Validity of the Socially Acceptable Behavior (SAB) test as a measure of aggression in dogs towards non-familiar humans

Validiteit van de Maatschappelijk Aanvaardbaar Gedrag (MAG)-test als meetinstrument voor de mate van agressie bij honden ten opzichte van onbekenden

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ABSTRACT

For many years dog aggression has been a matter of concern for the authorities and dog breeding groups. In order to assess aggressive tendencies in dogs, an aggression test was developed (Netto and Planta, 1997). This test consisted of 43 subtests, had to be performed in an indoor enclosure and lasted for approximately 45 minutes per dog. It seemed impossible to use this test for a large population, therefore the Dutch Kennel Club (Raad van Beheer) asked the first author to develop a shorter version of this test that preferably should be performed outdoors. The test, called the Socially Acceptable Behavior test (SAB test), consists of only 16 subtests and is performed outdoors. The definition of aggressive biting during the test includes not only aggressive bites or snaps, but also aggressive attacks in which the dog makes a lunge in an attempt to bite, which fails because it has reached the end of its leash. In this article the validity of the test for aggressive biting behavior is examined by analyzing the data for 330 dogs. To do so, a comparison was made between the test result and the aggressive biting behavior of the dogs prior to the test, as reported by the owners and confirmed by behavioral consultants. The correspondence between the history of biting and the aggressive biting behavior during the test is 82%, when no aggressive biting behavior at all is considered acceptable. When the aggressive biting behavior is allowed in maximum one of 8 specified subtests, in biting behavior is allowed in maximum one of 8 specified, the correspondence raises to 88%, and of the 27 false negatives (28.7%) 18 dogs performed only territorial aggression prior to the test.

In the second phase, the predictability of aggressive biting behavior towards people, as shown in the test, is calculated by comparing the test results of 220 dogs with the aggressive biting behavior of these dogs shown in a period of at least 1 year after the test, as reported by the owners. The predictability is 81.8%. The test can be considered to predict in a statistically significant way the occurrence of future aggressive biting behavior of dogs towards unfamiliar people in a non-territorial context in the first year after the test. The existence of false negative results means that the assumption that a dog that passes the test will never bite later is not correct, as aggression is often very contextual. The value of the individual test is that it supplements the other evaluation methods in terms of behavioral consultation and risk evaluation. Further investigation is necessary to compare a dog's individual result to its behavior over a longer period later in life and to investigate the use of the test as a tool in breeding programs.

SAMENVATTING

Sinds enkele jaren zijn agressieve honden een reden voor bezorgdheid bij overheden en hondenfokverenigingen. Om de neiging tot agressie bij honden te kunnen inschatten, werd in 1997 een agressietest ontworpen. Deze test bestond uit 43 subtests, moest in een binnenruimte worden afgenomen en nam ongeveer 45 minuten per hond in beslag. Omdat het onmogelijk bleek deze test te doen bij een grote populatie honden, heeft de Raad van Beheer, de Nederlandse kynologische vereniging, aan de eerste auteur gevraagd een kortere versie van deze test te ontwikkelen die bij voorkeur buiten zou kunnen afgenomen worden. Deze test, de MAG (Maatschappelijk Aanvaardbaar Gedrag)-test, bestaat uit slechts 16 subtests en wordt buiten afgenomen. De definitie van agres-

sief bijten in de test omvat niet alleen het agressief bijten en snappen, maar ook het agressief uitvallen door de hond met de bedoeling te bijten maar waarbij de hond door de lengte van de leiband belet wordt dit te doen. In dit artikel wordt de validiteit van de test voor het agressief bijten onderzocht uitgaande van de analyse van de gegevens van 330 honden. Daarvoor werd een vergelijking gemaakt tussen het resultaat van de test en het agressief bijtgedrag van de honden dat ze vóór het uitvoeren van de test vertoonden, zoals werd meegedeeld door de eigenaars en bevestigd door gedragsconsultants. De overeenkomst tussen de bijtgeschiedenis van de hond en het testresultaat is 82%, als er geen enkele agressieve beet in de test wordt aanvaard. Wanneer het agressief bijten in maximum één van 8 specifieke subtests wordt toegestaan, dan stijgt de overeenstemming tot 88% en vertonen 18 van de 27 valsnegatieve honden (28,7%) enkel territoriale agressie in hun bijtgeschiedenis. In een tweede fase werd de voorspelbaarheid van agressief bijtgedrag tijdens de test berekend door het resultaat van 220 honden te vergelijken met hun bijtgedrag gedurende een periode van minstens één jaar na de test, zoals door de eigenaars werd meegedeeld. Deze voorspelbaarheid bedraagt 81%. De test wordt geacht om op een statistisch significante manier het optreden van het toekomstig agressief bijten van onbekenden door honden in een niet-territoriale context te voorspellen gedurende het eerstvolgende jaar na het uitvoeren van de test. Het bestaan van valsnegatieve resultaten betekent dat de veronderstelling dat een hond die geslaagd is voor de test, later nooit zal bijten niet correct is, vermits agressie vaak zeer contextgebonden is. De waarde van een individuele test kan het best worden gezien als een aanvulling op andere evaluatiemethoden, zoals een gedragsconsult en een risico-evaluatie. Verder onderzoek is nodig om het individuele resultaat van de hond te vergelijken met zijn gedrag tijdens een langere periode. Ook het gebruik van de test als hulpmiddel in fokprogramma's moet verder onderzocht worden.

