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RESEARCH ARTICLE

Reliability and validity of the Japanese version of the camouflaging autistic traits questionnaire

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Abstract

This study investigated the factor structure and determined the reliability and validity of the Camouflaging Autistic Traits Questionnaire–Japanese version (CAT-Q-J) among 204 autistic and 410 non-autistic people. Since a confirmatory factor analysis revealed no factor validity of the CAT-Q-J for both autistic and non-autistic adults, an exploratory factor analysis was conducted to ensure the psychometric properties matched those of the original scale as much as possible. The results showed the CAT-Q-J comprised three subscales, a four-item compensation subscale, a five-item masking scale, and a five-item assimilation subscale. The overall CAT-Q-J and all three subscales showed sufficient internal consistency and moderate-to-good and stable test–retest reliability in both the autistic and non-autistic samples. Convergent validity was also supported by the correlations found with measures of autistic traits, well-being, anxiety, and depression. Different from the original CAT-Q, compensation/masking for the autistic sample was not correlated with mental health or autistic traits. The reliability and the validity of the overall CAT-Q-J were confirmed; however, caution should be exercised when interpreting its subscales.

Lay Summary

Social camouflaging refers to the behavior of autistic people in which they hide their autistic traits and act like non-autistic people. While this may facilitate communication with non-autistic people, it may also promote anxiety and depression as autistic people continue to pretend to be someone they are not. We examined whether the Camouflaging Autistic Traits Questionnaire (CAT-Q) developed in the UK could be adapted for use with autistic and non-autistic individuals in Japan. The findings confirmed that the overall 14-item CAT-Q-J can measure social camouflaging in autistic individuals in Japan as effectively as the CAT-Q in the UK.

KEYWORDS

autism, factor analyses, Japan, social camouflaging, validation study

INTRODUCTION

Autism is a common neurodevelopmental condition with a reported prevalence of about 1.0–1.7% among the child population in the United States and UK (Baio et al., 2018; Baird et al., 2006). In Japan, pediatric developmental conditions have been the focus of attention since the 1980s. An epidemiologic study of Japanese individuals aged 20–75 years found a high autism prevalence of 5.1% in adults (Umeda et al., 2021). Further, 79% of

autistic adults have a psychiatric condition such as depression and anxiety, which is significantly higher than the prevalence rate (48.8%) among non-autistic individuals (Lever & Geurts, 2016). One factor contributing to this is social camouflaging behavior (Bargiela et al., 2016; Hull et al., 2017).

According to Keating et al. (2022), there is no universally accepted way of talking about autism, and we should follow the community by asking autistic people about their preferences. Identity-first language ("autistic person") is used, and terms like "disorder" are avoided to prevent stigmatization.

Social camouflaging behaviors include explicit efforts to "hide" or "compensate for" autistic traits and use conscious or unconscious techniques that result in less autistic behavior (Hull et al., 2017; Lai et al., 2017; Livingston & Happé, 2017). Social camouflaging behaviors were first explored through qualitative studies of autistic girls and women (Bargiela et al., 2016; Tierney et al., 2016). Camouflaging autistic traits can facilitate integration into the community of typically developing individuals, such as making friends and performing better in job interviews. Pretending to be "normal" through camouflaging can lead to identity fluctuation as one pretends to be a "fake" version of oneself (Hull et al., 2017). Camouflaging behavior requires consistent thinking about how one is perceived by others, leading to exhaustion and burnout (Hull et al., 2017). Therefore, camouflaging behavior can have negative effects on mental health, including anxiety and depression (Cage et al., 2018). Further, social camouflaging behaviors can lead to missed or delayed diagnoses of autism and make it more difficult to access social support and services (Kopp & Gillberg, 1992).

Camouflaging is used in other cultures to describe an individual's adaptive behavior to the environment. In Japan, it is called over-adaptation—defined as "an individual's attempt to conform to the demands and expectations of the environment to the point of near perfection, making efforts to meet external expectations and demands even if this means forcibly suppressing internal needs" (Ishizu & Ambo, 2008, p. 23). The term "over-adaptation" has been applied to autistic people and may include an inability to appropriately distance themselves from social norms. They may go to extremes in an inflexible manner to satisfy the norms completely, and the attempt to adapt one's own behavior may instead cause maladaptation (Yoneda, 2011). Behavior that strictly adheres to norms is a difficulty related to restricted repetitive behaviors (RRB), one of the diagnostic criteria for autism.

From an interpersonal perspective, the term "over-adaptation" represents a substantial effort to hide autistic traits by autistic people to fit into their environment by behaving socially in interpersonal situations, similar to non-autistic people (Honda, 2018). Over-adaptation is similar to camouflaging behavior in that it involves hiding autistic traits and acting like a non-autistic person. However, while social camouflaging is a behavioral tendency of autistic people in interpersonal situations (Hull et al., 2019), over-adaptation in Japan includes, in addition to adaptation to one's surroundings for interpersonal situations, compliance with external environments such as school and work rules and the inability to stop complying. Thus, over-adaptation involves RRB in addition to social communication. In this respect, compared to camouflaging behavior, over-adaptation is a concept that lacks autonomy.

