



Developing the Cyberostracism Scale and Examining its Psychometric Characteristics

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Abstract

This study aims to develop the Cyberostracism Scale (CS) to assess university students' perceptions of virtual social exclusion. Validity and reliability studies were carried out with 3 different groups ($N = 692$; %69 women). In the developing process of the scale, EFA, CFA, Item Response Theory (IRT), and criterion-related validity and reliability (Cronbach's α , McDonald's ω , and test-retest) analyses were used. EFA results indicated that the CS has a 3-dimensional structure (Direct Excluded, Indirect Excluded, Ignored) which explains 55.74% of the total variance. The CFA results showed that the 3-factor structure of the scale had an acceptable level of fit indices and had a measurement invariance across gender. IRT analysis showed that all items of the scale were coherent and fit with the model. The results indicated that the scale had satisfactory reliability coefficients. The cyberostracism was found to be associated with the ostracism. Results of the study show that the CS is a valid and reliable measurement tool.

Keywords Cyberostracism · Ostracism · Social exclusion · Social media · Validity · Reliability

With the rapid spread of Internet usage as well as its becoming a popular communication tool, people from all around the world can be said to be connected like never before (Poon 2019). The Internet offers people of all ages a wide range of options such as communicating with other people, socializing, spending time efficiently, doing research, learning, and doing business. Due to the number of these options expanding with each passing day, the number of individuals who use the Internet and create social media accounts is increasing day by day (Mihçı and Kılıç Çakmak 2017). According to the Digital 2020 Report (Kemp 2020), while more than 4.5 billion people use the Internet for various purposes, the number of social media users exceeds 3.8 billion.

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In the same report, the reader learns that more than half the world's population will use social media by the mid-2020s. According to the results from the Turkish Statistical Institute's (TÜİK) (2019) Household Information Technologies Usage Survey published in August 2019, 75.3% of individuals between the ages of 16 and 74 are found to have used the Internet; this percentage was determined to have been 72.9% in 2018. Together with the increase in Internet usage has been reported an increase in the use of social media tools for creating and maintaining social relations (Karlen and Daniels 2011), and social media is reported to be at the top of the area where Internet usage is focused (Demirci 2019). Any website or platform that allows social interactions is considered to be a social media site (Obar and Wildman 2015). With respect to the number of active users as of April 2020, Facebook takes first place among the most popular social media networks worldwide with approximately 2.5 billion active users per month. This is followed in order by YouTube, WhatsApp, Facebook Messenger, WeChat, Instagram, and TikTok (Clement 2020). This increasing in internet and social media usage has also led to the increase of virtual communities worldwide. Virtual communities are a new form of communication where community members share information for mutual learning and/or problem solving (Lechner and Hummel 2002) and are defined as "a group of people interacting in cyberspace in line with their common interests or goals" (Koh and Kim 2003, p. 76). Virtual communities give individuals the opportunity to socialize, as well as to experience the feelings of belonging to the group, being able to influence group members, need fulfillment, emotional connections, and being in a flowing state while interacting with community members (Blanchard and Markus 2004; Koh and Kim 2003).

Positive contributions have been reported such as the use of the Internet and social media to socialize and communicate (Bonetti et al. 2010; Wood et al. 2016) and the development of learning skills and support of educational processes (Cain and Chretien 2013; O'Keeffe and Clarke-Pearson 2011). In addition, social media platforms have been stated to play an important role in the friendship and identity experiences of adolescents and to support identity development in adolescence by promoting important peer processes such as online peer communication and a sense of belonging and self-disclosure (Davis 2012). Although Internet and social media use offers individuals various opportunities for social experiences, they can also cause various problems such as cyber-bullying (Erdur-Baker 2010; Gözrig and Frumkin 2013; Ho et al. 2017) and Internet and social media addiction (Bahk et al. 2010; Lu 2008; Sun et al. 2008; Yang et al. 2015), as well as reveal new problems in individuals' relationships with one another (Hadjipanayis et al. 2019). While the increased use of social media supports individuals' forming online groups and having new socializing experiences as well as developing belonging, psychological wellbeing, and identity, at the same time cases of exclusion and being ignored in the virtual environment, which is expressed as cyberostracism, have been reported to increase (Allen et al. 2014).

Cyberostracism

The phenomenon of ostracism is defined as being ignored and excluded by one or more people (Williams et al. 2000), and it threatens the fundamental social needs such as self-esteem, belonging, control, and meaningful existence (Williams 2007, 2011; Williams et al. 2000, 2002). Because of the threat to basic needs, individuals generally experience boredom and anger when they perceive being excluded by other people (Williams 2007). In addition to ostracism being a tool for a group of peers to remove members from the group who are unwanted, ostracizing leads to inappropriate reactions for the exposed individuals such as

avoiding coping strategies. The effect of long-term or frequent victimization through ostracism has been stated to be able to have a more negative impact on people (Hadjipanayis et al. 2019).

The phenomenon of ostracism may also be experienced through the Internet and social media (Vorderer and Schneider 2017; Williams et al. 2000; Greitemeyer et al. 2014). Various forms of cyberostracism can be seen in the form of avoiding eye contact, not responding verbally, or not responding to individuals' shares and messages in online chat rooms or on social media accounts (Williams et al. 2002). Cyberostracism has been emphasized as a common form of exclusion that emerges during online social interactions (Nezlek et al. 2012; Williams et al. 2000). Hayes et al.'s (2018) qualitative study performed on 37 people researched individuals' perceptions on cyberostracism in terms of the "liked" status from other users for the content they posted or shared on social media platforms. With respect to the findings, the result was reached that shared content not being liked by someone they know or by popular social media users is perceived as cyberostracism.