INTRODUCTION

Dogs have been selectively bred to perform specific tasks for humans and for their positive interactions with humans (Simpson, 1997). Many dogs spend their lives in close social association with humans (Simpson, 1997). In general, the signals used by dogs in interactions with other dogs (including the aggressive ones) are also used to communicate with humans (Simpson, 1997; Reisner, 1997). Aggression is part of the normal social behavior of dogs (Abrantes, 1997; Reisner, 1997).

Aggressive behavior in dogs is a serious problem, as is evidenced by the reported number of human injuries (Cornwell, 1997; Mills and Levine, 2005), the distribution of cases seen by behavioral specialists and the reasons given for the relinquishment of dogs to humane societies (Landsberg, 1991; Wright, 1991; Miller *et al.,* 1996; Hunthausen, 1997; Hsu and Serpell, 2003). In an attempt to find a solution for the aggression problem, an aggression test was developed (Netto and Planta, 1997; Planta, 1999). A dog fails this test if she/he shows aggressive biting behavior in more than 6 of the 43 subtests. Using this criterion, the correspondence between previous biting of humans and the test result is 67%, specificity is 83% and sensitivity is 29.3% (for dogs that only bite humans). The Aggression test has to be performed in an inside enclosure and takes about 45 minutes for each dog.

In order to be able to test a larger population, a simplified behavioral test was developed. The primary goal of this Socially Acceptable Behavior test was to test the aggressive (biting) behavior and fear behavior of the dog. Since the SAB test is performed outdoors and the total time per dog is approximately 15 minutes, it is possible to test a larger population of dogs in a relatively short time. This paper examines the validity of this test with regard to previous biting behavior and assesses its predictability with regard to future aggressive biting behavior.

MATERIALS AND METHODS

Subjects and biting history

For validation purposes, data from 330 dogs were analyzed. All the dogs came from private owners (N = 330). The dogs belonged to 63 different breeds or were mongrels (Table 1). They were recruited through behavioral consultants and breeders. Of these 330 dogs, 94 had bitten people at least once, while 236 had never done so. Biting incidents prior to the test were reported by the owners in a Questionnaire 1, which was completed prior to the test, and this aggressive biting behavior was confirmed by the behavioral consultants in their observation reports. Questionnaire 1 consists of 48 questions covering 6 different topics. In addition to the initial 330 dogs used for the validation, another 179 dogs were tested as well, and the owners of all 509 dogs received Questionnaire 2, which was sent to them at least 1 year after the test for the purpose of determining the predictability of the test. In Questionnaire 2 the owner reported the occurrence of aggressive biting behavior in everyday life since the test. Questionnaire 2 consists of 55 questions on 6 different topics. Complete copies of Questionnaires 1 and 2 can be obtained from the first author. The questions related to aggressive behavior can be found in Annexes 1 and 2.

Performance of the SAB test

The SAB test consists of 16 subtests. These subtests are performed outdoors and in a fixed order. The minimal requirements of the outdoor area are that it be an enclosed area of 750 m2, and that it not be familiar to the dog. No public is allowed within 25 m of the dog, and all precautions are taken to prevent distracting events from occurring during the test. The dogs are exposed to the stimuli at seven different locations in the enclosure (Figure 1).

The distance between these locations is 12-15 meters.

Table 1. Breeds of the dogs that were tested.

