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Methodology

The objective of the present methodology is performing adjustments in Ages and Stages Questionnaire - Brazil – ASQ-BR – (Filgueiras, Pires, Maissonette, & Landeira-Fernandez, 2013; Filgueiras, 2011) in order to improve its reliability and adaptation to the context of Brazilian municipal daycare and preschools of Rio de Janeiro. Two different approaches were adopted to identify the elements that needed more improvement in ASQ-BR: (1) items with psychometric indexes lower than the established criteria should be modified and (2) items considered inadequate to the Brazilian context by directors – with a Pedagogy degree – of Rio de Janeiro municipal daycare and preschools should be as well modified.

The first step was identifying items with psychometric inconsistencies. That was established based on two psychometric criteria reported by Filgueiras (2011): item-total correlation lower than 0.30 ($r < .30$), and Loevinger H lower than 0.20 ($h < .20$). The criteria were based in different theoretical premises. Pearson product-moment correlation coefficient, which relates the item score and the total score of each respondent, is proposed by the Classical Test Theory (CTT) while Loevinger H (ρ), which analyses consistency based on a scales's scalability, derives from Item Response Theory (IRT). This study does not discuss theoretical differences between CTT and IRT nor questions regarding the methodology adopted by Filgueiras (2011). Alternatively, the psychometric characteristics revealed by the above-mentioned study were used to detect items with problems in order to modify them for ASQ-BR's following version, ASQ-BR-2011. Further information on CTT and IRT can be found especially in Pasquali (2008) and Cohen & Swerdlik (2009) as well as in the psychometric literature as a whole.

The second step consisted of working with a team with experts on ASQ-BR and directors of Rio de Janeiro public municipal preschools. Three experts on ASQ-BR met 24 directors of Rio de Janeiro public municipal preschools in groups

of seven people, each consisting of one expert and six directors. All the directors had been trained on the instrument by virtue of the 2010 application. All the items with psychometric problems were introduced and the directors were free to express their opinions on any issue they considered relevant, including items without psychometric indexes below the established criteria.

A multidisciplinary team with experts on child development formed by psychologists ($N=2$), educationalists ($N=1$), health scientists ($N=1$) and economists ($N=2$) were gathered in order to examine the opinions given by the daycare and preschool directors and suggest modifications to the items with psychometric problems. Based on that, a new provisional version of ASQ-BR was prepared. That version with all the changes made by the multidisciplinary team was evaluated and agreed upon by the author of the original ASQ, Prof. Jane Squires.

Afterwards, ASQ-BR's revised version – ASQ-BR-2011 – was applied to 67.522 children from 9 to 66 months of age enrolled in the municipal daycare and preschools of Rio de Janeiro. A total of 11.664 directors, teachers and caregivers filled 16 types of questionnaires according to the child age. New CTT analyses were performed based on the collected data to compare ASQ-BR and ASQ-BR-2011. The present study aimed at the internal improvement of ASQ-BR measure, and did not deal with validity issues. The details of the methodology are described below.

6.1

Criteria for item selection

The criteria used to select the items to be modified were a continuation of the criteria used by Filgueiras (2010): item-total correlation; Loevinger's h (R. J. Cohen & Swerdlik, 2009; Pasquali, 2008); and expert reports of inadequacy to the actual context of the municipal daycare and preschools of Rio de Janeiro. The three methods were selected according to the corresponding literature as well as social demand surveyed by educationalists regarding ASQ-BR context adequacy (Fórum Permanente de Educação Infantil do Estado do Rio de Janeiro, 2011; Oliveira & Guimarães, 2013).

Performing item-total correlation (r) is a classic procedure for item evaluation in CTT. Item-total correlation algorithm uses Pearson product-moment correlation coefficient to statistically evaluate the linear correlation between a respondent score on a given item and the total score of the scale (R. J. Cohen & Swerdlik, 2009). In ASQ-BR each scale is formed by a group of 6 items that evaluate a specific developmental domain in a given age category. Hence, the correlation of the item to the total of the scale statistically reflects the linear relationship between an item of a certain domain in a given age category (for example, item 1 of domain Gross Motor Coordination of the 10-month age category). The raw total score is reached by adding up all the items of the scale (for example, summing all the items in domain Gross Motor Coordination of the 10-month category). Item-total coefficient reveals the internal consistency, *e.g.*, the reliability of the scale. According to CTT, a group of items should contribute evenly to the total score of the scale (Pasquali, 2008). Thus, an item belonging to a scale is expected to correlate positively to the total score. Moreover, the item is supposed to have moderate to high correlation with the total score. Correlation coefficients vary from 0 to 1 and have classic classification criteria: 0.00-0.29 – low correlation; 0.30-0.69 – moderate correlation and 0.70-1.00 – high correlation (R. J. Cohen & Swerdlik, 2009). An item with low correlation to the total score is actually lowering its internal consistency instead of contributing to the scale.

Moderate and high correlations show convergence of the variables to the same direction, while low correlations lack an adequate linear association with the rest of the scale. According to Cohen e Swerdlik (2009), there are three basic reasons for an item not to relate to the total of the scale it belongs to: (1) the item does not belong to the dimension evaluated by the remaining items of the scale and therefore is not associated with that sum; (2) the item indeed evaluates the desired factor but is obscure to the respondent thus inducing him/her to misinterpreting the item and (3) the item evaluates the desired dimension and its content is clear but the very construct has more than one dimension and should, as well as the ones associated to it, be understood as part of a multidimensional structure. In the latter case, the scale should be considered multidimensional and, as such, use factor analysis and not the sum of the raw score. Illustration 1, on the next page, shows the three examples.