Being excluded, rejected, or ignored in virtual environments, which is expressed as cyberostracism, has been emphasized as able to be as harmful as the ostracism experienced in social face-to-face relations (Allen et al. 2014). The Internet, whose popularity as a communication tool has increased, allows individuals to hide their identity in the virtual environment. This anonymity the virtual environment offers can be assumed to protect individuals to some extent from the negative effects of cyberostracism when compared with ostracism. Like ostracism, however, cyberostracism also negatively impacts the provision of individuals' basic needs such as belonging, meaningful existence, self-esteem, and sense of control (Abrams et al. 2011; Allen et al. 2014; Hartgerink et al. 2015; Hayes et al. 2018; Karlen and Daniels 2011; Lei et al. 2018; Niu et al. 2016; Poon 2019; Reich et al. 2018; Schneider et al. 2017; Tobin et al. 2015; Wolf et al. 2015; Zadro et al. 2004). Additionally, individuals exposed to cyberostracism have been reported to be able to experience negative emotions (Karlen and Daniels 2011). Thanks to the magnetic resonance imaging scanner (MRI), Eisenberger et al. (2003) found the area of the brain that is activated during physical pain to also be activated when exposed to cyberostracism.

Measuring the Phenomenon of Cyberostracism

The number of studies reporting the phenomenon of cyberostracism to be more commonly seen together with the increase of Internet and social media usage has increased. When examining the literature, various paradigms are seen to have been used in measuring the phenomenon of cyberostracism. The most common one among these is the measure of the phenomenon of cyberostracism using manipulation through an online game known as Cyberball (Abrams et al. 2011; Hartgerink et al. 2015; Heeren et al. 2012; Liu et al. 2018; Poon 2019; Poon and Chen 2016; Williams et al. 2000, 2002; Williams and Zadro 2001; Zadro et al. 2004). In research using the Cyberball paradigm, the participants are requested to sit alone at the computer and play an online ball-throwing game (Cyberball). Each participant engages in a spontaneous ball toss game with two other participants (the researcher or virtual player appointed by the computer). At the start of the game, the other two individuals begin to constantly throw the ball between themselves after throwing the ball to the participant once or twice. After finishing the game, the participants are asked to fill out the questionnaire they are given for the purpose of determining basic satisfaction levels (self-esteem, belonging, control, and meaningful existence) and to additionally respond to statements such as "excluded," "ignored," and "neglected."

The Cyberball paradigm, commonly used for assessing the effects of cyberostracism, is stated to be a successful manipulation tool (Hartgerink et al. 2015; Vorderer and Schneider 2017) but to be lacking in providing the opportunity for feedback typical in social media (like, heart, star, applause, comment, share) and thus to remain insufficient for researching the effects of cyberostracism in the social media environment (Schneider et al. 2017; Smock et al. 2011). For this reason, participants in the Ostracism Online paradigm, which Wolf et al. (2015) developed for the purpose of manipulating the phenomenon of cyberostracism on social media platforms, are told that they will participate in an online group activity. In reality, only one person participates in the experimental application at the same time, and preprogrammed computer command files determine the behavior of the other group members. The participants are told they need to determine an avatar and create a personal profile composed of a short statement so that the group members can meet. Afterward, the participants are directed to an introduction page where group members can view each other's personal profiles. In this stage, group members have a 3-min window for being able to read and like each other's profiles in a similar way as the Facebook application. The cyberostracism level is manipulated through the number of likes a participant's personal profile receives. Ostracism Online has been stated to be able to be used for manipulating cyberostracism (and thus examining its impact) by adjusting the likes across the group to very high or very low levels (Wolf et al. 2015). Schneider et al.'s (2017) experimental study, which used the Ostracism Online paradigm, found the negative impacts of cyberostracism on belonging, self-esteem, and meaningful existence to be higher compared to those not exposed to cyberostracism and cyberostracism to negatively impact emotional wellbeing.

Some experimental studies are seen to have researched the phenomenon of cyberostracism by manipulating over Facebook. Karlen and Daniels's (2011) study performed on a sample of university students had the participants form six different Facebook profiles (the ostracized person, the person not ostracized, the individual with a relationship to the ostracized person, the individual with a relationship to the non-ostracized person, and two people who have relationships with both ostracized and non-ostracized people) to determine their experiences with cyberostracism. In both the included and ostracized cases, the participants were made to watch Facebook screenshots belonging to these six people and a video of different Facebook interactions. The participants were asked to imagine that the profile they watched was actually their own Facebook page and to evaluate how they feel in these situations. Tobin et al.'s (2015) study examined the results from the lack of feedback to Facebook status updates. The scores from belonging, self-esteem, meaningful existence, and sense of control for the participants who received no feedback regarding status updates were determined to be at a lower level compared to those who had received feedback. Reich et al.'s (2018) experimental study performed with 780 individuals researched the extent to which the participants' Facebook shares being liked or not liked by friends or acquaintances impacted their needs for belonging and self-perception as well as their positive and negative emotions. The number of likes received on status updates was seen to have a significant impact on the positive and negative emotion scores.

Only one study is encountered in the literature that used a self-reporting scale as a written test in measuring the phenomenon of cyberostracism. The Cyberostracism Scale, which is a written test, was first developed by Niu et al. (2018) on a sample of Chinese adolescents ($N = 623$). In the process of developing the scale, the scale items were first written based on semi-structured interviews with 24 people. The implementation started with a 5-point Likert-type scale (1 = never, 5 = always) that had 18 items. Exploratory and confirmatory factor analyses

(EFA and CFA) were performed for the construct validity of the scale. As a result, a 14-item and 3-factor (cyberostracism in online personal chats, cyberostracism in online group chats, and cyberostracism in personal web spaces) structure was seen to emerge that explained 78% of the variance in the total score of the scale. According to the results from the CFA, the scale is determined to have good fit values. The reliability coefficients for the scale have been determined to vary between .80 and .85 for the sub-dimensions and to be .88 for the total score. Niu et al.'s (2018) study, however, was seen to not perform a criterion-related validity or test-retest reliability analysis.