1 Akita Inu	**17** Cao de Aqua	**33** Hollandse Schapendoes	**49** Rateiro do Alentejo
2 Alaskan Malamute	**18** Cavalier King Charles Spaniel	**34** Hovawart	**50** Rhodesian Ridgeback
3 American Staffordshire Terrier	**19** Dalmatian	**35** Jack Russel Terrier	**51** Rottweiler
4 American Bulldog	**20** Dobermann	**36** Karabash	**52** Sarplaninac
5 Appenzeller Sennenhund	**21** Dogo Argentino	**37** Kooikerhond	**53** Scottish Shepherd
6 Australian Shepherd	**22** German Shepherd	**38** Mongrel	**54** Sharpei
7 Bearded Collie	**23** Drahthaar	**39** Labrador Retriever	**55** Sint Bernard
8 Berner Sennenhond	**24** English Cocker Spaniel	**40** Leonberger	**56** Staffordshire Bull Terrier
9 Boer Boel	**25** Entlebucher Sennenhund	**41** Mastino Napoletano	**57** Tervueren Shepherd
10 Bordeaux Dog	**26** Fila Brasileiro	**42** Malinois	**58** Tibetan Mastiff
11 Border Collie	**27** Flat-Coated Retriever	**43** Schnauzer	**59** Tsjechischer Wolfshund
12 Bouvier	**28** Golden Retriever	**44** Miniature Bull Terrier	**60** Weimaraner
13 Boxer	**29** Gos d´Atura	**45** Newfoundlander	**61** Welsh Corgi Pembroke
14 Briard	**30** Greyhound	**46** Old English Sheepdog	**62** West Highland White Terrier
15 Bull Terrier	**31** Groenendaeler	**47** Poodle	**63** Yorkshire Terrier
16 Cairn Terrier	**32** Dutch Shepherd	**48** Pyrenean Mountain dog	

Table 2. Main characteristics and the exact order of the different subtests.

Subtest	Description	Presence of the owner	Attached to a leash
1	friendly approach by one person who tries to pet the dog with an artificial hand	yes	fixed 1 meter flexi 8 meter
2	exposure to an unfamiliar visual stimulus (flapping blanket)	yes	flexi 8 meter
3	exposure to an unfamiliar visual stimulus (silhouette of a giant cat that suddenly appears from behind a screen)	yes	flexi 8 meter
4	exposure to an unfamiliar sound (horn)	yes	flexi 8 meter
5	exposure to an unfamiliar sound (metal cans behind a screen)	yes	flexi 8 meter
6	neutral approach by three persons in a normal way	yes	flexi 8 meter fixed 2 meter
7	neutral approach by three persons in an accelerated way	yes	flexi 8 meter fixed 2 meter
8	approach by an unfamiliar dog of the same size, different breed and same sex	no	2 x fixed 2 meter
9	friendly approach by one person who tries to pet the dog with an artificial hand	no	2 x fixed 2 meter
10	exposure to an unfamiliar sound (bell)	no	2 x fixed 2 meter
11	exposure to an unfamiliar visual stimulus (umbrella that is opened and closed rapidly)	no	2 x fixed 2 meter
12	exposure to an unfamiliar visual stimulus (doll on a sledge that is pulled towards the dog)	no	2 x fixed 2 meter
13	friendly approach by one person who tries to pet the dog with a doll	no	2 x fixed 2 meter
14	approach by a person who is staring at the dog	no	2 x fixed 2 meter
15	friendly approach by this same person, who then tries to pet the dog with an artificial hand	no	2 x fixed 2 meter
16	friendly approach by the owner, who tries to pet the dog with a doll	yes	2 x fixed 2 meter

For subtests 1 to 7, the dog is attached to an extendable leash (Flexi ®) that is held by the owner. This leash may only be blocked in an emergency si-tuation. If the owner needs to stop the dog, the test leader ends the test. All subtests last 20 seconds. The complete test is carried out without intermission. One exception can be an intermission between subtests 8 and 9,

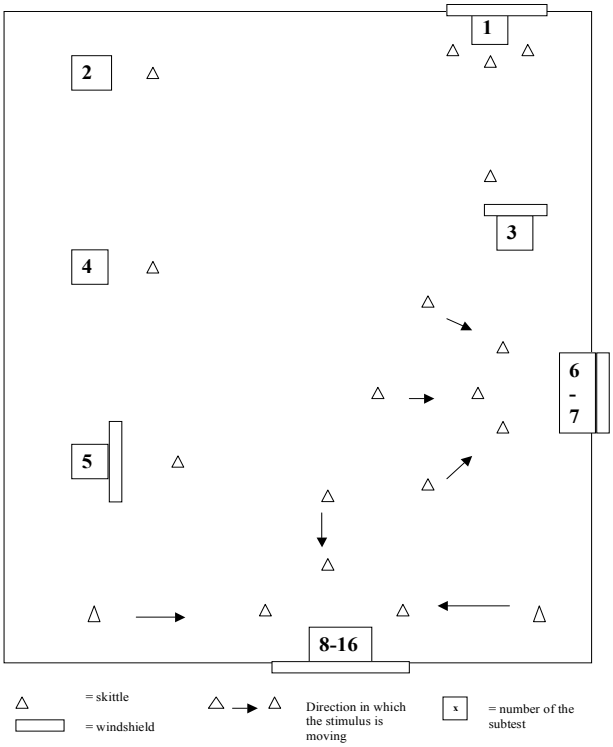

Figure 1. Ground plan of the test area.

since 9 does not start until the stimulus dog has left the test area. All precautions must be taken to limit the time of the intermission. Besides the two helpers who make the video recordings, a judge and at least three helpers are also needed.