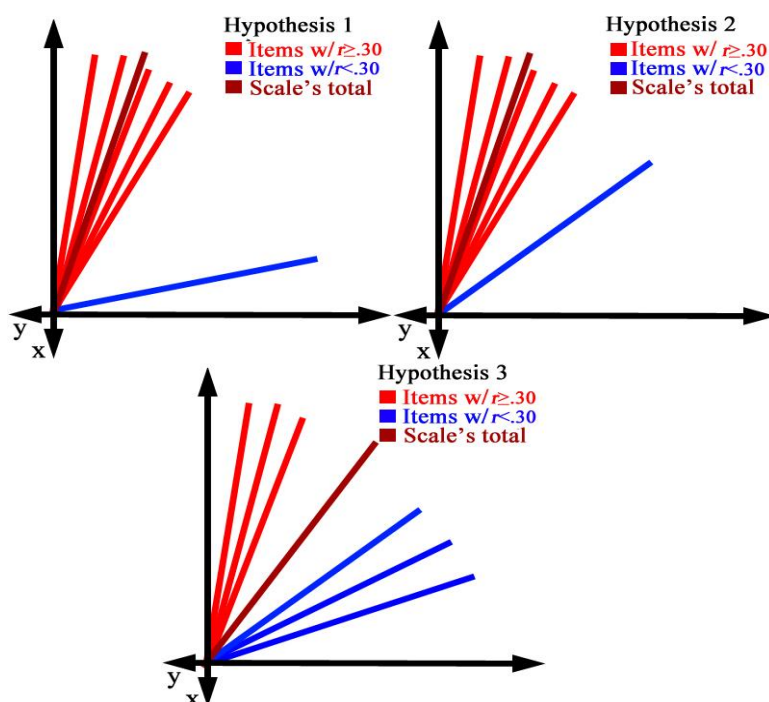


Illustration 1.

Cartesian plans of Cohen e Swerdlik's (2009) three hypotheses on items with item-total correlation problems containing 6 items – similar item quantity as in ASQ-BR-2011 scales.

Each item with item-total correlation lower than 0.30 in Filgueiras et al.'s (2013) results were listed and evaluated to be modified according to the three possibilities above-mentioned. The most noteworthy aspect of internal consistency is that, once an item is changed, the whole structure of the scale may change with it. Being so, two different consequences may occur to the data when item-total correlation increases, that is, the item contributes more than before to the sum: (1) the scale becomes more consistent or (2) the sum of the items associate better with the altered item but other items dissociate from the sum thus generating consistency problems in the scale and causing item-total correlation lower than 0.30 in unchanged items. Because of that, careful examination should take place to detect possible flaws regarding situation (2) and try to adjust items to a single scale domain.

Loevinger h coefficient is a scalability index that derives from nonparametric IRT Mokken-Molenaar model (Filgueiras, 2011). Few studies on the technique have been published in Brazilian scientific journals (*e.g.*, Filgueiras et al., 2012; Sá et al., 2011). According to IRT, a scales items contribute

differently to the score – diversely from CTT approach (Pasquali, 2008). Some of the items contribute considerably to the sum of the raw score but do not discriminate subjects well, since almost all respond similarly to the item (in ASQ-BR-2011, that would be all the children answering “yes”). On the other hand, a few items contribute little to the scale total but help discriminate subjects who present large scores in a certain cognitive domain, that is, have large amounts of certain latent trait (in ASQ-BR those would be the children who had more “yes” in the most difficult items or rarely answered positively).

Between the extremes, part of the items discriminate or contribute to the total score in different amounts. That is when concept ‘scalability’ arises: every scale has items with different probabilities of being answered positively, depending on how the respondent scores in that domain (Filgueiras et al., 2012; Sá et al., 2011). For example, most of the children researched by ASQ-BR have “not yet” answers to an item. But if a child already performs a certain behavior (“yes”), it is probable that he/she has a better development in that domain if compared with most of the other children. The item can be considered difficult, *i. e.*, an item that contributes little to the total score in most of the cases but reveals a lot, since only children with abilities well developed in the domain respond positively to it. According to Sá et al. (2011), a scale must have items that are able to evaluate the levels of a given domain or construct in equal intervals so that it is considered consistent and scalable.

Loevinger h coefficient was proposed by researcher Jane Loevinger in 1948 as a scalability index of items and scales. Similarly to item-total correlation, the coefficient varies between 0 and 1. Nevertheless, values above 0.20 are considered adequate so that an item is scalable (Filgueiras, 2011; Filgueiras et al., 2012). Illustration 2 shows two situations regarding Loevinger h : (a) when a six-item scale – like ASQ-BR – has perfect scalability: and (b) when the same scale has an item with scalability problems, *i. e.*, $h < .20$.

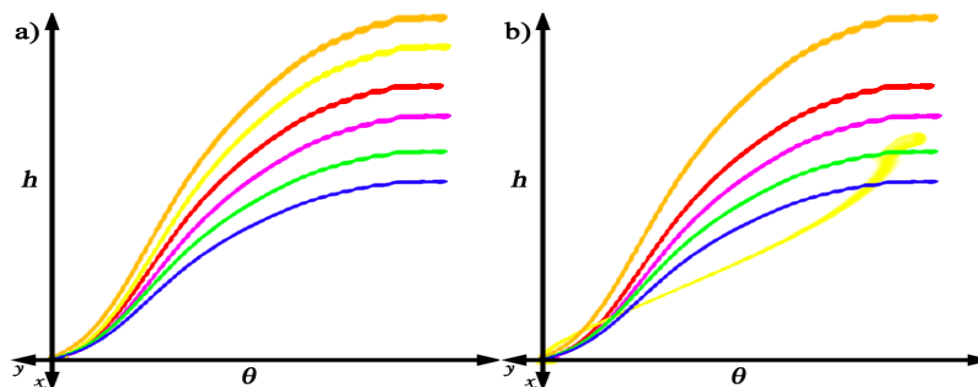


Illustration 2: On the left (a), item characteristic curves (ICC) of a six-item scale with perfect scalability and (b) on the right, a scale with a problematic item that will be considered for the calculation of Loevinger h .

