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Visual Reaction Time and Plethysmography as Measures of Sexual Interest in Child Molesters

Gene G. Abel,[1,2] Jeffrey Huffman,[1] Brent Warberg,[1] and Clarence L. Holland[2]

It is important to determine the sexual interests of those accused of child molestation. Visual reaction time and plethysmography are two means of measuring sexual interest with some objectivity, but there has been no direct comparison of these methodologies. The reliability and validity of visual reaction time and plethysmography were evaluated in groups of individuals with sexual interest in children of various ages and genders. Results showed that both methods of assessment had a high reliability and validity. Visual reaction time has the added advantages that it can be used without nude slides and is a briefer assessment.

KEY WORDS: aggression; assessment; incest; pedophilia; penile plethysmograph; sexual offending.

INTRODUCTION

The objective measurement of sexual interest has been important in investigations of sexual drive, the use of pornography, adult gender preference, and atypical sexual interests such as interest in children. The traditional objective measure of sexual interest has been plethysmography: penile plethysmography for males (Earls & Marshall, 1983; Laws & Osborn, 1983; Murphy & Barbaree, 1988) and vaginal photoplethysmography for females (Hoon, Murphy, Laughter, & Abel, 1984).

A number of social, medical, and economic changes have made the use of plethysmography more difficult. Depiction of nude adults and children

[1]Behavioral Medicine Institute of Atlanta, Atlanta, Georgia 30327.
[2]Department of Psychology, Georgia State University, Atlanta, Georgia 30303.

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during plethysmography measurement has always been controversial. The use of nude children has been seen as ethically questionable because some believe it victimizes these children. Increasing concern has been expressed about the distribution of erotic pictures of children. Transporting such pictures across state lines, even for the valid purpose of evaluating and treating perpetrators of child molestation, can lead to the arrest of the researcher, making comparative studies across research sites difficult. A further challenge to plethysmography has been the increasing concern about sexually transmitted diseases, especially HIV. Attempts to reduce assessment and treatment costs have highlighted the length of time required for plethysmography measurement as well as the extensive amount of time required to train evaluators to properly administer and interpret plethysmography measures. Finally, plethysmography measurement has been problematic because some males fail to have significant erection responses, making it difficult to interpret their responses (Murphy & Barbaree, 1988).

An alternative to plethysmography has been described by Osborn, Abel, and Warberg (1995) employing visual reaction time. The amount of time an individual views a stimulus has been called visual reaction time, visual fixation time, fixation time, and viewing time and has been used to measure sexual interest in a variety of settings. Rosenzweig (1942) first reported a strong correlation between ratings by psychiatric staff members of patients' interest in sex and the amount of time patients looked at slides depicting sexual versus nonsexual content. Similar findings have been reported by a number of researchers (Abel, Lawry, Karlstrom, Osborn, & Gillespie, 1994; Abel, Rouleau, Lawry, Barrett, & Camp, 1990; Brown, Amoroso, Ware, Pruesse, & Pilkey, 1973; Love, Sloan, & Schmidt, 1976; Ware, Brown, Amoroso, Pilkey, & Pruesse, 1972; Wright & Adams, 1994; Zamansky, 1956). Zamansky (1956) compared the visual reaction times of male homosexuals to those of male heterosexuals. Homosexual males had longer visual reaction times to pictures depicting males, while heterosexual males had longer visual reaction times to slides depicting females. Abel and his colleagues (1990) compared the visual reaction times of 151 heterosexual and homosexual males viewing 80 slides depicting males and females of various ages. Visual reaction times to slides depicting the patient's preferred adult gender were significantly longer than to the nonpreferred gender.

Wright and Adams (1994) compared the visual reaction time of 80 adults in one of four categories: 20 heterosexual males, 20 heterosexual females, 20 homosexual males, and 20 homosexual females. Visual reaction times to slides depicting nude males were significantly longer for homosexual males than for heterosexual males and homosexual females but did not differ from those of heterosexual females. Heterosexual males and ho-

mosexual females had longer visual reaction times to slides depicting adult females than did heterosexual females or homosexual males.