In Japan, psychiatrists and others are reporting through case studies that over-adaptation in autistic people may be detrimental to their mental health (Chida & Okada, 2021). While there are eight measures of over-adaptation in Japan (Kazama, 2017), no quantitative research has been conducted using these measures for over-adaptation in autistic people (Chida & Okada, 2021). In Japan no empirical research has been conducted on social camouflaging behavior and over-adaptation in autistic individuals. After qualitatively studying autistic people's experiences through interviews, Hull et al. (2019) developed the 25-item Camouflaging Autistic Traits Questionnaire (CAT-Q), comprising three subscales: compensation (used to compensate for one's own social and communication difficulties), masking (used to hide one's autistic side or show a non-autistic personality to others), and assimilation (the need to change oneself to be accepted by others). The CAT-Q is the only self-report instrument quantitatively measuring social camouflaging behavior in autistic people. The CAT-Q has been validated with autistic and non-autistic adults in the UK and with university students in Italy, with good internal consistency and validity (Dell'Osso et al., 2022; Hull et al., 2019), while the Dutch and French versions have good reliability but poor measurement consistency across autistic and non-autistic adults (Bureau et al., 2023; Van Der Putten et al., 2023). The Taiwanese version was validated with autistic and non-autistic child-adolescents and their caregivers; it had a two-factor factor structure of compensation-masking and assimilation, as well as good reliability (Liu et al., 2023).

We examined the factor structure, both internal consistency and test–retest reliability, and convergent validity of the Japanese version of the CAT-Q (CAT-Q-J) among autistic and non-autistic individuals in Japan.

The Japanese versions of the following scales were used to test convergent validity (Hull et al., 2019): Broad Autism Phenotype Questionnaire (BAPQ-J; Sakai et al., 2014), Liebowitz Social Anxiety Scale (LSAS-J; Asakura et al., 2002), Warwick–Edinburgh Mental Well-being Scale (WEMWBS-J; Suganuma et al., 2016), Patient Health Questionnaire-9 (J-PHQ-9; Muramatsu, 2014), and Generalized Anxiety Disorder-7 (J-GAD-7; Muramatsu, 2010). Based on the original study (Hull et al., 2019), we expected to find a correlation between camouflaging and autistic traits, social anxiety, general anxiety, well-being, and depression.

METHODS

Participants

A follow-up survey of non-autistic and autistic adults in Japan was conducted at two-time points, 2 weeks apart; the retest follow-up survey was to examine the reliability of the CAT-Q-J. Non-autistic adults were those who self-reported that they had never been diagnosed with autism. Contrastingly, autistic adults were asked to self-report their autism diagnosis, type of diagnosis (autism, Asperger's syndrome, autism spectrum disorder, and so on), and the age they were diagnosed by a primary physician. In one survey, 100 non-autistic adults were recruited in late February 2020; 30 of them participated in a retest follow-up survey. The other survey recruited 350 non-autistic and 150 autistic adults in February 2021. Of these, 150 non-autistic and 78 autistic adults underwent the retest follow-up survey. Owing to the small number of autistic adults recruited through the online survey compared to the sample in Hull et al. (2019), 60 autistic adults were outpatients attending psychiatry departments in eastern and western Japan were hand-delivered questionnaires, which they returned by hand delivery or mail from February to April 2021. Twelve autistic adults received a retest follow-up survey. All 60 autistic adults were diagnosed with autism by a primary physician (based on the Diagnostic and Statistical Manual of Mental Disorders, fourth or fifth edition [DSM-IV or DSM-5, respectively]) 11 met the cutoff for autism, measured using the Autism Diagnostic Observation Schedule (ADOS-2; Lord et al., 2000) or Autism Diagnostic Interview-Revised (ADI-R; Lecavalier et al., 2006; Lord et al., 1994). In summary, 450 non-autistic and 210 autistic adults completed the self-report questionnaire. Of these, 180 non-autistic and 90 autistic adults completed a retest follow-up survey. All participants were of legal age to give informed consent on their own behalf in Japan (aged ≥20 years).

Participants first read an explanation that the survey would be conducted anonymously and that they would not be compelled to respond. They were then asked to complete the survey only if they agreed to participate. Respondents to the online survey were given points that could be redeemed for merchandize. Respondents to the in-person survey were given a prepaid card worth 1000 yen (approximately 7 U.S. dollars) as a reward.

Materials

Demographic data

Participants were asked to provide personal data, including sex, age, and occupation. Autistic people were also asked about their age at diagnosis.

CAT-Q-J

The CAT-Q comprises 25 items across three subscales (Hull et al., 2019): compensation (nine items), masking (eight items), and assimilation (eight items). Each item is rated on a seven-point Likert scale from 1 (*strongly disagree*) to 7 (*strongly agree*). The CAT-Q total score ranges from 25 to 175. A high total score indicates more severe camouflaging.

The internal consistencies of the CAT-Q total in the autistic and non-autistic samples of the original version (Hull et al., 2019) were 0.91 ($n = 200$) and 0.93 ($n = 202$), respectively, while the Pearson's r and intraclass correlations (ICCs) in the autistic sample were 0.77 and 0.77, respectively ($n = 30$). The internal consistencies of the three subscales in the autistic and non-autistic sample in Hull et al. (2019) were 0.88 and 0.90 (compensation), 0.87 and 0.84 (masking), and 0.86 and 0.89 (assimilation), respectively. Pearson's r and ICCs for the autistic sample in Hull et al. (2019) were 0.78 and 0.77 (compensation), 0.70 and 0.70 (masking), and 0.73 and 0.73 (assimilation), respectively.

After receiving permission from Dr. Hull, the original English CAT-Q was translated into Japanese by two psychologists from a translation agency with Japanese as their first and English as their second language. Then, the two Japanese translations were compared and integrated. Finally, the integrated version was back-translated into English by two bilingual graduate students majoring in clinical psychology, and the two back-translated English versions were compared and integrated. This back-translation was sent to Dr. Hull, and permission was obtained to use it as the CAT-Q-J with no modifications (Data S2).

