008) was applied for testing the significance of the indirect effects. We used 5,000 bootstrap resamples to calculate the bias-corrected 95% confidence interval (CI).

Results

Multiple linear regression

Model 1. For girls the level of loneliness in grade 6 was higher than in grade 5. Although for boys the effect was statistically insignificant, the regression coefficient was also positive in value (see Table 2). In further models the variable of the grade played only the control function.

Model 2A. Two statistically significant coefficients occurred: in boys it was the negative effect of liking and in girls the positive effect of disliking. Although the two other effects were insignificant, it could be concluded that liking reduces loneliness and disliking enhances it. Liking / disliking variables and the control variable (grade) explained the relatively small part of the variance, 7% among boys and 11% among girls[2].

Model 2B. In boys as well as in girls unpopularity was significantly connected with loneliness. Two things were of importance; first of all, the effect was twice as strong among boys; secondly, popularity explained – in the case of boys – more variance of loneliness than of the measure of liking: 15% vs. 7%. The opposite situation was observed in the case of girls: 8% vs. 11%. Among boys loneliness depended more on unpopularity, while among girls loneliness depended on disliking[3].

Model 3. The analysis including a total of four measures of the network position confirmed the above result. In the case of boys, the only influencing variable was unpopularity, while among girls it was disliking.

Model 4. The inclusion of metaperception of the network position in positive and negative networks resulted in disliking no longer being significantly related to loneliness in the case of girls. In fact, among female pupils the only variable that affected loneliness was metaperception of the negative dimension of network position. This suggests a mediating role of metaperception in the mechanism of the influence of disliking on loneliness. The metaperception of a position in the negative network also increased loneliness among boys, while including it in the model did not suppress the effect of unpopularity. What is more, unpopularity among boys affected loneliness almost 3 times as much as metaperception did. Once again, this indicates that unpopularity generates loneliness primarily among boys, while among girls it is disliking mediated by metaperception that counts more.

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[2] Within the preliminary analysis we tested a model which additionally included a liking/disliking interaction but because the effect turned out to be statistically insignificant, the component was not included in Model 2A

[3] Similarly to Model 2A, we first tested a model with the popularity/unpopularity interaction and after showing that the factor was irrelevant to explaining loneliness, in the final Model 2B we only considered the additive components.

Table 2. Regression parameters and r-square for structural part of the models (n_{boys} = 305, n_{girls} = 322)

	Model 1				Model 2A				Model 2B				Model 3				Model 4			
	Boys		Girls		Boys		Girls		Boys		Girls		Boys		Girls		Boys		Girls	
	Est	(SE)	Est	(SE)	Est	(SE)	Est	(SE)	Est	(SE)	Est	(SE)	Est	(SE)	Est	(SE)	Est	(SE)	Est	(SE)
Grade	.18	(.15)	.33*	(.14)	.15	(.13)	.35*	(.13)	.19	(.13)	.29*	(.13)	.15	(.12)	.36**	(.13)	.16	(.12)	.30*	(.13)
Like					-.15*	(.07)	-.13	(.07)					-.06	(.07)	-.11	(.08)	-.01	(.08)	-.05	(.08)
DisLike					.15	(.08)	.22**	(.08)					-.11	(.10)	.18*	(.09)	-.14	(.10)	.11	(.08)
Pop									-.07	(.06)	-.09	(.07)	-.05	(.07)	-.02	(.08)	-.06	(.06)	-.01	(.08)
UnPop									.35**	(.06)	.18**	(.06)	.42**	(.08)	.06	(.07)	.42**	(.09)	.07	(.07)
PosMet																	-.07	(.06)	-.11	(.07)
NegMet																	.14**	(.05)	.28**	(.07)
R-square	.005		.028		.074		.114		.147		.079		.161		.115		.189		.187	

Note. *p<.05, **p<.01; Est – estimation of standardized coefficient; SE – standard error; Like – Likeability; DisLike – Unlikeability; Pop – Popularity; UnPop – Unpopularity; PosMet – Positive metaperception; NegMet – Negative metaperception.

Source: Authors' research.

The mediation model

The structural equation model presented in Figure 1 allowed us to look at the relations between these variables as a whole, thus facilitating the perception of the basic pattern of the network determinants of loneliness. Some cross-gender similarities could be observed. Firstly, positive metaperception was affected by liking but not by popularity. Similarly, negative metaperception was associated with disliking, but not with unpopularity. Secondly, disliking was deemed to be a predictor of loneliness only indirectly, through the filter of negative metaperception (the direct impact of disliking on the sense of isolation is insignificant). Thirdly, the popularity/unpopularity dimension did not affect (positive/negative) metaperception, respectively. Effectively, it is the negative rather than positive dimension of the position in the network that is significant to loneliness. In both gender groups, isolation was only significantly affected by negative metaperception (indirectly) or disliking (directly).