Two studies used visual reaction time with child molesters. Abel *et al.* (1994) compared the visual reaction times of 101 normal, non-child molesting males with the reaction times of 30 molesters of adolescent boys, 25 molesters of boys under 14 years of age, 57 molesters of adolescent girls, and 73 molesters of girls under 14. One hundred sixty slides were presented, half depicting nudes and half depicting nonnudes in five stimulus categories: adult females, adult males, girls 8–10 years of age, and boys 8–10 years of age, plus a neutral category (landscapes). All child molesters had admitted their sexual interest in children. The data were analyzed with discriminant analyses to determine the sensitivity and specificity of reaction times for categorizing individuals into one of four categories of interest in children: girls under 14 years of age, boys under 14 years of age, girls 14 to 17 years of age, and boys 14 to 17 years of age. Results showed a high sensitivity to, and specificity at, categorizing those interested in adolescent boys; a moderate sensitivity to, and high specificity for, those interested in males under 14; and a high sensitivity for those interested in adolescent girls or girls under 14; but a low specificity for those reporting interest in adolescent girls or girls under 14.

There appears to be sufficient research to justify a direct comparison of visual reaction time with plethysmography as measures of sexual interest. This study compares these two measures in a group of admitted child molesters who report interest in children in four discrete categories: girls under 14 years of age, boys under 14 years of age, girls 14–17 years of age, and boys 14–17 years of age.

METHOD

Participants

The participants in this study were 157 males referred to the Behavioral Medicine Institute of Atlanta, an outpatient private practice, for evaluation and possible treatment of their sexual interests, following allegations that they had been involved in inappropriate sexual behavior. Of those clients who completed the evaluation process, only those who admitted to inappropriate sexual behavior were included, to maximize the likelihood that they would be responsive to stimuli depicting children. Fifty-six participants completed both plethysmography and the visual reaction time measurement. The remaining participants did not undergo plethys-

mographic measurement because the first author ceased used of this methodology.

The majority of participants (80.1%) were between 18 and 49 years of age, 1.5% were below age 18, and 18.3% were ages 50 to 79. Only 22.3% of the participants did not complete high school, 20.8% obtained a high-school diploma, and 56.9% attended or graduated college or graduate school. Over half the participants (58.1%) were employed full-time, 7.8% were employed part-time, 6.2% were students, 6.2% were retired, 12.4% were unemployed, and 9.3% indicated some other source of support. Approximately 40% of participants reported an income of less than $15,000 per year, 43% reported an income of between $15,000 and $59,999 per year, and 18% reported earning more than $60,000 per year. Almost half the participants (44.2%) were either married or living with a partner; 23.3% were separated, divorced, or widowed; and 32.6% indicated that they were single. The majority of participants were Caucasian (77.3%); 18.9% were African American; and less than 4% of the participants were of Amerasian, Native American, or other ethnic origin. Less than 5% of participants reported no religious affiliation, 62.7% identified themselves as protestant, 14.7% as Catholic, 1.6% as Mormon, and 26.3% as having some other religious affiliation.

Procedure for Plethysmography Measurement

Materials

The stimuli used included four slides in each of 11 categories, including males and females, 4, 8, 12, 16, and 22 years of age, and landscapes. The slides were those commonly labeled as the Multisite Study Slides (MSS) (Laws, Gulayets, & Frenzel, 1995). These slides met the guidelines of the Association for the Treatment of Sexual Abusers (1997) stimulus materials except that they did not include depictions of coercive, forcible, sadistic, or aggressive themes, nor did they include culturally diverse models. Each slide depicted a frontal view of a nude model against a pale blue background. No figure was depicted as sexually aroused. Slides were presented to all participants in the same random order and projected using a Kodak Ektagraphic 3-E Plus projector.

Changes in penile circumference were measured by sterilized mercury-in-rubber strain gauges manufactured by the D. M. Davis Company and were converted and amplified by the Computer Assisted Therapy (CAT) Model 300 manufactured by Farrall Instrument Company. The CAT 400-

UL, Version 4.58, scoring program was employed to record the participants' responses to each stimulus presentation.