BAPQ-J

The BAPQ-J is the Japanese version of the BAPQ (Hurley et al., 2007)—a 36-item self-report scale measuring the broad autism phenotype (Sakai et al., 2014). Each item is rated on a six-point Likert scale from 1 (*almost never*) to 6 (*often*). The total score is calculated from the average of 36 items, and the score of each subscale (aloofness, pragmatic language, and rigidity) is calculated from the average of 12 items (range = 1–6). Validity and reliability have been confirmed (Sakai et al., 2014). We used the BAPQ-J to measure the autistic traits in autistic and non-autistic samples as in Hull et al. (2019). Excluding missing data, 609 participants (199 autistic and 410 non-autistic adults) completed the BAPQ-J. The internal consistency of the scale in this study (based on the total sample) was 0.93.

LSAS-J

The LSAS-J is the Japanese version of the LSAS (Liebowitz, 1987)—a self-report scale comprising 24 items measuring social anxiety (Asakura et al., 2002). The scale

requires participants to imagine being in different social situations (such as talking to a sales assistant in a shop) and asks how much fear they would experience and how much they would avoid the situation, using a four-point Likert scale: fear = 0 (*none*) to 3 (*severe*) and avoidance = 0 (*never*) to 3 (*usually* [68–100%]). The LSAS-J is reliable and valid (Asakura et al., 2002). Excluding missing data, 604 participants (194 autistic and 410 non-autistic people) completed the LSAS-J. Internal consistency was high (α = 0.98).

WEMWBS-J

The WEMWBS-J is the Japanese version of the WEMWBS (Tennant et al., 2007)—a 14-item self-report questionnaire measuring general well-being in the last 2 weeks, which is reliable and valid (Suganuma et al., 2016). Each item is rated on a five-point Likert scale from 1 (*never*) to 5 (*usually*). Excluding missing data, 522 participants (204 autistic and 318 non-autistic adults) completed the WEMWBS-J. Internal consistency in the total sample was high (α = 0.95).

J-PHQ-9

The Japanese version of the PHQ-9 is a nine-item simplified assessment tool for major depressive disorder (Muramatsu, 2014). Each item is rated on a four-point Likert scale from 0 (*never*) to 3 (*usually*). The PHQ-9 total score ranges from 0 to 27. A high total score indicates a high depression level. Validity has been confirmed (Muramatsu, 2014). Excluding missing data, 613 participants (203 autistic and 410 non-autistic adults) completed the J-PHQ-9. Internal consistency in the total sample was high (α = 0.95).

J-GAD-7

The Japanese version of the GAD-7 is a seven-item simplified assessment tool for Generalized Anxiety Disorder (Muramatsu, 2010). Each item is rated on a four-point Likert scale from 0 (*never*) to 3 (*usually*). The GAD-7 total score ranges from 0 to 21. A high total score indicates a high general anxiety level. Validity has been previously confirmed (Muramatsu, 2010). Excluding missing data, 612 participants (202 autistic and 410 non-autistic adults) completed the J-GAD-7. Internal consistency in the total sample was high (α = 0.93).

Ethical conditions

We provided the study aim and an informed consent form on the cover of the questionnaire, and we asked respondents whether they agreed to participate. These procedures were approved by the ethics committee of Chiba University (no. 3708; January 8, 2021).

Data cleaning

Surveys using online survey companies have often shown satisficing or lack of effort responses (Miura & Kobayashi, 2015). Similar to Fujino et al. (2015), who examined the validity of the Japanese version of the Mindfulness Attention Awareness Scale using an online survey company, we excluded respondents who consistently gave the same response (i.e., straight-lining) except for the middle response (e.g., 3 on a five-point scale of 1 to 5) for a subscale that included both positive and negative items. In the first online survey, 6 autistic and 40 non-autistic respondents were excluded. In the second online survey for retest, 3 autistic and 14 non-autistic respondents were excluded. Consequently, the first survey analysis included 204 autistic and 410 non-autistic people, and the second survey analysis for the retest included 87 autistic and 166 non-autistic people (Figures A1 and A2 in the Supplemental Materials).

Analyses

Factorial validity

We performed a confirmatory factor analysis (CFA) to confirm the factor structure. We used the values recommended by Hu and Bentler (1999): Comparative fit index (CFI) ≥0.95, Root mean squared error of approximation (RMSEA) ≤0.06, and Standardized root mean square residual (SRMR) ≤0.08. The CFA was performed with 203 autistic and 410 non-autistic participants, respectively. The analysis for both groups revealed a lack of factorial validity. Therefore, we conducted an exploratory factor analysis (EFA) using the maximum likelihood method with a promax rotation. Pearson's correlations among the three subscales of the 14 items CAT-Q-J were extracted based on the result of the EFA. A one-way analysis of variance (ANOVA) was performed to compare the total CAT-Q-J scores and the three subscales in the autistic and non-autistic samples.

Reliability

Data from 204 autistic and 410 non-autistic participants who completed the CAT-Q-J were analyzed to calculate Cronbach's α and McDonald's ω for internal consistency; 203 autistic individuals were included in the CAT-Q-J total score analysis and the assimilation subscale because of missing data for one autistic individual. All were judged to be sufficiently reliable (≥0.7).

Test–retest reliability at a two-week interval was measured using correlations (Pearson's r) and ICCs [2, 1]. Data

from 87 autistic and 166 non-autistic participants who completed the CAT-Q-J retest were analyzed. No participants had missing scores in the retest. Values between 0.50 and 0.75 indicated moderate reliability, and values above 0.75 indicated good reliability (Koo & Li, 2016).