Description of the subtests

The complete protocol of the test can be obtained from the first author, but the main characteristics and the exact order of the different subtests are given in Table 2. A video of the test can be seen on www.magtest.nl (→ Mag gedragstest → SAB test on film). The dog in the video shows no aggressive biting behavior in any subtest.

Interpretation of the behavior shown in the test

For the interpretation of this test, aggressive biting behavior includes the behavioral elements 'aggressive biting' (approach and full contact of the jaws with the artificial hand or the doll), 'aggressive snapping' (a clear intention to bite with opening of the mouth, but without full contact of the jaws with the artificial hand or the doll) and 'aggressive attacking' (lunging at the stimulus with open mouth, where biting is made impossible due to the safety design). These three elements are recorded when the dog shows them at least once during a subtest and when they are accompanied by at least one of the following elements: growling, barking, piloerection, baring of teeth, direct staring, and stiffening of the body (definitions in van den Berg, 2006). If a dog shows a play bow before, during or after the bite (attack) in the same subtest this is considered not to be an aggressive bite or aggressive attack.

Validation method

For the validation of the test, the occurrence of aggressive biting behavior in the test was compared to the biting history of the dog as reported by the owner or the behavioral consultant. The hypothesis was that when a dog had bitten people before, then it would also show aggressive biting behavior in the test, and that dogs that not had bitten before would not show aggressive biting behavior in the test. On the basis of the information received from the owners, those dogs that had never bitten unfamiliar humans in the past were put in group A, while those that had were put in group B. As unfamiliar adults, we define here: adults others than those living permanently in the dog's presence (i.e. the owners). A behavior consultant confirmed the aggressive nature of the bites that were reported by the owners

In the literature, the validity of tests is assessed by different parameters (Mausner and Kramer, 1985). These parameters are determined by correlating the test result with an external value. In this study this external value is the biting record of the dog. The different parameters are presented in Table 3. The following parameters determine the validity:

- correspondence between test result and biting record: a+d/a+b+c+d
- false positives: dogs with no biting record that fail the test: b/a+b
- sensitivity: the ability of the test to detect dogs with a biting record (true positives): d/c+d
- false negatives: dogs with a biting record that pass the test: c/c+d
- specificity: ability of the test to detect dogs with no biting record (true negatives) a/a+b
- predictive value of the positive test: chance that a dog correctly fails the test: d/b+d
- predictive value of the negative test: chance that a dog correctly passes the test: a/a+c

All parameters were calculated according to the above formula.

Method of analysis of predictability

The predictability of the test was calculated by comparing the test result with the occurrence of aggressive biting behavior of the dog during a period of at least 1 year after the test, as reported by the owner. For this purpose, 509 questionnaires were sent to the owners. Only 242 questionnaires (47.5%) were returned, of which 220 were suitable for analysis (22 incomplete). The dogs that were reported not to have shown aggressive biting behavior towards humans were included in group C, while those that did were put in group D.

Table 3. Different parameters used in the validation of the test.

	Pass the test	Fail the test	
No previous biting record	true negatives (a)	false positives (b)	total number of dogs with no biti
Previous biting record	false negatives (c)	true positives (d)	total number of dogs with a bitin
	total number of dogs that pass the test	total number of dogs that fail the test	total number of tested dogs

Analysis

Data was collected and analyzed using EXCEL 97 SR-1 and SPSS 10.0. For comparison purposes, the Mann-Whitney U test, kappa coefficient and Chi-square were used. The Mann-Whitney U test compared the average of the amount of positive subtests in group A with the average of the amount of positive subtests in group B and the mean frequency of aggressive biting behavior during the SAB test of groups C and D. The kappa coefficient was estimated as a measure of agreement between the occurrence of aggressive biting behavior in and after the test. The Chi- square test was used to see whether frequencies of occurrences did or did not differ between the different groups considered.