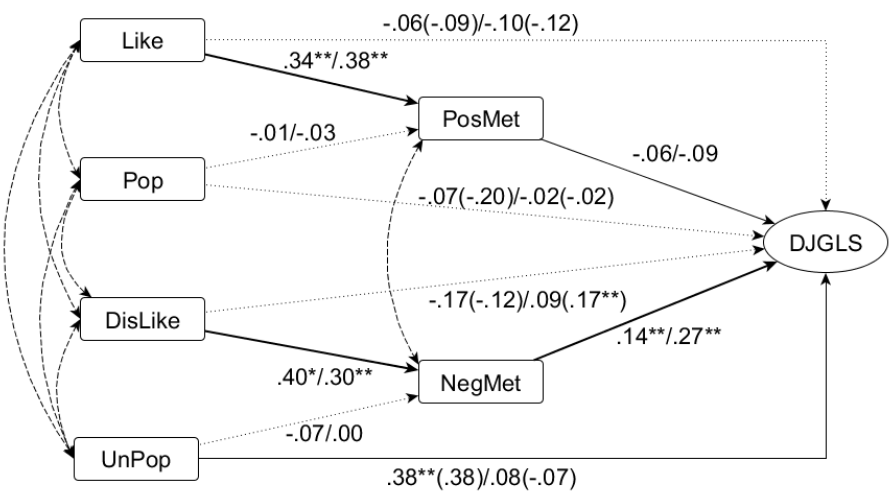

Figure 1. Structural equation model for mediation analysis with standardised coefficients.

Source: Authors' research.

Note. DJGLS – de Jong Gierveld Loneliness Scale; CI – confidence interval; Like – Likeability; DisLike – Unlikeability; Pop – Popularity; UnPop – Unpopularity; PosMet – Positive Metaperception; NegMet – Negative Metaperception; before slash coefficients for boys; after slash coefficients for girls;

in brackets estimations of total effects; solid lines – regression paths; dashed lines – correlation paths.

Cross-gender differences also occurred: in boys the dimension of unpopularity affected loneliness relatively strongly, whereas no such link was revealed among girls, which confirmed the relevance of (un)popularity to boys' sense of loneliness and (dis)liking in the case of girls. This also means that a position in the negative networks is more relevant to loneliness.

Discussion

The preliminary analyses of the DJGLS among early adolescents confirm the results of previous research with regards to the reliability and essential unidimensionality of the scale (Grygiel et al., 2013; 2019). It has been demonstrated that the DJGLS is partially strictly invariant across gender.

Our analyses showed that among boys loneliness was linked with unpopularity, while among girls loneliness increased under the influence of disliking (the support for the H1 and H2 taken together). The fact that among boys loneliness is mostly linked to unpopularity and among girls to disliking proves the existence of cross-gender differences in the "location" of the source of stress that impacts loneliness: a fixed reputation of being unpopular among boys and negative dyadic relationships among girls. An interesting thread of interpretation of this result would be an analysis involving psychological gender and dimensions of masculinity and femininity (Cramer & Neydley, 1998). This is a possible clue for future research.

These findings are consistent with previous research results. As popularity has been linked to resource control and dominance (Pellegrini at al., 2011), it comes as no surprise that it may be more relevant to boys than to girls (Breslend at al., 2018). The few studies conducted in this area indicate that unpopularity increases the risk of the internalization of problems for boys, but not girls, while disliking increases the risk of symptoms of depression and anxiety for girls, but not boys (Sandstrom & Cillessen, 2006).

The last hypothesis (H3) was the assumption that the influence of a position in the peer network on loneliness would be mediated by metaperception. As expected, the mediating role of awareness became transparent in both gender groups in the case of disliking whereas no traces of it were found in the case of unpopularity or both positive criteria, i.e. liking and popularity. The question is, however, why it is that the expected mediation occurred in the case of disliking, but not in the case of unpopularity?

One possible explanation is the mechanism of loneliness-formation based on biological factors beyond the control of consciousness. Research indicates that unpopularity is associated, both directly and indirectly through victimization, with the physiological response of the body (Lafko at al., 2015), including increased levels of cortisol, the stress hormone (Gunnar at al., 2003); it has been proven that an elevated level of cortisol is associated with the sense of loneliness (Adam, 2006). Based on unpopularity, a stress-related increase in cortisol concentration may contribute to an increased intensity of loneliness without a person realizing the position he/she occupies in negative networks.

Yet the inclusion of physiological processes does not explain the reasons for disliking being mediated by the perception of the position while unpopularity is not. This discrepancy may be linked with the cognitive abilities of early adolescents. Perhaps in this period of development it is easier to assess one's position in dyadic relationships (a higher correlation and therefore higher likelihood of the occurrence of mediation) than unpopularity (lower correlation, lower chance of mediation).

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