Validity

Convergent validity

Convergent validity was examined using correlations (Pearson's r) between the total CAT-Q-J and the subscales, as well as measures of autism-like traits (BAPQ-J), social anxiety (LSAS-J), well-being (WEMWBS-J), generalized anxiety (J-GAD-7), and depression (J-PHQ-9). As 18 in-person surveys in the autistic sample had missing responses on some measures, multiple imputations were performed to reduce the bias potential by maximizing the sample's usable proportion. Multiple imputations were performed using SPSS Statistics Missing Values, with estimates from five imputations pooled to produce the imputed data, which were integrated with the original data to produce a final dataset of 204 autistic participants. As all surveys for non-autistic participants were conducted online, none had missing responses.

All analyses were performed using SPSS 27.0 (Armonk, NY: IBM Corp.).

RESULTS

Descriptive characteristics

Table 1 shows the sample characteristics. Autistic participants were significantly younger than non-autistic participants ($t(612) = 7.05$, $p < 0.01$, $d = 0.55$). The ratio of females to males was significantly lower for autistic than for non-autistic samples ($\chi^2(1) = 4.244$, $p < 0.05$, $\varphi = 0.083$). The BAPQ-J scores of autistic (mean = 4.02, $SD = 0.70$) and non-autistic (mean = 3.15, $SD = 0.53$) participants were significantly different ($p < 0.001$, $d = 0.59$).

Factorial validity

A CFA was performed using a hypothetical model with the same three factors as the original version. The items corresponded to each factor, as shown in Table 2. Based on the relevance criteria adopted by Hu and Bentler (1999), the values we obtained were not within a permissible range. We thus concluded that the same items and three factors are not valid as in the original version.

As a tool for conducting research on the social camouflaging behaviors comparing autistic and non-autistic people in Japan, the goal of this study was to develop the CAT-Q-J that preserved as much of the comparable reliability, validity, and psychometric properties of the original scale as possible. Therefore, to create a scale comprising common items for both autistic and non-autistic people while maintaining the three-factor structure of the original scale, the following three criteria

TABLE 2 Fit of 25-Item Full CAT-Q scale across autistic ($n = 203$), non-autistic ($n = 410$).

Sample	χ^2	Df	CFI	RMSEA	SRMR
Autistic	920.400	272	0.670	0.109	0.115
Non-Autistic	1591.830	272	0.741	0.109	0.108

TABLE 1 Sample characteristics.

	Total sample		Autistic sample		Non-autistic sample		
Variable	***N* = 614**	**%**	***n* = 204**	**%**	***n* = 410**	**%**	
Sex (male/female)	319/295	52.0/48.0	118/86	57.8/42.2	201/209	49.0/51.0	$\chi^2 = 4.24$, $p = 0.39$
Mean age in years (SD)	42.15 (12.91)		37.53 (10.33)		44.45 (13.45)		t = 7.05, $p < 0.01$
Age range (years)	20–65		20–64		20–65		
20–25	–		32	15.7	36	8.8	
26–35	–		60	29.4	100	24.4	
36–45	–		60	29.4	67	16.3	
46–55	–		47	23	87	21.2	
56–65	–		5	2.45	120	29.3	
Mean age at autism diagnosis (SD)	–		28.70 (12.16)		–		
Age range at autism diagnosis (years)	–		0–53		–		
Employed full- or part-time	412	67.1	114	55.9	298	72.7	
Student	33	5.4	21	10.3	12	2.9	
Homemaker	72	11.7	11	5.39	61	14.9	
Unemployed or unable to work	97	15.8	58	28.4	39	9.5	

were used in the EFA to select items for the autistic and non-autistic samples.

1. Examination of the meaning of the factors: Since the three factors in the original version were hypothesized, if a factor extracted by EFA differed from the hypothesized factor, the items comprising that factor can be removed.
2. Examination of factor loadings: Items with factor loadings smaller than 0.3 or items with negative factor loadings that contradict the intent or meaning of the factor to which they belong can be removed.
3. Examination of the factor-item relationship: Items belonging to factors different from those in the original version can be removed.

Items that fit these criteria in both or one of the samples were deleted in both samples. The EFA was repeated using the same procedure according to these criteria.

Maximum likelihood method analyses using promax rotation were performed on the autistic and non-autistic samples, respectively. Three factors for the autistic sample and four factors for the non-autistic sample were determined to be optimal from each scree plot, but we decided to conduct an EFA with the three factors—the same as the original scale. The process of sorting the items in the EFA is shown in the Supplemental Materials. Finally, the CAT-Q-J had 14 items, with four items on the compensation subscale, five items on the masking scale, and five items on the assimilation subscale. The factor loadings of each item for the three-factor model are shown in Table 3. Subscale correlations were high (Cohen, 1988) between all subscale in all samples in Table 4.

Group differences in CAT-Q-J scores

Table 5 presents the means and SDs for the total CAT-Q-J score and subscale scores for the autistic and non-autistic samples. The one-way ANOVA revealed that autistic participants scored significantly higher than non-

TABLE 3 Factor loadings of the 14-Item CAT-Q-J in the autistic and non-autistic samples.