RESULTS

Frequency of aggressive biting behavior

We tested 330 dogs, 207 of which did not show any aggressive biting behavior in the test, as defined above, while 123 did at least once. The numbers of dogs in both groups that showed aggressive biting behavior in each subtest is shown in Table 4. For dogs belonging to group A, the level of aggressive biting behavior was found to be highest in subtest 13, while for those belonging to group B the highest levels were in subtests 1 and 9. The dogs in group B showed significantly ($p<0.001$) more aggressive biting behavior, expressed as the average of positive subtests, compared to dogs with no history of biting. The average amount of positive subtests equaled 2.63 in group B, while in group A this was only 0.27. Of the 220 usable follow-up questionnaires returned, 184 (83.6%) of the dogs were reported not to have shown aggressive biting behavior, while 36 (16.4 %) did. The owners reported that nine dogs had been euthanized because of aggressive biting behavior towards humans. These dogs were categorized as human biters after confirmation by the behavioral consultant.

Validity

In order to validate this test, a decision has to be made as to whether or not aggressive biting behavior is to be accepted in none, one or more of the subtests and, if so, in which of the subtests. When no aggressive biting behavior at all is considered to be acceptable (Table 5), the correspondence between histories of biting and aggressive biting behavior during the test is 82%. The sensitivity is 84% and the specificity is 81%. The predictive value of the positive test is 64% and that of the negative test is 93%. The Chi-square is 122.97, with $p<0.0001$.

The results as shown in Table 5 have been interpreted on the basis of the assumption that aggressive biting behavior in only one of the different subtests is considered acceptable. The correspondence between history of biting and actual aggressive biting behavior during the test is 87%. The sensitivity is 67% and the specificity is 95%. The predictive value of the positive test is 83% and the predictive value of the negative test is 88%. The Chi-square is 143.50, with $p<0.0001$.

Table 5 contains the results interpreted on the basis of the assumption that aggressive biting behavior is accepted in one of the subtests 1, 8, or 11 to 16. The correspondence of the test is 88%, the sensitivity is 71.3% and the specificity is 94.5%. The predictive value of the positive test is 84% and of the negative test it is 89%. The Chi-square is 158.33, with $p<0.0001$. The choice to allow aggressive biting behavior in only these subtests was made because of the high percentage of dogs of group A in the total number of dogs that bite during these subtests ($\geq$16.7%, see Table 4).

Predictability

184 (83.6%) of the dogs were reported not to have shown aggressive biting behavior towards humans (group C), while 36 (16.4%) did (group D). The percentiles of the frequency of aggressive biting behavior during the SAB test of these two groups are shown in Figure 2. The Mann-Whitney U test showed significant differences ($p<0.0001$) in the mean frequency of aggressive biting behavior during the SAB test of these two groups. The 50th percentile of group D is 1 and 0 for the dogs in group C. The results (in percentage of dogs) are shown in Figure 3. The number of dogs that showed aggressive biting behavior more than once during the SAB test was compared between group C and group D. The number of dogs per category is given in Table 6, as well as the occurrence of $\leq$1 incident of aggressive biting behavior (the Chi-square is 46.85, with $p<0.0001$). The agreement between the occurrence of aggressive biting behavior ($\leq$1 incident during the test) in and after the test is 81.8 % (kappa-coefficient is 0.420, with $p< 0.0001$). The specificity of the test is 84.2% and the sensitivity 69.4%. Of the 11 false negative dogs, 7 showed only occasional aggression towards adult human beings and were friendly in general. Of the 25 true positive dogs, 20 showed aggression towards combinations of several subjects (for example adults, dogs and children).

DISCUSSION

This paper focuses on the detection or identification with the help of a behavioral test of pet dogs that

Table 4. Frequency of biting dogs in groups A and B in each subtest.*

Subtest	Freq. of biting dogs (%) in group A	Total number of dogs in group A	Freq. of biting dogs (%) in group B	Total number of dogs in group B	Total number of biting dogs in the subtest	Percentage of biting dogs of group A in the total number of biting dogs
1	12 (5.1)	236	45 (47.9)	94	57	21.1
2	0 (0.0)	236	2 (2.1)	94	2	0.0
3	0 (0.0)	236	4 (4.3)	94	4	0.0
4	0 (0.0)	234	0 (0.0)	93	0	0.0
5	1 (0,4)	234	7 (7.5)	93	8	12.5
6	0 (0.0)	233	6 (6.4)	94	6	0.0
7	0 (0.0)	233	19 (20.2)	94	19	0.0
8	6 (2.6)	232	21 (22.8)	92	27	28.6
9	3 (1.3)	231	34 (37.8)	90	37	8.1
10	0 (0.0)	231	6 (6.8)	88	6	0.0
11	8 (3.5)	229	17 (20.0)	85	25	32.0
12	3 (1.3)	228	7 (8.3)	84	10	30.0
13	16 (7.1)	226	27 (33.0)	82	43	37.2
14	3 (1.4)	218	11 (14.9)	74	14	21.4
15	5 (2.3)	217	25 (34.3)	73	30	16.7
16	6 (2.6)	227	17 (20.5)	83	23	26.1

Group A: dogs that according to the owners had not bitten unfamiliar humans in the past
Group B: dogs that according to the owners had bitten unfamiliar humans in the past
* The number of dogs differs per subtest and declines further in the test except for subtest 16. This is because not all dogs completed the test, as the test was stopp dog's panic reactions were too severe. Subtest 16, which is performed by the owner, was attempted in any case.