Loevinger index is associated with scalability and, as mentioned before, its theoretical paradigm is other than item-total correlation paradigm. That has caused a few ASQ-BR items to present item-total correlation problems, though not related to index h , and vice-versa.

The last criterion adopted for item selection and alteration was item inadequacy to daycare and preschool contexts. Although that has not been reported by Filgueiras (2011), there were several ASQ-BR item adequacy discrepancies relative to the daycare and preschool daily activities (Fórum Permanente de Educação Infantil do Estado do Rio de Janeiro, 2011; Observatório da Educação, 2011; Oliveira & Guimarães, 2013). Based on that criticism, members of the multidisciplinary committee decided to hear the directors of the researched municipal daycare and preschools. A meeting held at the Municipal Secretary of Education premises in August 2011, brought together 24 of those directors. They were divided in discussion groups and worked with one of the members of ASQ-BR's multidisciplinary team as a mediator. The directors were invited to examine ASQ-BR and point out flaws or problems regarding item adequacy to their daycare and preschool context. For example, they discussed about how the words chosen for certain items could possibly jeopardize the understanding of the item content by ASQ-BR respondents.

Besides referring to problems, the discussion groups suggested changes in the ASQ-BR-2011 items to be applied later that year. Those suggestions, together with items that had psychometric problems, formed the group of items to be modified in order to improve ASQ-BR internal consistency and adequate it to the

actual application context. Table 1 shows the items chosen to be changed in ASQ-BR and the criteria adopted in the modifications for ASQ-BR-2011.

Table 1. ASQ-BR items (per domain) that had at least one of the above-mentioned problems in order to be modified from 2010 to 2011 application.

Item in ASQ-BR to be modified for ASQ-BR 2011	Modification criteria		
	Item-total correlation	Loevinger <i>h</i>	Context inadequacy
Communication			
Quando está brincando com sons, o bebê faz grunhidos, sons que lembram rugidos ou outros sons graves?	X		
Quando ocorre um barulho alto, o bebê se vira para ver de onde veio o som?	X	X	
Se você imita os sons que o bebê costuma fazer, ele repete os mesmos sons para você?	X	X	
O bebê fala três palavras, como, por exemplo, “Mamã”, “Papá” e “Nenê”? <i>(Uma “palavra” é um ou mais sons que o bebê fala regularmente referindo-se a alguém ou a alguma coisa.)</i>	X		X
Se você aponta para a figura de uma bola (gato, copo, chapéu, sapato, carro etc.) e pergunta à criança “O que é isso?”, ela nomeia corretamente pelo menos uma figura?	X	X	
Gross Motor Coordination			
A criança desce escadas se você segurar uma das mãos dela? Ela pode se apoiar também no corrimão ou na parede. (Você pode observar isso numa loja, no parquinho, em casa ou na creche.)		X	X
A criança sobe ou desce sozinha pelo menos dois degraus? Ela pode se apoiar no corrimão ou na parede. (Você pode observar isso numa loja, no parquinho, em casa ou na creche.)		X	X
A criança sobe escadas colocando apenas um pé em cada degrau? <i>(Quando o pé esquerdo está num degrau, o direito deve estar no outro.)</i> Ela pode se apoiar no corrimão ou na parede. (Você pode observar isso numa loja, no parquinho, em casa ou na creche.)		X	X

Fine Motor Coordination

O bebê estende o braço para alcançar um pedacinho de pão ou biscoito e o toca com o dedo ou a mão? (Se ele já pega um objeto pequeno do tamanho de um grão de milho, marque “sim” para esta questão).

X X

Depois de você rabiscar de um lado para o outro (posição horizontal) um papel com um giz de cera (ou lápis ou caneta), a criança imita você, rabiscando também? (Se ela já rabisca sozinha, marque “sim” nesta questão.)

X X

A criança liga e desliga interruptores de luz?

X X

Faça uma linha em uma folha de papel. Usando tesoura sem ponta, a criança **corta** o papel ao **meio**, mais ou menos em linha reta, fazendo com que as lâminas se abram e se fechem? (*Observe cuidadosamente o uso da tesoura por razões de segurança.*)

X X

Problem Solving

O bebê pega dois brinquedos pequenos, um em cada mão, e os segura por cerca de 1 minuto?

X

O bebê cutuca ou tenta pegar um pedacinho de pão ou biscoito que está dentro de uma garrafa transparente (como uma garrafa de refrigerante ou mamadeira)?

X X

Depois de ver você desenhar uma linha que vai **de cima para baixo (direção vertical)** em uma folha de papel com um giz de cera (ou lápis ou caneta), a criança imita você, desenhando uma única linha no papel em **qualquer direção**? (*Marque “ainda não” se a criança rabisca em várias direções.*)

X

Se você fizer algum dos seguintes gestos, a criança imita **pelo menos um** deles?

X X X

Enquanto a criança observa, alinhe **quatro**

X X

objetos, como blocos ou carrinhos, em uma **fileira** (como se fosse um trenzinho). A criança copia ou imita você e também alinha **quatro** objetos em uma fileira? (*Você também pode usar carretéis de linha, caixinhas ou outros brinquedos.*)

Se a criança quer alguma coisa que não consegue alcançar, ela procura uma cadeira ou uma caixa para subir e alcançar o objeto (por exemplo, para pegar um brinquedo sobre um balcão ou para “ajudar” você na cozinha)?