			Autistic (n = 203)			Non-autistic (n = 410)		
No.	**CAT-Q (Hull et al., 2019)**	**CAT-Q-J**	**Factor 1**	**Factor 2**	**Factor 3**	**Factor 1**	**Factor 2**	**Factor 3**
Compensation								
11		I practice my facial expressions and body language to make sure they look natural	0.34	0.30	0.16	**0.48**	0.17	0.11
17		I have researched the rules of social interactions (for example, by studying psychology or reading books on human behavior) to improve my own social skills	0.34	0.21	−0.01	**0.58**	0.05	0.13
20		I learn how people use their bodies and faces to interact by watching television or films, or by reading fiction	**0.84**	0.03	0.01	**0.80**	0.04	−0.04
23		I have spent time learning social skills from television shows and films, and try to use these in my interactions	**0.86**	−0.11	0.04	**0.88**	−0.13	0.02
Masking								
2		I monitor my body language or facial expressions so that I appear relaxed	0.16	**0.65**	−0.14	0.15	**0.68**	−0.23
6		I adjust my body language or facial expressions so that I appear interested by the person I am interacting with	−0.13	**0.94**	−0.14	−0.07	**0.85**	−0.03
9		I always think about the impression I make on other people	−0.12	**0.42**	0.15	−0.06	**0.71**	0.03
15		I monitor my body language or facial expressions so that I appear interested by the person I am interacting with	0.07	**0.77**	−0.12	0.15	**0.67**	0.05
21		I adjust my body language or facial expressions so that I appear relaxed	0.27	**0.67**	−0.10	0.38	**0.51**	−0.06
Assimilation								
7		In social situations, I feel like I'm "performing" rather than being myself	−0.18	**0.53**	0.28	−0.21	**0.67**	0.31
10		I need the support of other people in order to socialize	0.02	−0.08	**0.48**	0.29	−0.03	**0.51**
13		I have to force myself to interact with people when I am in social situations	0.03	0.07	**0.79**	−0.08	−0.01	**0.93**
16		When in social situations, I try to find ways to avoid interacting with others	0.06	−0.11	**0.69**	0.07	−0.11	**0.79**
25		In social situations, I feel like I am pretending to be "normal"	−0.10	**0.53**	0.33	0.15	0.23	**0.41**

Note: Figures in bold show factor loadings >0.40. CAT-Q-J: Camouflaging Autistic Traits Questionnaire—Japanese version.

TABLE 4 Subscale correlations in autistic ($n = 204$) and non-autistic ($n = 410$) samples in the CAT-Q-J.

	Compensation		Masking	
	Autistic	Non-autistic	Autistic	Non-autistic
Making	0.62**	0.64**	—	—
Assimilation	0.51**	0.61**	0.51**	0.60**

Abbreviations: CAT-Q-J: Camouflaging Autistic Traits Questionnaire—Japanese version.
**$p < 0.01$.

TABLE 5 CAT-Q-J total and subscale mean scores (SD)and internal consistency (Cronbach's α and McDonald's ω) in the autistic and non-autistic ($n = 410$) samples.

	No. of items	Mean (SD)		p	Internal consistency (Cronbach's α)		Internal consistency (McDonald's ω)	
		Autistic[a]	Non-autistic		Autistic[a]	Non-autistic	Autistic[a]	Non-autistic
Total	14	4.19 (1.02)	3.38 (1.01)	<0.001	0.85	0.91	0.84	0.91
Compensation	4	3.52 (1.36)	3.00 (1.15)	<0.001	0.75	0.82	0.76	0.82
Masking	5	4.00 (1.37)	3.63 (1.17)	0.002	0.84	0.85	0.84	0.85
Assimilation	5	4.95 (1.19)	3.44 (1.18)	<0.001	0.71	0.83	0.69	0.83

Abbreviation: CAT-Q-J, Camouflaging Autistic Traits Questionnaire—Japanese version.
[a]Total and assimilation, $n = 203$; compensation and masking; $n = 204$.

autistic participants on the total CAT-Q-J ($F(1, 611) = 85.48$, $p < 0.001$, partial $\eta^2 = 0.12$), the compensation ($F(1, 612) = 24.33$, $p < 0.001$, partial $\eta^2 = 0.04$), the masking ($F(1, 612) = 9.87$, $p = 0.002$ partial $\eta^2 = 0.02$), and assimilation ($F(1, 611) = 219.69$, $p < 0.001$, partial $\eta^2 = 0.26$) subscales.

Reliability consistency (Cronbach's α and McDonald's ω)

Table 5 shows Cronbach's α and McDonald's ω for the total CAT-Q-J and each subscale for the autistic and non-autistic samples. These values were sufficiently reliable for the total CAT-Q-J and all subscales for both samples.

Test–retest reliability

The non-autistic sample in the retest was significantly older on average than the non-autistic sample in the first survey ($t(574) = 2.056$, $p = 0.040$, $d = 0.19$); however, there was no significant age difference in the autistic sample in the first survey and retest ($t(289) = 1.646$, $p = 0.101$, $d = 0.21$). There were no significant sex differences between the autistic and non-autistic participants in the first survey and retest ($\chi^2(1) = 0.927$, $p = 0.336$, $\varphi = 0.056$; $\chi^2(1) = 0.699$, $p = 0.403$, $\varphi = 0.035$, respectively; Table A1 in Supplemental Material S1). There were no significant differences in the mean total BAPQ-J scores between the first survey and retest samples of autistic and non-autistic participants ($t(283) = 0.668$, $p = 0.505$; $d = 0.086$, $t(574) = 1.529$, $p = 0.127$, $d = 0.141$, respectively).

Moderate to good stability was found, as measured by Pearson's r and ICCs [2, 1] for the total scale and all three subscales for both the autistic and non-autistic samples (Table 6).

Convergent validity

Correlations were performed between the total and subscale CAT-Q-J scores, and scores on autism-like traits (total BAPQ-J score and subscale scores), social anxiety (total LSAS-J score), well-being (total WEMWBS-J score), generalized anxiety (total J-GAD-7 score), and depression (total J-PHQ-9 score) to investigate convergent validity. Results in the autistic and non-autistic samples are detailed in Table 7.