Although a considerable number of studies are present in the literature on the topic of cyberostracism, no study has been encountered on this topic in Turkey. As in the world, the phenomenon of cyberostracism in connection with the increase in Internet and social media usage is thought to be widespread in Turkey. As a result, measuring the phenomenon of cyberostracism that individuals are able to experience in virtual environments such as the Internet and social media has gained importance. Therefore, the main purpose of this study is to develop a valid and reliable Cyberostracism Scale.

Method

Study Group

In the research, exploratory factor analysis (EFA) has been applied to the data obtained from the study group composed of 226 university students. The students' ages vary between 18 and 24. Their average age has been calculated as 20.4 ($SD = 1.52$). Of the students, 170 are female and 56 are male. The students use social media for an average of 4.02 h ($SD = 2.22$) per day. The study group for the confirmatory factor analysis (CFA) of the research is composed of 418 university students. The students' ages range from 18 to 40. Their average age has been calculated as 20.7 ($SD = 1.48$). Of the students, 281 are female and 137 are male. The test-retest study group of the research is composed of 48 university students. The students' ages vary between 18 and 21. Their average age has been calculated as 19.31 ($SD = .90$). Of the students, 30 are female and 18 are male. The findings take place in Table 1.

Data Collection Tools

Cyberostracism Scale

In this study, the Cyberostracism Scale (CS; see [Appendix](#)) was developed to measure the university students' perceptions/experiences of virtual social exclusion. The CS comprises 14 items and three dimensions (Cyber Ignored, Cyber Direct Excluded, Cyber Indirect Excluded)

Table 1 Demographic characteristics of the study groups

Variables	EFA ($N = 226$)		CFA ($N = 418$)		Test-retest ($N = 48$)	
	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%
Female	170	75.2	281	67.2	30	62.5
Male	56	24.8	137	32.8	18	37.5

and is rated on a 5-point Likert-type scale (1 = Never, 2 = Rarely, 3 = Sometimes, 4 = Mostly, and 5 = Always). The following instruction is used in answering the scale: Consider your last year, indicate how often you experience the following situations about your use of social media (Facebook, Instagram, Twitter, WhatsApp, etc.).

Ostracism Experience Scale for Adolescents

This study uses the Ostracism Experience Scale for Adolescents (OES-A) as the data collection tool for the purpose of testing the criterion correlation validity of the Cyberostracism Scale. The OES-A was developed by Gilman et al. (2013) and adapted to Turkish by Akın et al. (2016). When examining the CFA results of the Turkish version of the OES-A, which was developed for the purpose of assessing adolescents' perceptions on being accepted or ostracized in social settings, the fit indices were found to be good. The reliability coefficients for Cronbach's alpha of internal consistency have been detected as .93 for the factor of being ignored, .90 for the factor of being excluded, and .89 for the entire scale. Getting high scores on the OES-A shows the perceived ostracism to be high (Akın et al. 2016). In this study, EFA results indicated that the scale has a 2-dimensional structure that explains 66.28% of the total variance. In this study, Cronbach's alpha internal consistency coefficients were .88 for the ignored factor, .87 for the excluded factor, and .87 for the total score of OES-A.

Data Collection

Before collecting the research data, an application was made to the Human Research Ethics Committee, and permission was obtained from the ethics committee related to the study (No: 2020/57; date: 2020/05/03). The research data was collected over the Internet using the Google Forms application, and informed consent was received from the participants. The informed consent contains information such as the purpose of the research, personal information will remain confidential, the data will only be used for the research, the research may be terminated at any time, and volunteerism is required for participation in the study. The Helsinki Declaration has been adhered to for every stage of the research.

Data Analysis and Interpretation

A literature review has been conducted primarily for developing the Cyberostracism Scale. The research on cyber psychology and ostracism was examined. Afterwards, 132 university students were made to write a composition on their experiences of cyberostracism. A draft form of 30 items was prepared based on the literature and the students' statements. The draft form, which was created from the students' responses and based on the literature, was sent to experts for evaluation in terms of content validity. Lawshe (1975) analysis was performed for each item in line with the opinions and suggestions of the experts; as a result of the analysis, items were rearranged, and eight items were removed from the draft form. Afterward the pilot implementation of the scale was made on the sample of 60 students, and in line with the students' feedback, the final version of the 22-item form was created, and data was collected from the participants. Scores are obtained from the scale using a 5-point Likert-type evaluation (1 = Never, 2 = Rarely, 3 = Sometimes, 4 = Often, 5 = Always).

The acceptable skewness and kurtosis values for normal distribution was below ± 3 and ± 10 respectively (Kline 2015). The skewness and kurtosis values of all the items in the EFA sample are within the acceptable range. It shows that the distribution does not deviate severely from normality. Exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) were utilized in order to validate the factor structure of the Cyberostracism Scale. In the EFA study, items with factor loading values less than .10 or higher than .55 for the items loaded with different factors have been removed from the scale. The number of factors was decided by comparing the parallel analysis, slope accumulation graph, factors' eigenvalues, and variance rates that the factors explain during the analysis. As a result of the item and reliability analyses on the EFA sample, all items are found to have item total score correlation over .30, and no item has been detected to lower the reliability.

CFA has been applied in order to test the validity of the structure that emerged as a result of the EFA. In accordance with Kline's (2015) recommendations, the χ^2/df ratio, *CFI*, *NNFI*, *SRMR*, and *RMSEA* indices have been examined for determining the goodness of fit of the model tested in the CFA. Values of *RMSEA* < .08, *SRMR* < .10, χ^2/df < 3, *CFI*, and *TLI* > .90 are considered as indicators of acceptable compliance (Hu and Bentler 1999; Kline 2015; Van de Schoot et al. 2012). The maximum likelihood method was used as the estimation method. The measurement invariance across gender of the scale was also examined. Examination of measurement invariance includes testing 4 nested hierarchical models (configural invariance, weak invariance, strong invariance, and strict invariance) (Byrne and Stewart 2006; Stark et al. 2006; Wu et al. 2007). While testing whether the measurement invariance can be achieved, χ^2 and the comparative fit index specified above are used (Byrne and Stewart 2006; Vandenberg and Lance 2000; Wu et al. 2007). After determining the fit of the first model, pairwise comparisons of other models are examined. Since the value of χ^2 is affected by the assumption of normality and the sample size, it should be supported by some goodness of fit values. In terms of model fit, it is expected that the χ^2/df value is less than 3 and the *CFI* value is greater than .90 (Buchanan 2020; Kline 2015). In addition, the ΔCFI value obtained by comparing the models in pairs is equal to or less than .01 which shows that the tested invariance assumption is met (Chen 2007; Cheung and Rensvold 2002; Wu et al. 2007).