X X X

Quando você aponta para a **figura ao lado** e pergunta à criança “O que é isso?”, ela diz uma palavra que se refere a uma pessoa ou algo similar? (*Marque “sim” para respostas como “boneco”, “menino”, “menina”, “papai”, “astronauta” e “macaco”.*) Escreva a resposta da criança aqui:

X X

Personal/Social

Quando diante de um espelho grande, o bebê sorri ou faz sons suaves para si mesmo?

X

O bebê age com estranhos de maneira diferente do que faz com você e com outras pessoas conhecidas? (Reações a estranhos podem incluir olhar fixamente, franzir a testa, retrair-se ou chorar).

X

O bebê toma água, suco ou leite em uma caneca enquanto você segura a caneca? (*Não use caneca com tampa nem bico.*)

X X

O bebê come sozinho um biscoito?

X X X

Quando você está jogando bola com o bebê, ele rola ou joga a bola para você de forma que você possa jogá-la de volta?

X X

Quando você tira a roupa da criança, ela ajuda você tirando peças como meias, boné ou sapatos? (Se ela já tira as peças sozinha, marque

X X X

“sim”)			
A criança come sozinha com uma colher, ainda que derrame um pouco de comida?	X		X
A criança brinca com um(a) boneco(a) ou bicho de pelúcia, abraçando-o(a)?	X	X	X
Ao se olhar no espelho, a criança oferece um brinquedo à própria imagem?	X		
A criança bebe no copo ou caneca e coloca de volta na mesa sem derramar quase nada?	X	X	X
A criança copia atividades que você faz, como secar algo que derramou, varrer, fazer a barba ou escovar os cabelos?	X	X	X
Quando está brincando com um bichinho de pelúcia ou com um boneco, a criança faz de conta que está embalando, alimentando, trocando fraldas, colocando o brinquedo para dormir e assim por diante? <i>(Basta que a criança faça uma dessas brincadeiras).</i>	X	X	X
A criança come com garfo?	X	X	X
Se você faz algum dos seguintes gestos, a criança imita pelo menos um deles?	X		X
A criança usa colher para se alimentar sem derramar quase nada?	X	X	
A criança se serve, tirando comida de um recipiente para outro, usando talheres? Por exemplo, ela utiliza uma colher grande para pegar comida da travessa e colocar no prato?	X		X
A criança veste casaco, jaqueta ou camisa sozinha?	X	X	X
A criança informa pelo menos quatro dos seguintes dados pessoais? Marque os itens que ela sabe.	X	X	X
A criança põe e tira a roupa sem ajuda (exceto no caso de colchetes, botões e zíperes)?	X	X	
A criança lava as mãos com água e sabão e depois se seca com uma toalha, sem ajuda?	X		X

6.2

Item modification

The Municipal Secretary of Education of Rio de Janeiro (SME-RJ) invited 24 public daycare and preschool directors with a degree in pedagogy. The multidisciplinary committee was composed of four specialists (one psychologist, two educationalists and one economist) to conduct the discussions about ASQ-BR material. They were randomly divided in groups of six directors and one specialist and met for two sessions of 4 hours each. They read all ASQ-BR material and indicated what items they thought had problems. Afterwards, the committee introduced the items with psychometric problems and asked suggestions for changes on all the items – including the ones the directors found inadequate to the daycare and preschool actual context.

The directors of the daycare and preschools gave suggestions regarding the adequacy of the items to the context of their institutions. They suggested several changes in the way the items were written so that they could be more easily understood by individuals responding to the questionnaire. The director's suggestions were added to ASQ-BR-2011. The multidisciplinary committee met weekly for 4 hours during August and September of 2011 to verify if the modifications suggested were implemented according to children's proper cognitive capacity. Further suggestions from the committee were discussed and became the basis for the preparation of a new version of ASQ-BR. All the changes in the items are shown in table 2, on the next page. The new version was back translated into English by a North American translator also fluent in Portuguese ('back translation' is the process of translating a document that has already been translated into a foreign language back to the original language, preferably by an independent translator).

The back translation was then sent to Prof. Jane Squires, main author of the original scale – ASQ-3 (Squires, Bricker, Twonbly, & Potter, 2009). After making a few suggestions, Prof. Squires analyzed and authorized the modifications. They were added to ASQ-BR in order to be applied in 2011. The term ASQ-BR is used to identify the instrument used in 2010 and the one used in 2011 was called Ages & Stages Questionnaire-Brasil-2011 (ASQ-BR-2011).

Table 2. Changes from ASQ-BR's to ASQ-BR-2011 per domain, age interval and corresponding position in questionnaire.