The total CAT-Q-J score and all CAT-Q-J subscales were significantly positively correlated with autistic-like traits, social anxiety, depression and generalized anxiety in autistic and non-autistic samples, with the exception of the compensation and masking subscales which were not significantly related to almost all of them in the autistic sample. The total CAT-Q-J and the compensation and assimilation subscales were significantly negatively correlated with well-being in the non-autistic sample; however, in the autistic sample, only the assimilation subscale was significantly negatively correlated with well-being.

TABLE 6 Test–retest reliability of the CAT-Q-J total and subscales in the autistic and non-autistic samples.

	Autistic ($n = 87$)			Non-autistic ($n = 166$)		
	Pearson's r	ICC [2, 1]	95% CI	Pearson's r	ICC [2, 1]	95% CI
Total	0.80	0.80	0.71, 0.86	0.57	0.57	0.46, 0.67
Compensation	0.82	0.82	0.73, 0.88	0.55	0.55	0.43, 0.65
Masking	0.77	0.77	0.66, 0.84	0.54	0.54	0.43, 0.64
Assimilation	0.73	0.73	0.61, 0.81	0.66	0.66	0.56, 0.74

Abbreviations: CAT-Q-J, Camouflaging Autistic Traits Questionnaire—Japanese version; CI, confidence interval; ICC, intraclass correlation.

TABLE 7 Correlations between the CAT-Q-J total and subscale scores and autistic traits (BAPQ-J), social anxiety (LSAS-J), depression (J-PHQ-9), generalized anxiety (J-GAD-7), and well-being (WEMWBS-J) for the autistic and non-autistic samples.

	Total BAPQ-J	BAPQ-J: Aloofness	BAPQ-J: Pragmatic language	BAPQ-J: Rigidity	Total LSAS-J	WEMWBS-J	PHQ	GAD
Autistic ($n = 204$)								
CAT-Q total	0.24**	0.13	0.28**	0.20**	0.27**	−0.02	0.18*	0.19**
Compensation	0.00	−0.11	0.17*	−0.04	0.05	0.13	0.05	0.13
Masking	−0.03	−0.13	0.04	0.02	0.12	0.10	0.05	0.05
Assimilation	0.61**	0.57**	0.48**	0.48**	0.47**	−0.29**	0.32**	0.27**
Non-autistic[a]								
CAT-Q total	0.36**	0.15**	0.44**	0.30**	0.28**	−0.22**	0.35**	0.34**
Compensation	0.30**	0.09	0.43**	0.22**	0.15**	−0.13*	0.27**	0.27**
Masking	0.12*	−0.06	0.23**	0.14**	0.13**	−0.05	0.24**	0.23**
Assimilation	0.52**	0.36**	0.49**	0.40**	0.42**	−0.37**	0.39**	0.37**

Abbreviations: CAT-Q-J, Camouflaging Autistic Traits Questionnaire—Japanese version; BAPQ-J, Broad Autism Phenotype Questionnaire—Japanese version, GAD-7, Generalized Anxiety Disorder-7; LSAS, Liebowitz Social Anxiety Scale—Japanese version; PHQ-9, Patient Health Questionnaire-9; WEMWBS: Warwick–Edinburgh Mental Well-being Scale—Japanese version.

[a]$n = 410$ for correlations between CAT-Q-J total and subscale scores and autistic traits (BAPQ-J), social anxiety (LSAS-J), depression (PHQ), and generalized anxiety (GAD); $n = 318$ for correlations between CAT-Q-J total and factor scores and well-being (WEMWBS-J).

*$p < 0.05$.

**$p < 0.01$.

DISCUSSION

This study psychometrically verified the CAT-Q-J in autistic and non-autistic samples. When a CFA was performed to confirm that the CAT-Q-J has the same three-factor structure of "compensation," "masking," and "assimilation" as the original scale, no fit was found for both autistic and non-autistic samples. Therefore, an EFA was conducted on each sample to determine whether the scale would have the same factor structure with the same items in the autistic and non-autistic samples. Eleven of the 25 items in the original version were deleted, and the CAT-Q-J became a scale comprising 14 items, of which two items belonging to the masking factor were semantically interpreted and added to the assimilation factor. Finally, the CAT-Q-J had four items for the compensation factor, five items for the masking factor, and five items for the assimilation factor, which comprised the same items as the original scale. The reliability and validity of the 14-item CAT-Q-J were examined. As in several previous studies (Dell'Osso et al., 2022; Hull et al., 2019; van der Putten et al., 2023), the autistic sample's overall CAT-Q-J and all three subscale scores were significantly higher than the non-autistic sample, indicating that the CAT-Q-J measures camouflaging behaviors in autistic people. The overall CAT-Q-J and all three subscales, except both compensation and masking in autistic sample, were positively correlated with autism-like traits in both autistic and non-autistic samples, suggesting that the more autism-like traits a person has, the more they camouflage those traits, regardless of the autism diagnosis. Internal consistency and retest reliability of the over CAT-Q-J and all three subscales were sufficiently validated in the autistic and non-autistic samples. The validity of the overall CAT-Q-J and three subscales were verified for both the autistic and non-autistic samples, except for the compensation and masking subscales in the autistic sample. These results suggest that the overall CAT-Q-J and the assimilation subscale measure camouflaging behaviors in autistic people but the compensation and masking subscales in the autistic people were not validated and should be used with caution.