Table 5. Distribution of dogs per group if no biting at all / biting in a maximum of one subtest / biting in a maximum one out of 8 selected subtests is accepted as criterion for passing the test.

	Passed the test			Failed the test			Total
	no biting at all is accepted*	biting in maximum one subtest accepted**	biting in maximum one out of 8 selected subtests accepted***	no biting at all is accepted*	biting in maximum one subtest accepted**	biting in maximum one out of 8 selected subtests accepted***	
Group A	192	223	223	44	13	13	236
Group B	15	31	27	79	63	67	94
Total	207	254	250	123	76	80	330

Group A: dogs that according to the owners had not bitten unfamiliar humans in the past.
Group B: dogs that according to the owners had bitten unfamiliar humans in the past.
* Chi-square: 122.97 ; $p<0.0001$

** Chi-square: 143.50 ; $p<0.0001$

*** Chi-square: 158.33 ; $p<0.0001$

Figure 2. Distribution of the frequency of aggressive biting behavior during the SAB test.

Group C: dogs that were reported not to have bitten humans in at least the first year after the test.
Group D: dogs that were reported to have bitten humans in the first year after the test.

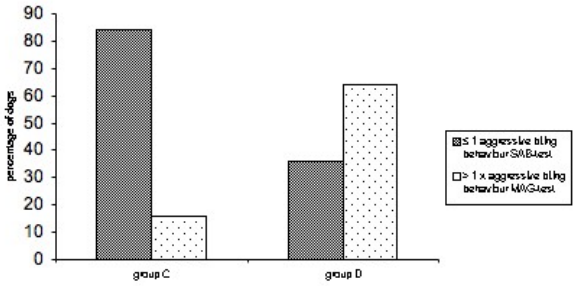

Figure 3. Percentage of dogs and frequency of their aggressive biting behavior during the SAB test.

Group C: dogs that were reported not to have bitten humans in at least the first year after the test.
Group D: dogs that were reported to have bitten humans in the first year after the test.

bite unfamiliar humans. To achieve this objective, the authors presented 16 possible aggression-eliciting situations to dogs and observed the aggressive biting behaviors expressed by the animals. Comments can be made regarding the use of an artificial hand and a doll. However, the use of these objects had already been tested and evaluated as being valid tools for testing aggressive biting behavior towards humans in the Aggression test (Netto and Planta, 1997) and in the test for shelter dogs (van der Borg *et al.,* 1991).

Owners sometimes reported that the dog had never before showed a reaction to a specific stimulus analogous with the one presented in the test. This could be explained by the fact that the multiple observations during the test of the body signals generally shown by dogs under stress suggest that the test poses considerable stress on the dogs (Beerda *et al.,* 2000). Assuming this information by the owners to be true, it is possible that the dogs do not bite under normal life conditions but that they may bite in the test. This can also explain why the highest correspondence between biting history and test results was found when aggressive biting was allowed in at the most one of a number of specified subtests. These results have the highest Chi-square results, as well. Therefore this norm is suggested for passing or failing the test.

The difficulty of assessing validity parameters is that there are no criteria on the basis of which one could state that a test is sufficiently valid. In assessing the efficacy of pharmaceuticals, the criterion is used that a tested drug should be more than or at least just as effective as existing drugs. By analogy, the validity parameters of the SAB test should therefore at least be comparable to the Aggression test (Netto and Planta, 1997). Using the same norm (≤1 incident of aggressive biting behavior) in the Aggression test as is proposed for the SAB test, the specificity regarding aggression towards people is 94.5% (SAB test) and 57.5% (Aggression test). The sensitivity is 71. 3% and 73.1%, respectively. The Aggression test can be considered slightly better with regard to sensitivity by using the norm of a maximum of 1 subtest in which aggressive biting is accepted, but it is not better with regard to the specificity, as the Aggression test produces a lot more false positives. The correspondence between the history of the dogs' biting behavior and the test result in the SAB test is 88%, while the correspondence in the Aggression test is 67% if the criterion is accepted that to pass the test, the dog cannot show aggressive biting behavior in more than 6 of the 43 subtests. Based on the fact that the correspondence and the specificity are higher and the sensitivity is approximately the same, the validity of the SAB test can be considered to be better.