ASQ-BR Item	ASQ-BR-2011 Item	Age Interval (number of item in scale)																	
		6	8	10	12	14	16	18	20	22	24	27	30	33	36	42	48	54	60
Communication																			
Quando está brincando com sons, o bebê faz grunhidos, sons que lembram rugidos ou outros sons graves?	Quando está brincando com sons, o bebê faz ruídos ?	3																	
Quando ocorre um barulho alto, o bebê se vira para ver de onde veio o som?	Quando você faz um barulho alto, o bebê se vira para ver de onde veio o som?	2	3																
Se você imita os sons que o bebê costuma fazer, ele repete os mesmos sons para você?	Se você imita os sons que o bebê faz, ele repete de volta?	2	1	2															
O bebê fala três palavras, como, por exemplo, “Mamã”, “Papá” e “Nenê”? <i>(Uma “palavra” é um ou mais sons que o bebê fala regularmente referindo-se a alguém ou a alguma coisa.)</i>	O bebê fala três palavras como, por exemplo, “Mamã”, “Papá” e “Dá” <i>(Uma “palavra” é um som que o bebê fala regularmente referindo-se a alguém ou a alguma coisa).</i>				6	4	1												
Se você aponta para a figura de uma bola (gato, copo, chapéu, sapato, carro etc.) e pergunta à criança “O que é isso?”, ela nomeia corretamente pelo menos uma figura?	Se você aponta para figuras e pergunta à criança “O que é isso?”, ela nomeia corretamente pelo menos uma figura? (Exemplos de figuras: bola, gato, carro, casa, etc.)								6	1	2	1	1						
Gross Motor Coordination																			
A criança desce escadas se você segurar uma das mãos dela? Ela pode se apoiar também no corrimão ou na parede. (Você pode observar isso numa loja, no parquinho, em casa ou na creche.)	A criança desce escadas se você segurar uma das mãos dela? Ela pode se apoiar também no corrimão ou na parede. (Você pode observar isso na creche, no parquinho, em casa ou numa loja.)										1								
A criança sobe ou desce sozinha pelo menos dois degraus? Ela pode se apoiar no corrimão ou na parede. (Você pode observar isso numa loja, no parquinho, em casa ou na creche.)	A criança sobe ou desce sozinha pelo menos dois degraus? Ela pode se apoiar no corrimão ou na parede. (Você pode observar isso na creche, no parquinho, em casa ou numa loja.)										3	1							
A criança sobe escadas colocando apenas um pé em cada degrau? <i>(Quando o pé esquerdo está num degrau, o direito deve estar no outro.)</i> Ela pode se apoiar no	A criança sobe escadas colocando apenas um pé em cada degrau? <i>(Quando o pé esquerdo está num degrau, o direito deve estar no outro.)</i> Ela										6	5	4	3					

corrimão ou na parede. (Você pode observar isso numa loja, no parquinho, em casa ou na creche.)	pode se apoiar no corrimão ou na parede. (Você pode observar isso na creche, no parquinho, em casa ou numa loja.)
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ASQ-BR Item	ASQ-BR-2011 Item	Age Interval (number of item in scale)																	
		6	8	10	12	14	16	18	20	22	24	27	30	33	36	42	48	54	60

Fine Motor Coordination

O bebê estende o braço para alcançar um pedacinho de pão ou biscoito e o toca com o dedo ou a mão? (Se ele já pega um objeto pequeno do tamanho de um grão de milho, marque “sim” para esta questão).	O bebê estende o braço para alcançar um pão ou biscoito e o toca com o dedo ou a mão? (Se ele já pega um objeto pequeno do tamanho de uma chupeta, marque “sim” para esta questão).																		
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Depois de você rabiscar de um lado para o outro (posição horizontal) um papel com um giz de cera (ou lápis ou caneta), a criança imita você, rabiscando também? (Se ela já rabisca sozinha, marque “sim” nesta questão.)	Depois de você rabiscar um papel com um giz de cera (ou lápis ou caneta), a criança imita você, rabiscando também? (Se ela já rabisca sozinha, marque “sim” nesta questão.)																		
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A criança liga e desliga interruptores de luz?	A criança liga e desliga interruptores de luz? Abre a maçaneta ou trinco da porta? Abre e fecha torneiras? Caso a criança faça uma dessas atividades marque “sim”.																		
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Faça uma linha em uma folha de papel. Usando tesoura sem ponta, a criança corta o papel ao meio , mais ou menos em linha reta, fazendo com que as lâminas se abram e se fechem? (<i>Observe cuidadosamente o uso da tesoura por razões de segurança.</i>)	Faça uma linha dividindo ao meio uma folha de papel. Usando tesoura sem ponta, a criança corta o papel ao meio , mais ou menos em linha reta, fazendo com que as lâminas se abram e se fechem? (<i>Observe cuidadosamente o uso da tesoura por razões de segurança.</i>)																		
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Problem Solving