After the factor structure of the cyerostracism scale was determined by EFA and CFA, the Item Response Theory (IRT) was used to assess the validity of items of the Scale. The IRT analyses were made for each sub-dimension separately. Graded response model (GRM) was used in IRT analysis which is suitable for a 5-point Likert scale. The item characteristic curve (ICC) which tends to be S-shaped curves was examined, which shows the response characteristics of the items. The item discrimination (α) and difficulty (b) scores were calculated. An α value > 1.0 indicates that the item is strongly discriminant. The high b value indicates that the item works well in individuals with high cyerostracism level, and a low b value indicates that the item works well in individuals with a low cyerostracism level (Baker 2001).

Furthermore, corrected item total correlation coefficients and descriptive statistics for each item were also examined. Correlations between the CS and OES-A were examined for the criterion-related validity of the scale. The reliability of the scale has been calculated using the Cronbach alpha and McDonald omega coefficients. In addition, the application was made 4 weeks apart to study time-based invariance, and the test-retest reliability coefficient was calculated. The analyses of the study were run using IBM SPSS Statistics 25.0, Jamovi 1.2, JASP, 0.13.1.0, and Stata 15.

Results

Exploratory Factor Analysis

The KMO value, which shows the suitability of the data for the EFA study of the Ostracism Experience Scale for Adolescents, is found to be .89, and the Bartlett sphericity test is seen to be significant ($\chi^2 = 1807.133$, $SD = 231$, $p < .001$). As a result of the EFA, the scale is seen to consist of five factors with eigenvalues > 1 , and the factors are seen to explain 53% of the total variance. The parallel analysis results show the scale to possess a 3-factor structure and the factors to explain 47.5% of the total variance. Items loaded with more than one factor and whose factor loading is less than .55 have been removed from the scale. After removing the items, the scale is seen to have a 3-dimensional structure that explains 55.74% of the total variance. KMO = .85 has been found for the final factor structure, and the Bartlett Sphericity Test is seen to be significant ($\chi^2 = 998.152$, $SD = 91$, $p < .001$). The eigenvalue for the dimension of Cyber Ignored, consisting of six items, has been calculated as 4.95 and the explained variance as 35.33%. The eigenvalue for the dimension of Cyber Direct Excluded, consisting of four items, has been calculated as 1.46 and the explained variance as 10.45. The eigenvalue for the dimension of Cyber Indirect Excluded has been calculated as 1.39 and the explained variance as 9.95%. The factor loadings of the 14 items that form the scale vary between .57 and .89. The findings are presented in Table 2.

Confirmatory Factor Analysis

The three-factor model, second-order model (three-factor), two-factor model, and unidimensional model of the Cyber Ostracism Scale were tested by CFA. As a result of the analysis, it was determined that the fit indices of the three-factor model and second-order model were at an acceptable level ($\chi^2/df = 2.86$, $CFI = .94$; $TLI = .92$; $SRMR = .052$; $RMSEA = .067$). When

Table 2 The Cyberostracism Scale's factor structure and factor loadings

Items	Cyber ignored	Cyber Direct Excluded	Cyber Indirect Excluded
s14	.820		
s18	.767		
s22	.735		
s17	.729		
s15	.581		
s20	.565		
s6		.837	
s7		.806	
s5		.783	
s8		.561	
s9			.892
s3			.714
s11			.624
s10			.604
Eigenvalues	4.95	1.46	1.39
Explained total variance	35.34	10.46	9.95
Cumulative total variance	35.34	45.79	55.74

Extraction method: principal component analysis. Rotation method: Promax with Kaiser Normalization. Factor loads below .30 are not shown in the table

Table 3 Fit indices about structural models compared

Model	χ^2	df	χ^2/df	CFI	TLI	SRMR	RMSEA (CI)	AIC	ECVI
Three-factor model	211.085	74	2.86	.94	.92	.052	.067 (.056–.077)	10,343.82	0.653
Second-order (three-factor model)	211.085	74	2.86	.94	.92	.052	.067 (.056–.077)	10,371.82	0.720
Two-factor model (excluded and ignored)	369.348	76	4.86	.86	.84	.072	.096 (.086–.106)	10,498.08	1.022
Unidimensional model	525.722	77	6.83	.79	.75	.083	.118 (.109–.128)	10,652.45	1.392

Note. AIC Akaike Information Criterion, CFI comparative fit index, ECVI expected cross-validation index, TLI Tacker-Lewis index, RMSEA root mean square error of approximation, SRMR standardized root mean square residual

AIC and ECVI values are examined, it is seen that the three-factor model emerging in EFA has better fit values. The findings are presented in Table 3.

As a result of CFA, the standardized item factor loadings of the scale were found significant ranging from .39 to .83 and the error variances were low. The findings are presented in Table 4.

As seen in Table 5, when analyzing the configural, weak, strong, and strict invariance models, it is seen that χ^2/df values are below 3, CFI values are above .90, and ΔCFI values are less than .01. The chi-square difference test was found to be significant in configural and weak invariance model comparison and weak and strong invariance model comparison. However, the ΔCFI values value is below .01. In addition, weak and strong invariance models fit well. The results support that the model showed a configural, weak, strong, and strict invariance across the gender groups.