The SAB test is considered to be a less stressful test for dogs because of its higher specificity and its lower percentage of false positives when compared with the Aggression test. Furthermore, the SAB test is easier to perform since it can be performed outdoors and is less time consuming per dog.

Like the Aggression test, the SAB test was validated by comparing the occurrence of aggressive biting behavior during the test with a biting record provided by the owner or consultant. The disadvantage of this method is that the quality of the information provided by the owner is not easy to assess (van der Borg *et al.,* 1991). According to Segurson et al. (2005), dog owners often tend to minimize the aggressive behavior

Table 6. Number of dogs, frequency of their aggressive biting behavior during the SAB test (columns) and their aggression towards non-familiar humans in everyday life during at least one year after the test (rows).

Questionnaires (aggressive behavior after the test)	≤ 1 X aggressive biting behavior in SAB test	>1 X aggressive biting behavior in SAB test	
Group C	155	29	184
Group D	11	25	36
	166	54	220

Group C: dogs that were reported not to bite non-familiar humans in at least the first year after the test
Group D: dogs that were reported to bite non-familiar humans in the first year after the test

of their dog. This seems to be the case especially when they want to present their dog for adoption later on. In this study, however, we believe this is not likely, since the owners cooperated voluntarily and there were no consequences, either for the dog, or for the owner. Some of the owners reported their dog as a non-biter when the dog had perhaps never been in a situation where it could actually bite, either because the owner had prevented the dog from biting or had prevented the dog from encountering such a situation (e.g. close contact with children). Perhaps this explains the high percentage of false positive results in subtest 13 (7.1%), where the doll is touching the dog for 20 seconds. This is a situation that most dog owners will prevent their dog from coming into. If aggressive biting behavior is considered acceptable in one of the specified subtests, 28.7% (27) of the dogs with a biting record pass the test. This seems to be a high percentage, but 67% (n = 18) of these dogs only showed biting behavioral in a territorial context. This test is therefore not considered to test territorial aggression in a valid way. Nine dogs that were true biters passed the test. This proves that this test cannot provide a guarantee that the dogs that pass the test will never bite later in life. This is logical since aggression is a behavior elicited by multiple factors in different contexts (Christensen 2006). The fact alone that a dog that has bitten in one subtest can nevertheless pass the test, can create a misleading feeling of safety. In communicating the results, this must be clearly formulated in order to prevent a feeling of 100% security on the part of the owners, which could lead to accidents due to a lack of precaution. When the test is used as a tool to evaluate the danger of the individual dog, it must be completed with a thorough behavioral analysis of the dog and a risk analysis of the situation. Depending on the objective of the test, the criterion of zero or a maximum of one bite must be selected carefully, and the consequences of its sensitivity and specificity must be taken into account.

Precautions must be taken regarding the occurrence of (negative) associations between test situations and real-life conditions or events. Some authors suggest the possibility that aggression could be learned during the test (Hart, 1976). If the dog shows aggressive biting behavior at the end of a subtest, this could be the case. Test helpers and judges should therefore be instructed to act in such a way that the dog does not leave with the perhaps rewarding experience that biting enables it to control its environment. In order to prevent the dogs from leaving the testing grounds with panic and stress behaviors, the test should be stopped if a subtest elicits too much fear and stress, and, if possible, this subtest should be performed again in such a way that the dog makes a positive association with the situation. A description of the visible behavioral elements shown by the fearful dog can be found in van den Berg (2006).When a test is stopped, it is never completed again fully after the recovery of the dog. Only the subtest that provoked the fear/aggressive reaction is repeated in an adapted way till the emotion of the dog has become more positive and then in most of the cases a preferred play is started to help the dog to relax. To evaluate the risk on the development of these behaviors after the test, Questionnaire 2 also contained questions intended to find out whether the dog showed more fear in everyday life situations that were similar to the test situations. Only 6.3% of the owners reported this, but they also concluded that after a period of 1 year this behavior had spontaneously disappeared. This, however, emphasizes the importance of stopping the test as soon as the dog shows too many fear reactions and does not recuperate between the subtests.

As with every behavioral test, the possibility exists that due to intensive training and desensitization against or habituation to some of the stimuli, the results of the test can be influenced. Therefore research has to be done to develop possible alternative variations for some of the subtests.