O bebê pega dois brinquedos pequenos, um em cada mão, e os segura por cerca de 1 minuto?	O bebê pega dois brinquedos pequenos, um em cada mão, e os segura por algum tempo?																		
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O bebê cutuca ou tenta pegar um pedacinho de pão ou biscoito que está dentro de uma garrafa transparente (como uma garrafa de refrigerante ou mamadeira)?	O bebê percebe ou tenta pegar um pedacinho de biscoito ou um brinquedo que está dentro de um recipiente transparentes (garrafa, pote ou copo fechado)?																		
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ASQ-BR Item	ASQ-BR-2011 Item	Age Interval (number of item in scale)																		
		6	8	10	12	14	16	18	20	22	24	27	30	33	36	42	48	54	60	
Depois de ver você desenhar uma linha que vai de cima para baixo (direção vertical) em uma folha de papel com um giz de cera (ou lápis ou caneta), a criança imita você, desenhando uma única linha no papel em qualquer direção? (Marque “ainda não” se a criança rabisca em várias direções.)	Depois de ver você desenhar uma linha em uma folha de papel com um giz de cera (ou lápis ou caneta), a criança imita você, desenhando uma única linha em qualquer direção? (Marque “ainda não” se a criança rabisca em várias direções.)							5	3	4	5									
Se você fizer algum dos seguintes gestos, a criança imita pelo menos um deles? - Puxar a orelha. - Bater de leve na bochecha.	Se você fizer algum dos seguintes gestos, a criança imita pelo menos um deles? - Colocar a mão na cabeça. - Mandar beijo.								2											
Enquanto a criança observa, alinhe quatro objetos, como blocos ou carrinhos, em uma fileira (como se fosse um trenzinho). A criança copia ou imita você e também alinha quatro objetos em uma fileira? (Você também pode usar carretéis de linha, caixinhas ou outros brinquedos.)	Enquanto a criança observa, alinhe quatro objetos, como blocos ou carrinhos, em uma fileira , como se fosse um trenzinho. A criança copia ou imita você e também alinha quatro objetos em uma fileira? (Você também pode usar carretéis de linha, caixinhas ou outros brinquedos.)											4	3							
Se a criança quer alguma coisa que não consegue alcançar, ela procura uma cadeira ou uma caixa para subir e alcançar o objeto (por exemplo, para pegar um brinquedo sobre um balcão ou para “ajudar” você na cozinha)?	Se a criança quer alguma coisa que não consegue alcançar, ela procura alguma coisa para subir e alcançar o objeto (por exemplo, para pegar um brinquedo sobre uma preteleira ela sobre no bloco de espuma)?												4	2	3					
Quando você aponta para a figura ao lado e pergunta à criança “O que é isso?”, ela diz uma palavra que se refere a uma pessoa ou algo similar? (Marque “sim” para respostas como “boneco”, “menino”, “menina”, “papai”, “astronauta” e “macaco”.) Escreva a resposta da criança aqui:	Quando você aponta para a figura ao lado e pergunta à criança “O que é isso?”, ela diz uma palavra que se refere a uma pessoa ou algo similar? (Marque “sim” para respostas como “boneco”, “menino”, “menina”, “papai”, “mamãe”, “homem-aranha”, “Ben 10” ou “macaco”.) Escreva a resposta da criança aqui:													4	4	1				

criança faz de conta que está embalando, alimentando, trocando fraldas, colocando o brinquedo para dormir e assim por diante? <i>(Basta que a criança faça uma dessas brincadeiras).</i>	de conta que está embalando, alimentando, trocando fraldas, colocando o brinquedo para dormir e assim por diante? <i>(Basta que a criança faça uma dessas brincadeiras).</i>																		
ASQ-BR Item	ASQ-BR-2011 Item	Age Interval (number of item in scale)																	
		6	8	10	12	14	16	18	20	22	24	27	30	33	36	42	48	54	60
A criança come com garfo?	A criança escova os dentes.								6	4	5	1							
Se você faz algum dos seguintes gestos, a criança imita pelo menos um deles?	Se você faz algum dos seguintes gestos, a criança imita pelo menos um deles?									6		2	1						
- Puxar a orelha.	- Colocar a mão na cabeça.																		
- Bater de leve na bochecha.	- Mandar beijo.																		
A criança usa colher para se alimentar sem derramar quase nada?	A criança usa colher para se alimentar sem derramar muito?												3	2					
A criança se serve, tirando comida de um recipiente para outro, usando talheres? Por exemplo, ela utiliza uma colher grande para pegar comida da travessa e colocar no prato?	A criança sabe utilizar o potinho de sobremesa, jogando fora aquilo que não quer ou não deve comer, como caroço, casca ou bagaço.															2	2	1	3
A criança veste casaco, jaqueta ou camisa sozinha?	A criança veste casaco ou camisa sozinha?											4			4	5			
A criança informa pelo menos quatro dos seguintes dados pessoais? Marque os itens que ela sabe.	A criança informa pelo menos quatro dos seguintes dados pessoais? Marque os itens que ela sabe.																		
- Cidade onde mora	- Localidade onde mora																3	3	
- Número do telefone	- Nome da mãe, ou do pai, ou do responsável.																		
A criança põe e tira a roupa sem ajuda (exceto no caso de colchetes, botões e zíperes)?	A criança põe e tira a roupa sem ajuda? Ela pode pedir sua ajuda no caso de colchetes, botões e zíperes.																5		
A criança lava as mãos com água e sabão e depois se seca com uma toalha, sem ajuda?	A criança lava as mãos com água e sabão e depois se seca com uma toalha, sem ajuda? (Você pode mandá-la lavar as mãos e secar).															6	6	5	

6.3 Subjects

This study researched 76.850 children between 7 and 66 months old. Their questionnaires were completed by 11.664 preschool and daycare directors, teachers and caretakers in 972 municipal public daycare and preschools of Rio de Janeiro (471 daycare and 501 preschools). There were no respondents in age categories 2, 4 and 6 months due to lack of data – ‘missing data’ – and age categories with few participants – age category 8 months had only 17 children, thus making the statistical analysis impossible. The total of 9.328 children were considered ‘missing data’. The initial sample was reduced to 67.522 children between 9 and 66 months old. The characteristics of the final sample are described on table 3.

Table 3. Sample’s characteristics per age category: sample size (partial and total), biological sex, age mean and standard deviation.