Independent samples t tests were performed to determine whether there was a gender differences in EFA sample. Males reported statistically significantly higher levels of Cyberostracism ($t = -4223$, $p < 0.001$, $d = -.65$), Cyber Ignored ($t = -3.337$, $p < 0.01$, $d = -.51$), Cyber Direct Excluded ($t = -3.307$, $p < 0.01$, $d = -.51$), and Cyber Indirect Excluded ($t = -3.312$, $p < 0.01$, $d = -.51$). Effect sizes were found moderate for EFA sample. The findings are presented in Table 6.

Table 4 Confirmatory factor analysis results for three-factor model

Factor	Items	λ	θ	z-value	λ_{female}	λ_{male}
Cyber Direct Excluded	c1	0.390	0.052	7.121***	0.438	0.419
	c2	0.536	0.040	10.078***	0.549	0.575
	c3	0.684	0.031	13.186***	0.609	0.777
	c4	0.626	0.033	11.986***	0.495	0.756
Cyber Indirect Excluded	c5	0.772	0.035	16.587***	0.771	0.818
	c6	0.769	0.039	16.519***	0.795	0.757
	c7	0.674	0.032	14.078***	0.584	0.756
	c8	0.400	0.050	7.702***	0.257	0.568
Cyber Ignored	c9	0.751	0.027	17.380***	0.701	0.813
	c10	0.613	0.026	13.300***	0.550	0.703
	c11	0.837	0.025	20.378***	0.799	0.861
	c12	0.825	0.025	19.939***	0.812	0.835
	c13	0.765	0.027	17.836***	0.743	0.791
	c14	0.619	0.029	13.441***	0.576	0.708

Note. λ standardized factor loadings, θ error variance, λ_{female} standardized factor loadings for females, λ_{male} standardized factor loadings for males, *** $p < 0.001$

Table 5 Measurement invariance across gender

Model	χ^2	df	χ^2/df	$\Delta\chi^2$	Δdf	<i>p</i>	CFI	ΔCFI	TLI	SRMR	RMSEA (CI)
Female	162.347	74	2.19	—	—	—	.923	—	.90	.069	.065 (.052–.079)
Male	148.495	74	2.01	—	—	—	.923	—	.91	.054	.066 (.052–.079)
Configural invariance	310.842	145	2.14	—	—	—	.923	—	.905	.064	.073 (.061–.084)
Weak invariance	334.601	159	2.10	23.76	14	0.049	.917	.007	.905	.066	.073 (.062–.084)
Strong invariance	357.312	170	2.10	22.71	11	0.019	.912	.005	.905	.064	.073 (.062–.083)
Strict invariance	376.098	184	2.04	18.79	14	0.173	.909	.003	.910	.068	.073 (.060–.081)

Note. *N* = 418, group 1 *n* = 281 and group 2 *n* = 137

Table 6 Cyberostracism and gender differences in EFA sample

	Group	<i>N</i>	Mean	SD	SE	<i>t</i>	df	<i>p</i>	Cohen's <i>d</i>
Cyber Direct Excluded	Female	170	5.90	2.37	0.181	−3.307	224	0.01	−0.510
	Male	56	7.23	3.26	0.436				
Cyber Indirect Excluded	Female	170	5.05	1.60	0.123	−3.312	224	0.01	−0.510
	Male	56	5.91	1.90	0.254				
Cyber Ignored	Female	170	8.11	2.56	0.197	−3.337	224	0.01	−0.514
	Male	56	9.46	2.87	0.384				
Cyberostracism	Female	170	19.06	5.09	0.390	−4.223	224	0.001	−0.651
	Male	56	22.61	6.45	0.862				

Independent samples *t* tests were performed to determine whether there was a gender differences in CFA sample. Males reported statistically significantly higher levels of Cyberostracism ($t = -3.829$, $p < 0.001$, $d = -.32$), Cyber Ignored ($t = -3.041$, $p < 0.01$, $d = -.32$), Cyber Direct Excluded ($t = -3.095$, $p < 0.01$, $d = -.32$), and Cyber Indirect Excluded ($t = -2.891$, $p < 0.01$, $d = -.30$). Effect sizes were found small for CFA sample. The findings are presented in Table 7.

Item Response Theory

According to Table 8, the item discrimination (α) values vary between 1.16 and 4.51. This situation shows that the discrimination of all items is high. Table 8 also includes item difficulty values (b). Although the scale items had 5 options, it was observed that fewer options were preferred for most of the items (except items 1, 5, and 8). The item characteristic curves (ICC) are shown in Fig. 1. Most of the items were exhibited an S-shaped curve.

Item Analysis and Reliability

The Sample for the Exploratory Factor Analysis

The strength with which the items that form the scale predict the scale's factor structure has been examined, as well as the item's corrected item total score correlation for determining whether or not the items are distinctive. The corrected item total score correlations for the items in the scale range between .40 and .66. Cronbach's alpha correlations if Item Deleted range between .54 and .78. The Cronbach's alpha