Since it was verified that the CAT-Q-J can measure the camouflaging behavior of autistic people in Japan, the CAT-Q-J informs future empirical research on how

the camouflaging behavior of autistic people affects their lives. High levels of successful camouflaging can lead to missed clinical diagnoses (Tierney et al., 2016). Further research is needed regarding its potential application in clinical situations. The results of the reliability and validity of the 25-item CAT-Q-J were presented in Tables A2, A3 and A4 in Supplemental material.

Five reversal items (items 3, 12, 19, 22, and 24) were deleted as a result of the EFA. Of these, three items (items 3, 12, and 22) were deleted in the autistic and non-autistic samples, and one item (item 19) was deleted in the non-autistic sample because it either loaded low on any of the three factors or resulted in a different value direction implied by the factors.

Because reversal items are usually included to prevent respondents from becoming accustomed to answering questions with similar value orientations, caution should be exercised in understanding and responding to reversal items. In addition, in English, negative terms (e.g., "not") appear at the beginning of a sentence, whereas in Japanese they appear at the end of a sentence, which may need participants to understand and respond with sustained attention. For surveys conducted by online research companies, such as the one in this study, respondents are more likely to not read the explanatory text carefully; that is, to respond with insufficient power, than for surveys targeting university students, who are less anonymous when participating in research and have more daily exposure to academic research (Miura & Kobayashi, 2015). Data collection for the autistic sample in this study was conducted in two ways: hand-delivered and online; when EFA was performed on the two sets of data, the results for the online data sample were similar to those for the full autistic sample, but the results for the hand-delivered sample were different. Hence, it is possible that some of the CAT-Q-J reversal items in this study were influenced by the wording of the forward items without fully understanding the meaning of the items, to the point of using a Japanese online survey company. In the non-autistic sample, however, one factor was extracted in the EFA process, consisting only of items 19 and 22. Since both items were also reversal items and were assimilated subscales of the original scale, this factor cannot be called a reversal item factor. Further, the responses to the reversal items in the autistic and non-autistic samples were not exactly the same, despite the fact that the same data collection method was used; that is, online. Further research is needed to determine whether the results of the reversal items in this study were owing to inadequate understanding of the reversal items or to the content of the items themselves.

Four items were deleted because they did not load on the intended factors in the original scale. They were compensation subscales in the original scale in the autistic and non-autistic sample, but all loaded on the masking subscale in this scale (items 1, 4, 8, and 14). These four items may have been masking because they meant "seeing others around me and behaving the same way" and hiding one's true self.

In addition, items 7 and 25 loaded on the masking factor in this scale in the autistic and non-autistic sample. It is thought that "performing" in item 7 and "pretending to be normal" in item 25 were also taken as hiding one's self. Like Hull et al. (2019) results, the differences between autistic and non-autistic individuals on the masking subscale were smaller than on the other two subscales. Hull et al. (2019) suggested that masking might be less specific to autism than other components of camouflage, reflecting more general self-presentation and impression management strategies and impression management strategies might be applied to autistic traits.

Not only masking but also the compensation subscale did not correlate with autistic traits in the autistic sample. Hull et al. (2019) found no correlation between the masking subscale and autistic traits in autistic individuals, and they suggested that masking might be a response to being autistic rather than a response to the presence of specific autistic traits. In Japanese autistic people, not only masking but also compensation is a response to being autistic rather than specific autistic traits. Contrastingly, in the UK, masking was correlated with autistic traits in non-autistic individuals; however, in Japan, compensation as well as masking were correlated. As Hull and colleagues suggested, autistic and non-autistic individuals may have different motivations for using masking strategies. In Japan, the motives for using compensation and masking are thought to differ from those of non-autistic individuals. For autistic people, "social interaction" means interacting with a majority of non-autistic people with different communication styles. For Japanese autistic people, compensation and masking may be a strategy to draw closer to the communication style of the majority, non-autistic people.

Camouflaging in autistic adults may be associated with poor mental health outcomes, particularly social anxiety and general anxiety (Hull et al., 2021) and depression (Beck et al., 2020). The overall CAT-Q-J and the assimilation subscale were positively correlated with social anxiety, general anxiety, and depression measures, supporting this idea and providing convergent validity. The compensation and masking subscales were not positively correlated with measures of social anxiety, general anxiety, and depression. Nor did they correlate negatively with measures of well-being. The original scale also showed no negative correlation with well-being on the compensation and masking subscales in autistic people, and a weak positive correlation of 0.16 to 0.30 with measures of social anxiety, general anxiety, and depression. Hull et al. (2019) suggested that the lack of correlation between the compensation and masking scales and well-being may reflect complex individual differences in the impact and success of camouflaging. Individual differences include the social and cultural context in which a person lives, such as gender. In previous studies, the

association between camouflage and negative outcomes was weaker in autistic women than in men (Lai et al., 2017). Sunagawa (2023), who interviewed 10 adult Japanese women, found that for autistic women, camouflaging is a survival strategy, which reduces conflicts with their surroundings and keeps them healthy.

Conformity is the act of matching attitudes, beliefs, and behaviors to group norms or like-minded people (Cialdini & Goldstein, 2004). Research on individual factors of conformity behavior indicates that people with weaker self-esteem are more likely to conform as compared to their counterparts (Aronson, 1988). This could explain why autistic people, who are socially positioned as "handicapped" and "inferior," exhibit more camouflaging behavior than non-autistic people both in the UK and Japan. Further, conformity behavior is more likely to occur in highly cohesive groups (Festinger, 1953). According to Hofstede (1980), Japan has a cooperative culture, which is more cohesive than Western individualism. Unlike the UK results, there was no negative correlation between compensation and masking and mental health in Japanese autistic individuals. The results suggest that for some Japanese autistic individuals, compensation and masking cause stress, while for others, because Japan is a society with strong conformity, it is better to exercise means to assimilate into society to avoid conflicts with those around them and to maintain their health.