Age category (in months)	Sample	Boys			Girls		
		Percentage	Age Mean	Standard Deviation	Percentage	Age Mean	Standard Deviation
10	73	54%	9.93	0.35	46%	10.00	0.42
12	141	57%	11.97	0.60	43%	11.93	0.61
14	216	47%	14.08	0.53	53%	14.14	0.52
16	545	53%	16.20	0.50	47%	16.18	0.52
18	972	54%	18.04	0.58	46%	18.02	0.57
20	1143	53%	20.05	0.57	47%	20.04	0.58
22	1259	54%	22.01	0.56	46%	22.00	0.57
24	1637	55%	24.27	0.73	45%	24.24	0.72
27	2390	53%	27.02	0.89	47%	27.01	0.86
30	3264	52%	30.02	0.89	48%	30.01	0.87
33	3375	53%	32.99	0.86	47%	32.99	0.86
36	4689	53%	36.80	1.30	47%	36.79	1.34
42	7703	53%	42.04	1.70	47%	42.09	1.69
48	6921	52%	47.72	1.60	48%	47.70	1.61
54	9511	51%	53.87	1.87	49%	53.81	1.85
60	23683	49%	61.73	1.94	51%	61.83	1.99
Total	67522	51%	44.83	12.67	49%	44.39	13.48

6.4

Application procedures

The first phase of this study took place with the 972 daycare and preschool directors. They were invited to take part in a training given by 11 professionals, 4 psychologists and 7 educationalists hired by the Municipal Secretary of Education of Rio de Janeiro for eight hours along two weeks. The professionals, including the author of this study, were trained on ASQ-BR by Alberto Filgueiras, author of ASQ-3's translation and adaptation in Brazil. Table 4, at the end of this chapter, shows all the steps taken for the preparation of this thesis, including the application procedures.

A Powerpoint presentation was prepared for the training of the directors so that all the directors had the same content in their training. The initial group of trained professionals transmitted the training received as accurately linked to the original training as possible to groups of 20 or 30 daycare and preschool directors. The second round of trainings took two more weeks and ASQ-BR was introduced to the directors. Items that could possibly present difficulties at the moment of the application were discussed. The changes on the ASQ-BR implemented from 2010 to 2011 were informed to the trainees, especially because many had taken part in the application of the previous year.

Impression, distribution and application of the instrument were SME-RJ's responsibility and were based on the procedure described next. From the birth date of each child and period when he/she would be interviewed, it was possible to select the proper questionnaire according to the child's age category. The child's birth date was subtracted from each child's application date – between November 11th, 2011 and December 9th, 2011. This way, the name of the child to be interviewed and the respective ASQ-3 age category to be used by each child could be printed on the questionnaires by SME-RJ beforehand. The directors were then scheduled to take all the filled questionnaires back to their respective Regional Educational Coordination (CRE).

SME-RJ collected and keyed in the material with the help of a typing mask especially developed to register the data. The data bank was built with coding 1, 2 and 3. Those were the values respective to the columns of answers of ASQ-BR: 1

represented the 1st column (“yes”); 2 represented the 2nd column (“sometimes”) and 3 was the code for the 3rd column (“not yet”). ASQ-3 manual set 10 points to category “yes”, 5 points to category “sometimes” and no points to category “not yet”. The transformation of the data bank ASQ-3 value type was made through *Microsoft Excel*.

Incomplete and incorrect data – ‘9.328 missing data’ – were dealt with according to ASQ-3 manual: (1) if a scale has up to 2 items unanswered, replace them with the mean, and (2) if a scale had more than three items unanswered, exclude the participant because it is not possible to calculate the score for the scale. Despite the *missing data* were replaced by the average of the remaining items, the present study is a psychometric comparison between the data from 2010 and 2011. ASQ-BR answers use a Likert scale, thus presuppose equal intervals between answers. Categories were 0, 5 and 10 and averages of the responded items could be 6.7, 8.7, or others. If the averages were actually included, the main characteristic of the instrument, ordinal answers, would be lost. With the purpose of respecting the measure characteristics and avoiding the inclusion of non-ordinal answers in the Likert scale, this study replaced the missing data whenever possible – case #1 – through the measures of categorical central tendency not to lose the properties of the Likert categories. For that reason, mode was used instead of arithmetic mean to replace missing data, according to the procedure previously adopted by Filgueiras (2011). From that point on, the statistical analyses were developed.

6.5 Statistical Analyses

The first step was analyzing ASQ-BR-R through descriptive and inferential statistics. Reliability coefficients derived from psychometric analyses were used in ASQ-BR-R similarly to Filgueiras et al. (2011, 2013). Factor analyses were performed to detect each ASQ-BR-R scale dimensionality. The results of the present study were compared to those found by Filgueiras et al. (2011, 2013) and item modifications were evaluated according to empirical evidences.

In order to keep the same descriptive method as the first application of ASQ-BR in 2010, the descriptive methods for the comparison between ASQ-BR applications in 2010 and 2011 were the same used by Filgueiras et al. (2013): arithmetic average of each scale, standard deviation and reports organized according to the child's age. As the objective of the present study was comparing ASQ-BR psychometric results between 2010 e 2011, inferential analyses were also performed comparing the age category data banks in both years. According to classic recommendations of the literature (Pasquali, 2008), when there are two independent samples to be statistically compared, the hypothesis test should be carefully chosen between Student's *t*-test for independent samples with parametric data or Mann-Whitney-Wilcoxon for two samples (R. J. Cohen & Swerdlik, 2009). The first is a parametric test, that is, the parameters of the samples are known and there is a normal distribution of the variance. Therefore Student's *t*-test is supposed to be used in samples with normal distribution. Mann-Whitney-Wilcoxon test can be used for independent samples with non-parametric data – distributions other than normal. That is because the technique ranks the data to prioritize them in order to produce inferential results for the null hypothesis test.

The proper selection method was chosen according to Fischer's law of large numbers. According to Cohen e Swerdlik (2009), the British statistician Ronald Fisher empirically demonstrated that when the sample equals or outpasses 30 elements, normality is assumed and parametric tests can be performed. Since all the samples in ASQ-BR (2010) and ASQ-BR-R (2011) are larger than 30 elements, this study used Student's *t*-test for independent samples with a significance criterion to be lower than 0.05 to consider significant differences

between samples. All the analyses were conducted through SPSS and Microsoft Excel software.