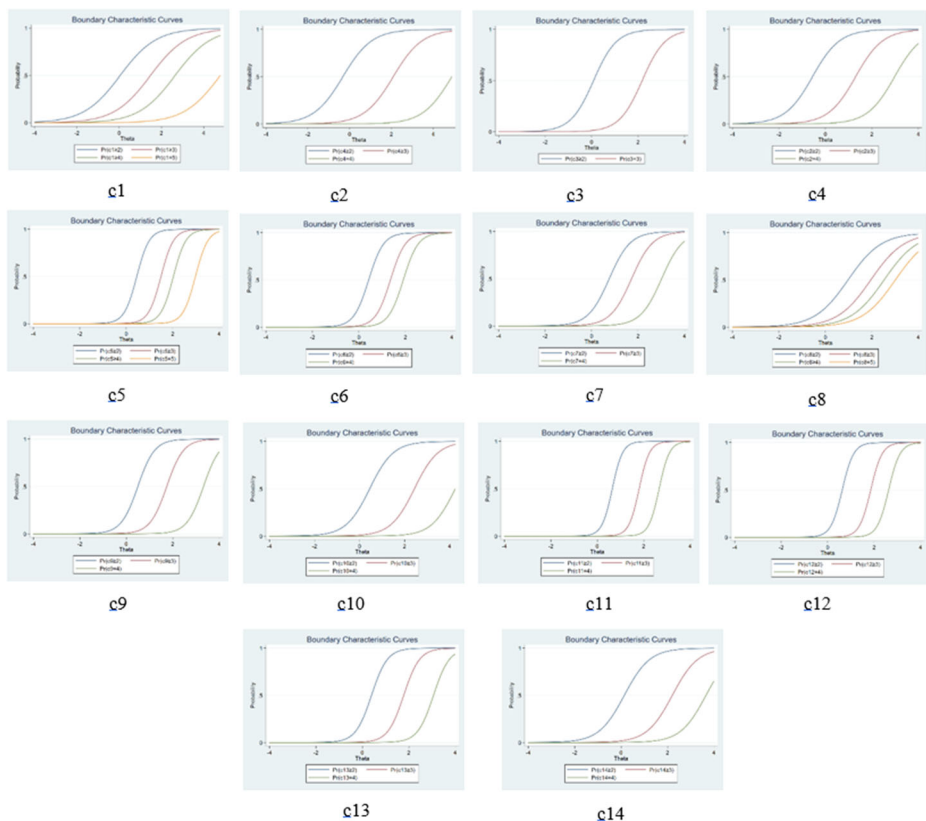
Table 7 Cyberostracism and gender differences in CFA sample

	Group	<i>N</i>	Mean	SD	SE	<i>t</i>	df	<i>p</i>	Cohen's <i>d</i>
Cyber Direct Excluded	Women	281	6.64	2.00	0.119	−3.095	416	0.01	−0.323
	Man	137	7.30	2.16	0.184				
Cyber Indirect Excluded	Women	281	5.65	2.24	0.133	−2.891	416	0.01	−0.301
	Man	137	6.37	2.66	0.227				
Cyber Ignored	Women	281	8.13	2.60	0.155	−3.041	416	0.01	−0.317
	Man	137	9.04	3.33	0.284				
Cyberostracism	Women	281	20.42	5.09	0.304	−3.829	416	0.001	−0.399
	Man	137	22.71	6.85	0.585				

Table 8 Cyberostracism Scale item response theory estimates

Factor		α	b_1	b_2	b_3	b_4
Cyber Direct Excluded	c1	1.16	0.43	1.47	2.64	4.77
	c2	1.69	– .55	1.30	2.98	–
	c3	2.01	.08	2.17	–	–
	c4	1.43	– .32	2.08	4.88	–
Cyber Indirect Excluded	c5	3.68	.45	1.49	2.03	2.98
	c6	3.10	.42	1.36	1.91	–
	c7	2.19	.76	1.72	3.02	–
	c8	1.39	.98	1.96	2.53	3.01
Cyber Ignored	c9	2.75	.49	1.74	3.33	–
	c10	1.89	.49	2.43	4.25	–
	c11	4.51	.65	1.80	2.66	–
	c12	4.04	.63	1.85	2.63	–
	c13	2.92	.39	1.78	3.07	–
	c14	1.82	.14	2.21	3.66	–

of internal consistency has been calculated as .84 for the Cyberostracism Scale, .81 for the dimension of Cyber Ignored, .76 for the dimension of Cyber Direct Excluded, and .70 for the dimension of Cyber Indirect Excluded. Also, the McDonald's ω reliability has been calculated as .86 for the Cyberostracism Scale, .82 for the

**Fig. 1** Cyberostracism Scale item characteristic curve (ICC)

dimension of Cyber Ignored, .78 for the dimension of Cyber Direct Excluded, and .71 for the dimension of Cyber Indirect Excluded. The findings are provided in Table 9.

The Sample for the Confirmatory Factor Analysis

The corrected item total score correlations for the items in the scale range between .35 and .74. Cronbach's alpha correlations if Item Deleted range between .50 and .87. The Cronbach's alpha of internal consistency has been calculated as .85 for the Cyberostracism Scale, .88 for the dimension of Cyber Ignored, .64 for the dimension of Cyber Direct Excluded, and .72 for the dimension of Indirect Excluded. Additionally, the McDonald's ω reliability has been calculated as .87 for the Cyberostracism Scale, .88 for the dimension of Cyber Ignored, .66 for the dimension of Cyber Direct Excluded, and .76 for the dimension of Cyber Indirect Excluded. The findings are provided in Table 10.

Test-Retest Reliability

The test-retest reliability coefficient was calculated as .81 for the total score of the Cyberostracism Scale. The retest reliability coefficients were calculated as .71 for the Cyber Ignored, .71 for the Cyber Direct Excluded, and .68 for the Cyber Indirect Excluded. The findings are included in Table 11.

Criterion-Related Validity

The correlations between the Cyberostracism Scale and the Ostracism Experience Scale for Adolescents (OES-A) have been examined. The findings showing the correlation coefficients between the Cyberostracism Scale and OES-A and their sub-dimensions are presented in Table 12. As seen in Table 6, a positive relationship is found for the Cyberostracism Scale and its sub-dimensions with the OES-A and its sub-dimensions.