Focusing on the camouflaging behavior of autistic people would reveal how autistic people, as a minority, are affected by society yet survive in society. Further, it is important to consider the sociocultural context when examining social influences; therefore, international comparative studies should be conducted. Further, it is important to consider the sociocultural context when examining social influences; therefore, international comparative studies should be conducted.

Limitations

There are four study limitations. First, the autistic sample comprised adults diagnosed with autism at mid-life (mean age of diagnosis was 28.70 years) and had no intellectual disabilities; thus, our results may not be generalizable to all autistic individuals in Japan. Further, owing to the small sample size, we did not validate the CFA or measurement invariance for the CAT-Q-J, which was determined with an EFA. In the future, the sample size should be increased, and a CFA of this scale should be conducted to confirm the goodness-of-fit of the factor structure. It is also necessary to include those diagnosed early and increase the sample size of autistic individuals and to examine whether the scale is valid for comparison between autistic and autistic individuals. Different from the original scale, the compensation and masking subscales in the CAT-Q-J were not associated with mental health, suggesting that camouflaging behavior is situation-dependent. Although autism has neurobiological origins, the associated traits are not necessarily a product of the individual but also that of environmental fit (Lai & Baron-Cohen, 2015). The CAT-Q was developed based on interviews with autistic people in the UK. The CAT-Q-J can be improved by qualitatively identifying strategies for camouflaging behavior in autistic individuals of all ages in Japan through interviews, which could then be applied clinically. In addition, an interesting topic for future research is the need to clarify, through international comparative studies, whether the camouflage strategies and outcomes of autistic people are related to sociocultural factors. Second, we also collected data on the autistic sample in two ways: online and hand-delivered. No significant differences were found across all measures (Table A5 in the Supplementary Material S1). However, missing values were found in the hand-delivered group. Missing values were processed but removed in some analyses, which is a limitation in that the number of data varied across analyses while not affecting the results. In the future, other data collection procedures will need to be devised, such as having researchers ensure that participants complete the questionnaire when using the hand-off method.

Although the sample size varied across analyses, it was not enough to determined significant differences in participants' characteristics between online and hand-delivered questionnaires. The missing values occurred for participants in the autistic sample who were requested to hand-deliver the data. The reason for this may be that unlike in the online survey, the scale was printed and handed over on paper, allowing participants to proceed to the next page without noticing that they had inadvertently skipped an item. Of these, there were many missing values for the LSAS-J and the BAPQ-J. The reasons for this are assumed to be that the number of items for these two scales was higher than for the others, and that the two scales were on the final page of all questionnaires, which could be associated with participants' fatigue. To avoid missing values, it is necessary to use IT devices, such as tablets and email to check for missed items, rather than hand delivery of paper. Further, all five reversal items were removed from this study as a result of the EFA. To clarify whether the current results were owing to the effect of the items being assessed without adequate understanding of their content through the online survey or owing to the content of the items themselves, it is necessary to validate the results by reversing the reversal items in future surveys.

Third, camouflaging in autistic people is affected by personal attributes such as sex and age (Anderson et al., 2020; Jorgenson et al., 2020). The sample of non-autistic individuals was significantly older than the autistic sample. Those aged between 56 and 65 years only

comprised 2.45% of the sample of non-autistic persons as compared to 29.3% for the sample of autistic persons. According to a survey that asked Japanese companies about the age group with the most mental health problems in their companies, 3.6% of respondents were in their 50s or older, while 29.0%, 39.9%, and 27.5% were in their 10s or 20s, 30s, and 40s, respectively (The Japan Productivity Center, 2021). Significantly more companies reported that those in their 40s or younger reported having mental health problems than those in their 50s or older. Further, those in their 50s or older were in management positions or were roughly stable with approximate prospects for retirement, however, those in their 20s or younger used to be in a training period to become a full-fledged worker. Now the company's training system has weakened, and workers are expected to be ready to work immediately, and those in their 30s and 40s have heavy job responsibilities but are not in management positions (i.e., there was an imbalance of responsibility and authority). Thus, the sample of non-autistic individuals in this study included many generations that were free from social pressure. Given that social pressures and expectations vary with age, we believe it is important to fully consider age in future studies of camouflaging.

Fourth, for the non-autistic sample, data were collected in 2020 and 2021 during the COVID-19 pandemic. We examined whether there were differences in mental health between the data from these two timepoints. Well-being was not compared because data were not collected in 2020. The analysis showed that the GAD-7, an indicator of general anxiety, was significantly higher in 2021 than in 2020, suggesting that the social context of the pandemic had an impact. The other two scales were not significantly different (Table A6 in the Supplemental Materials). The fact that data were collected at two different timepoints with different social situations is a limitation.

Conclusion

The CAT-Q-J comprised a four-item compensation subscale, a five-item masking scale, and a five-item assimilation subscale. Each item belonged to the same subscale as the original CAT-Q. Although the validity of the compensation and masking subscales was not verified, the CAT-Q-J had acceptable consistency, reliability, and validity as an assessment of social camouflaging behavior in autistic people in Japan. Caution should be exercised in interpreting the subscales of the CAT-Q-J.

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CONFLICT OF INTEREST STATEMENT

The authors have no conflicts of interest to declare that are relevant to the content of this study.

DATA AVAILABILITY STATEMENT

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

ETHICS STATEMENTS

This study was approved by the ethics committee of Chiba University (no. 3708; January 8, 2021). All participants provided informed written consent.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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