The first psychometric analysis done was exploratory factor analysis (EFA) – following the descriptive and inferential initial analyses. EFA consists of a set of techniques that reduce a group of elements or items – data – to groups that covariate among themselves, considering their shared covariance. That differentiates EFA from main components that reduce items into components using total variance (Damásio, 2012). Each set of six items that evaluate a cognitive domain of the given ASQ-BR age categories presuppose unidimensionality. Filgueiras et al. (2013) detected factorability problems in only 3 scales: 10, 54 and 60 months of domain Personal/Social. The three scales showed diverse dimensions according to the technique adopted to extract the factors. Several authors propose specific EFA in case of psychological data. For example, the literature recommends ‘maximum likelihood’ or ‘generalized least squares’ when the data have psychological nature (R. J. Cohen & Swerdlik, 2009). Inadequate use of EFA techniques in data with psychological nature may produce imprecise results and conclusions (Holgado-Tello, Chacón-Moscoso, Barbero-García, & Vila-Abad, 2008). Two techniques were adopted in this study to determinate the number of factors for each scale: eigenvalue above 1.0 (Cohen & Swedlik (2009) and minimum average partial (MAP) test (Velicer, 1976). Whenever there were two or more factors, maximum likelihood was used to extract factors and an oblique Promax rotation was applied as recommended by Filgueiras et al. (2011). SPSS was the software chosen for this analysis.

After EFA, two other CTT indexes were used to detect reliability problems in the scales. The first coefficient chosen was Cronbach’s alpha (α). That is an index of internal consistency that reveals how much a group of items measuring a specific domain is contributing to a homogeneous scale (R. J. Cohen & Swerdlik, 2009; Pasquali, 2008). A homogeneous scale has significant contribution from all the items to the final score. According to Pasquali (2008), low alphas also mean that the scale has several estimation errors. The classic criterion for considering a good alpha value is 0.70. Nevertheless, as ASQ-BR’s scales have few items (six) and alpha is indeed affected by the number of items in the scale, Filgueiras et al.’s (2013) recommendation was adopted, with 0.65 also as an acceptable value. Feldt’s W test was used to compare alphas on both samples (Bar-Anan, 2012;

Feldt, 1969). The test compares alphas in two different samples considering sample sizes and sample error probability. This way it is possible to say whether there was significant difference between 2010 and 2011 applications.

Finally, item-total correlation, an index associated with Cronbach's alpha that indicates each item's contribution to the total score of the scale, was used. Item-total correlation, Pearson product-moment correlation coefficient, is an index that estimates the linear association between two variables (R. J. Cohen & Swerdlik, 2009). In the item-total correlation specific case, each item is considered a variable that has to associate linearly with the sum of all the items – excluding itself from the total. Item-total correlation has been a very useful index in CTT as an indicator when a particular item is investigated. The correlation level of the item reveals its contribution to the total of the scale. Besides, if the item's correlation is low relatively to the sum of the other items, there is strong indication that its presence may jeopardize the reliability of the measure. Being so, Pasquali (2009) recommends the item to be withdrawn from the scale – that may or not improve the alpha – or be replaced by a more adequate item.

The correlation of each item in application years 2010 and 2011 were compared through Cohen & Cohen's test (1983). This test for comparing correlations was developed to compare product-moment correlations between two variables in different samples when transforming Fisher's r to z (J. Cohen & Cohen, 1983). In the process, Pearson correlation coefficient's values are transformed in z scores considering the sample error relatively to the sample size (Preacher, 2002).

The second option of modifications was adopted by Filgueiras (2011) to change the items from the 2010 version to the 2011 one, used in this study. The decision was based on the recommendations of Prof. Squires, who asked this study's authors to change the item according to the actual cultural context, as long as the six-item structure was kept. The internal consistency analyses – Cronbach's alpha and item-total correlation – were performed through software SPSS. Alpha comparisons through Feldt test were performed through a Microsoft Excel calculator programmed by Bar-Anan (2012). Cohen & Cohen's test (1983) to unveil correlations through transforming Fisher's r -to- z was performed through a java application developed by Preacher (2002).

Table 4. Summary of the methodological steps in this master thesis.

Step	Action	Observation
1	Identify items with psychometric inconsistencies in the first application of ASQ-BR (Filgueiras, 2010).	Criteria chosen: $r < 0.30$ and $h < 0.20$
2	Meetings of experts on ASQ and directors of Rio de Janeiro municipal daycare and preschools to collect reports on items considered inadequate to the Brazilian context.	Four meetings of 4 hours each, 1 meeting with each group. Groups consisted of 1 expert and 6 directors: preschool and daycare directors ($N=24$), psychologists ($N=2$), educationalists ($N=1$), health scientists ($N=1$) and economists ($N=2$)
3	A provisional version of ASQ-BR was made based on steps 1 and 2.	—
4	Back translation of the new provisional version.	—
5	Production of the printed tests by SME.	
6	The provisional version was evaluated, modified and fully approved ASQ-3 author (Prof. J. Squires).	—
7	Training on the last version of ASQ-BR was given to 972 municipal public daycare and preschool directors.	2 rounds of trainings given by 4 psychologists and 7 educationalists to groups of 20 to 30 directors of daycare and preschools.

8	ASQ-BR's revised version – ASQ-BR-2011 – was applied to 76.850 children from 9 to 66 months in 471 municipal public daycare and 501 preschools of Rio de Janeiro ($N=972$).	11.664 directors, teachers and caregivers filled 16 types of age-category questionnaires.
9	New CTT analyses were performed upon 67.522 children (missing data considered).	—
10	Production of this thesis	—