Table 9 Corrected item total test correlations, item averages, and standard deviations of the Cyberostracism Scale ($N = 226$)

Subscales (factors)	Items	$\bar{X}$	SD	Skewness	Kurtosis	Item total correlations for total score	Item total correlations for sub-scale	Cronbach's alpha if Item Deleted
Cyber Direct Excluded	c1	1.21	.52	2.537	8.724	.448	.531	.719
	c2	1.41	.64	2.444	4.955	.483	.611	.676
	c3	1.21	.46	1.283	.490	.558	.655	.670
	c4	1.43	.62	2.122	3.847	.455	.484	.750
Cyber Indirect Excluded	c5	1.62	.88	1.232	1.003	.502	.509	.626
	c6	1.83	1.01	1.371	1.250	.484	.625	.542
	c7	1.30	.76	1.004	.066	.426	.395	.690
	c8	1.47	1.01	3.007	9.701	.444	.440	.673
Cyber Ignored	c9	1.49	.73	2.346	4.702	.493	.583	.771
	c10	1.30	.51	1.832	4.452	.516	.525	.785
	c11	1.23	.50	1.384	.929	.566	.635	.765
	c12	1.25	.53	2.113	3.705	.560	.640	.762
	c13	1.53	.77	2.198	4.947	.594	.559	.780
	c14	1.65	.70	1.573	2.483	.434	.527	.784

Discussion

This study aims to develop the Cyberostracism Scale for the purpose of assessing university students' perceptions of virtual social exclusion and to perform the validity and reliability studies of the scale. In the study, the Kaiser-Mayer-Olkin (KMO) and Bartlett Tests show that the data obtained from the study group are suitable for factor analysis (Pullant 2001). For the validity of the Cyberostracism scale, EFA, DFA, and IRT were performed. As a result of EFA, it was seen that the Cyberostracism Scale has a structure with 14 items and three factors and explains 55% of the total variance. The items related to each factor were examined, and the scale's sub-dimensions were named Cyber Ignored, Cyber Direct Excluded, and Cyber Indirect Excluded. The 3-dimensional structure of the scale is seen to also overlap with studies performed on the topic of ostracism and cyberostracism (Gilman et al. 2013; Williams 2007; Williams et al. 2000, 2002; Zadro et al. 2004). In addition, it has been observed that the Cyberostracism Scale developed by Niu et al. (2018) in the sample of Chinese adolescents has a 14-item and 3-factor structure (cyber-exclusion in online personal chat, cyber-exclusion in online group chat, and cyber-exclusion in the personal web space). However, Niu et al. (2018) adopted similar contents for the online group chat and private web space questions. In addition, the dimensions of the Cyberostracism Scale are similar to the excluded and ignored dimensions of the Ostracism Scale developed by Gilman et al. (2013). Having item factor loadings above .40 is stated to be considered very good and above .70 to be considered perfect (Tabachnick and Fidell 2013). This study has determined the item factor loadings for the Cyberostracism Scale to range between .56 and above.

After the EFA, CFA was performed to validate the scale. The CFA showed that the goodness of fit values for the scale were at an acceptable level and confirmed the 14-item and 3-dimensional structure of the scale. The factor loadings of the Cyberostracism Scale were also found statistically significant. Then, the fit indexes of the three-factor model, the second-order model, the two-factor model, and the unidimensional model of the Cyberostracism scale were compared. The analysis show that the fit indices of the three-factor model and second-order model were at an acceptable level. When AIC and ECVI values are examined, it is seen

Table 10 Corrected item total test correlations, item averages, and standard deviations of the Cyberostracism Scale ($N=418$)

Subscales (factors)	Items	$\bar{X}$	SD	Skewness	Kurtosis	Item total correlations for total score	Item total correlations for sub-scale	Cronbach's alpha if Item Deleted
Cyber Direct Excluded	c1	1.78	.955	1.105	.437	.250	.388	.618
	c2	1.87	.758	.523	-.227	.398	.495	.509
	c3	1.53	.592	.620	-.561	.515	.460	.554
	c4	1.68	.640	.461	-.411	.519	.381	.594
Cyber Indirect Excluded	c5	1.48	.756	1.739	2.926	.480	.589	.615
	c6	1.55	.833	1.516	1.524	.482	.589	.608
	c7	1.38	.672	1.715	2.177	.546	.581	.631
	c8	1.49	.968	2.253	4.585	.385	.345	.779
Cyber Ignored	c9	1.40	.632	1.423	1.350	.646	.702	.850
	c10	1.40	.572	1.151	.758	.530	.582	.869
	c11	1.32	.599	1.957	3.839	.654	.758	.841
	c12	1.33	.605	1.969	4.074	.649	.744	.843
	c13	1.44	.636	1.329	1.347	.657	.716	.847
	c14	1.53	.628	.953	.699	.518	.578	.871

Table 11 Test-retest correlation coefficient

Scale	1	2	3	4	5	6	7	8
1. Cyberostracism I	1							
2. Cyber Indirect Excluded I	.790**	1						
3. Cyber Direct Excluded I	.869**	.576**	1					
4. Cyber Ignored I	.870**	.552**	.593**	1				
5. Cyberostracism II	.811**	.586**	.716**	.729**	1			
6. Cyber Indirect Excluded II	.719**	.684**	.509**	.662**	.856**	1		
7. Cyber Direct Excluded II	.657**	.438**	.712**	.488**	.811**	.563**	1	
8. Cyber Ignored II	.715**	.436**	.613**	.711**	.901**	.695**	.554**	1
Mean	21.98	5.92	6.88	9.19	22.10	6.04	6.21	9.85
Standard deviation	6.64	1.93	2.88	3.01	7.07	2.24	2.61	3.36

Note. ** $p < .01$

that the three-factor model emerging in CFA has better fit values (Hu and Bentler 1999; Kline 2015; Van de Schoot et al. 2012). Furthermore, the measurement invariance across gender of the three-factor Cyberostracism Scale was examined. The results support that the three-factor model showed a configural, metric, scalar, and strict measurement invariance across the gender groups. Based on these results, it can be said that comparisons can be made between gender subgroups for the Cyberostracism Scale, which provides measurement invariance across gender, and the difference between the groups is not due to the measurement tool. In the study, it was found that cyberostracism scores differ significantly according to gender in EFA and CFA samples. Cyberostracism scores of males were found to be higher than those of females. Studies examining cyberostracism scores in terms of gender variable are limited in the literature. It is thought that this phenomenon of cyberostracism is mostly due to the study under manipulated experimental conditions. Niu et al. (2018) also reached similar findings in Cyberostracism scores in terms of gender variable.