Apart from whether or not a test is valid, it must also be reliable. A preliminary investigation in which dogs were retested several times gave analogous results in the subtests (Borghijs, 2006, personal communication). Due to the learning processes that a dog can undergo during the test, it would be advisable to develop alternative subtests for when on wants to retest the dog. However, the choice was made to use prediction instead of retesting as in the test for shelter dogs (van der Borg, 1991). The category of 'Reliability' also contains the inter-observer reliability. To reach an acceptable level of reliability, education of the observers is necessary, followed by continuous evaluation. Every test should also be filmed so that the results can be checked later. Since for the evaluation of the test, as a measure of the tendency for aggressive behavior, only the occurrence of aggressive biting behavior must be recorded, a high level of inter-observer reliability can be expected when the observers are well trained.

CONCLUSIONS

Since the specificity, sensitivity and predictability of the test is better than or at least comparable with other validated alternatives, we conclude that the SAB test is a valid tool for testing the aggressive biting tendencies of dogs towards humans other than the owners outside a territorial context. For the assessment of the danger of an individual dog when confronted with a specific stimulus, in a territorial situation or towards the owners, this test was not validated and it should be supplemented with further information.

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Annex 1

Questionnaire 1
(questions relating to aggression)

1. How does your dog behave in general towards approaching children?
Anxious /inclined to bite/ bites/ friendly/ ignores/ obtrusive/ threatens/ never occurred.
Is this behavior problematic? Yes / No

2. How does your dog behave in general towards obtrusive children?
Anxious/ inclined to bite/ bites / friendly/ ignores / obtrusive / threatens / never occurred.
Is this behavior problematic? Yes / No

3. How does your dog behave in general if you give attention to a child?
Anxious / inclined to bite/ bites/ friendly/ ignores/ obtrusive/ threatens/ never occurred.
Is this behavior problematic? Yes / No

4. How does your dog behave in general towards unknown people (strangers) in the street?
Friendly/ distanced/ barks/ jumps/ threatens/ inclined to bite/ (snaps or) bites if touched/ (snaps or) bites if approached/ ignores/ obtrusive/ does not come in the street.
Is this behavior problematic? Yes / No

5. How does your dog behave in general to unknown people in the house or at the front door?
Friendly/ distanced/ barks/ jumps/ threatens/ inclined to bite/ (snaps or) bites if touched/ (snaps or) bites if approached/ ignores/ obtrusive/ does not come in the house
Is this behavior problematic? Yes / No

6. Has your dog ever threatened?
Unknown people/ known people/ own child/ unknown child/ yourself/ other dogs/ judge (jury?) (at dog show)/ never
Is this behavior problematic? Yes / No

7. Has your dog ever bitten (snap, bite)?
Unknown people/ known people/ own child/ unknown child/ yourself/ other dogs/ judge (at dog show)/ never
Is this behavior problematic? Yes / No

8. If you have answered that your dog has already (snapped or) bitten at someone, please write down how may times and in which situations?

9. If you have answered that your dog has never or rarely bitten (or snapped), please write down whether this is because you have prevented biting incidents.
Have you had to do something to prevent this type of behavior? Yes / No
If yes, please write down how you prevent this behavior.

Annex 2

Questionnaire 2
(questions relating to aggression)

1. How does your dog behave now in general towards approaching children?
Anxious /inclined to bite/ bites/ friendly/ ignores/ obtrusive/ threatens/ never occurred
Is this behavior problematic? Yes / No

2. How does you dog behave now in general towards obtrusive children?
Anxious / inclined to bite/ bites/ friendly/ ignores/ obtrusive/ threatens/ never occurred
Is this behavior problematic? Yes / No

3. How does you dog behave now in general if you give attention to a child?
Anxious / inclined to bite/ bites/ friendly/ ignores/ obtrusive/ threatens/ never occurred
Is this behavior problematic? Yes / No

4. How does your dog behave now in general towards unknown people on the street?
Friendly/ distanced/ barks/ jumps/ threatens/ inclined to bite/ (snaps or) bites if touched/ (snaps or) bites if approached/ ignores/ obtrusive/ does not get out on the street.
Is this behavior problematic? Yes / No

5. How does you dog behave now in general towards unknown people in the house or at the front door?
Friendly/ distanced/ barks/ jumps/ threatens/ inclined to bite/ (snaps or) bites if touched/ (snaps or) bites if approached/ ignores/ obtrusive/ does not come in the house
Is this behavior problematic? Yes / No

6. Has your dog threatened on any occasion between the test and now?
Unknown people/ known people/ own child/ unknown child/ yourself/ dogs/ judge (at dog show)/ never
Is this behavior problematic? Yes / No

7. Has your dog bitten on any occasion between the test and now?
Unknown people/ known people/ own child/ unknown child/ yourself/ dogs/ judge (at dog show)/ never
Is this behavior problematic? Yes / No

8. If you have answered that your dog has (snapped or) bitten (at someone), please write down how may times and in which situations?

9. If your dog does not show aggressive behavior, is this because you prevent the behavior now? Yes / No