The Item Response Theory (IRT) was used to assess the validity of items of the Scale. According item discrimination (α) values, the cyberostracism scale can be distinguished in terms of individuals with high and low cyberostracism levels. However, item difficulty values (b) indicated that the 5-point Likert option is not distinguished by the respondents. Furthermore, the corrected item total score correlations for the items in the scale are seen to vary between .40 and .66 in the EFA sample and between .35 and .74 in the CFA sample. In the literature, corrected item total values between .30 and .39 are considered good and .40 or higher to be very good (Aiken and Groth-Marnat 2006;

Table 12 Correlation coefficients between the ostracism experience scale for adolescents and Cyberostracism Scales

Scale	1	2	3	4	5	6	7
1. Cyberostracism	1						
2. Cyber Indirect Excluded	.804**	1					
3. Cyber Direct Excluded	.725**	.395**	1				
4. Cyber Ignored	.836**	.443**	.491**	1			
5 Ostracism	.577**	.393**	.427**	.548**	1		
6. Excluded	.442**	.302**	.303**	.433**	.922**	1	
7. Ignored	.573**	.388**	.468**	.519**	.708**	.379**	1
Mean	19.94	6.23	5.27	8.44	19.95	13.49	6.46
Standard deviation	5.65	2.67	1.72	2.70	5.89	4.50	2.46

Note. ** $p < .01$

Çokluk et al. 2012). Based on this data, the level of the discrimination index values for the scale items can be said to be quite high in the EFA sample and acceptable in the CFA sample.

Cronbach's alpha, McDonald's omega, and test-retest reliability coefficients were calculated to determine the reliability of the Cyberostracism Scale. Cronbach's alpha and McDonald's omega coefficients for the total score of the scale were calculated as .84 and above in EFA and CFA samples. For the test-retest reliability, Cronbach's alpha coefficient was found as .81 for the overall scale. The internal consistency coefficients of .70 or greater are considered sufficient (Tabachnick and Fidell 2013). However, Cronbach's alpha of internal consistency coefficients greater than .60 are claimed to be acceptable for measuring tools in cases not used for individual evaluations (Aiken and Groth-Marnat 2006). Based on these results, the reliability values of the scale can be said to be within acceptable limits.

Finally, the criterion-related validity analysis revealed significant positive correlations between the cyberostracism and ostracism scores. Based on these results, the possibility of individuals who are excluded in face-to-face relationships being excluded in virtual environments can be said to be high. No study examining the relationship between ostracism and cyberostracism was encountered when examining the literature. However, when examining the research addressing the relationships between bullying and cyber-bullying, as they are thought to have a similar structure to ostracism, findings were reached that overlap with the results from this study. These studies found significant relationships for cyber-bullying with traditional bullying (Bauman and Pero 2011; Casas et al. 2013; Erdur-Baker 2010; Menesini et al. 2013), school bullying (Schneider et al. 2012), and physical-verbal aggression (Peker 2015).

This study has limitations. The study was carried out on a sample of university students, and as such the Cyberostracism Scale can be used for individuals in early adulthood (18–24 years). Future studies can perform validity-reliability studies of the scale for other age groups. Another limitation of this study is that the phenomenon of cyberostracism has been measured over the participants' perceptions of cyberostracism rather than actual experiences. Therefore, subsequent studies are recommended to use the Cyberball and/or Ostracism Online paradigms together along with the Cyberostracism Scale.

As a result, the findings obtained from the validity and reliability analysis show the Cyberostracism Scale, which aims to measure university students' perceptions/experiences of virtual social exclusion, to be a valid and reliable measuring tool. Therefore, the Cyberostracism Scale can be said to be usable in measuring the phenomenon of virtual social exclusion in a sample of university students. The dynamics that impact the phenomenon of cyberostracism and what this phenomenon's impacts in peoples' lives can be researched in later studies.

Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

Informed Consent All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2000 (5). Informed consent was obtained from all patients for being included in the study.

Human and Animal Research Formal approval related to the study was receipt from the Human Research Ethics Committee (No: 2020/57; date: 2020/05/03).

Appendix

Table 13 Cyberostracism Scale

Turkish version of the CS	English version of the CS
1. Sosyal medyada beni engellerler.	1. They block me on social media
2. Sosyal medyada beni takip etmezler.	2. They do not follow me on social media.
3. Sosyal medyada arkadaşlık/takip isteklerimi kabul etmezler.	3. They do not accept my friendship/ following requests on social media.
4. Sosyal medyada onları takip etmeme rağmen beni takipten çıkarırlar.	4. They unfollow me even if I follow them on social media.
5. Toplu yapılan bir etkinlikte ilgili özelliklerle içinde yer almadığım fotoğrafları paylaşırlar.	5. They post photos without me intentionally of an event that I am involved in.
6. Sosyal medyada özellikle içinde benim yer almadığım hikâyeleri paylaşırlar.	6. They post stories without me intentionally on social media.
7. Önemli mesajları, benim yer almadığım sosyal medya gruplarında paylaşırlar.	7. They share important messages in a social media group where I was not involved.
8. Sosyal medyada paylaştıkları canlı yayınlara beni dâhil etmezler.	8. They do not include me in their social media live actions.
9. Sosyal medyada paylaştığım mesajları okumazlar.	9. They do not read my posts on social media.
10. Sosyal medyada paylaştığım hikâyelere bakmazlar.	10. They do not pay attention to my story posts.
11. Sosyal medyadan attığım kişisel mesajlara cevap vermezler.	11. They do not respond my personal messages on social media.
12. Sosyal medyada sorduğum sorulara cevap vermezler.	12. They do not answer my questions on social media.
13. Sosyal medya gruplarındaki mesajlarıma cevap vermezler.	13. They do not respond my messages on social media groups.
14. Sosyal medyadaki mesajlarıma/paylaşımlarıma sadece mavi tık (görüldü) atarlar.	14. They only leave blue tick (seen) to my messages/posts on social media.

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