Design and Procedure

Prior to each session, the CAT was calibrated to a maximum range of 20 mm of circumferential change. This was accomplished by placing the penile gauge on a calibrated cone at the minimum range (gauge size plus 5 mm) until a consistent reading was obtained. The gauge was then placed on the cone at the step 20 mm above the minimum step until a consistent reading was obtained. These steps were repeated until consistent readings were obtained at each end of the range.

After signing a statement of informed consent, participants were led into a room containing a comfortable chair, the seat cushion of which was covered with a sheet of examination-table paper. Slide images were projected through an aperture in the wall behind the participant onto the back of a door in front of the participant. The technician and the participant communicated through headsets with attached microphones.

Each participant was instructed to place the gauge on the middle of the shaft of his penis, approximately halfway between the head and the base of his penis. Each participant's baseline erection response was determined prior to the presentation of the first slide. Baseline was determined by allowing each participant to sit at rest, with no stimulus presentation, for at least 3 min. Transducer calibration and fitting followed the procedural guidelines of the Association for the Treatment of Sexual Abusers (1997).

Once a consistent baseline measure was obtained, the first slide was presented. Participants viewed each slide for 1 min while their erection response was measured. Between each slide presentation, the participant's erection response was allowed to return to within 5 mm of baseline. When the participant's erection response did not return to baseline within 1 min, he was given a distraction exercise (e.g., counting backward from 100 by 3's, naming state capitals, etc.). The interstimulus interval was a minimum of 30 sec. Each participant viewed a total of 40 slides.

The CAT-400 UL, Version 4.58, scoring program was set to eliminate movement artifact but the linearization feature was not employed. Each gauge was checked for linearity before and after each use. The maximum erection response to each slide presented was determined by measuring the change from the participant's lowest response to his subsequent highest response. (A special scoring program was written to calculate this measurement since the CAT scoring program measures the distance from the

lowest to the highest response, regardless of which occurs first.) The participant's maximum change scores for each of the four slides in a stimulus category were added together and the averages of these responses were determined to produce one score for each stimulus category.

Procedure for Visual Reaction Time

Materials

The test slides used included seven slides in each of six categories, including males and females aged 8–10, 14–17, and over 22 years of age. All slides depicted frontal views, with one model in each slide. Models wore bathing suits and were presented upon a blue background. Nontest slides were also viewed and were included as part of a standard visual reaction time protocol used by the clinicians. The full stimulus set also included seven slides per category and, in half of the cases, included depictions of clothed targets of exhibitionism, voyeurism, frottage, a suffering female, a suffering male, two males hugging, two females hugging, and a male and female hugging, as well as landscapes. In the other half of cases, each test category included an equal number of Caucasian and African-American individuals, and the categories of couples and landscapes were replaced by depictions of 2- to 4-year-old girls and boys. In all cases, the same test slides were included for all 157 participants undergoing visual reaction time measurement. These slides met the guidelines of the Association for the Treatment of Sexual Abusers (1997) for stimulus materials except that they did not include depictions of coercive, forcible, or aggressive themes.

Design and Procedure

After signing a statement of informed consent, participants were ushered into a room containing a Macintosh Powerbook 145 portable computer linked to a slide projector. Participants were shown how to use the computer to advance slides projected from an adjoining room through a glass window.

Participants first viewed a practice tray which included 15 slides similar in content to those of the test slides. They viewed the 15 slides once to familiarize themselves with the slides they would next be asked to rate. They were then instructed (via computer) to rate their sexual arousal to each slide on a Likert scale from 1 ("highly sexually disgusting") through

7 ("highly sexually arousing"), where 4 indicated that the slide was neither arousing nor disgusting. The scale remained on the computer screen while the participant entered his rating.

The computer measured the time the participant took to rate each slide and push the enter button to advance the next slide. Once the participant completed the rating of the practice tray, he then viewed and recorded his sexual arousal to the 160 test slides. Visual reaction time data were screened for disparate responses and these were removed prior to data analysis.

RESULTS

Reliability

Statistical reliability refers to the extent to which several measurements for a particular stimulus yield similar responses. Both visual reaction time and plethysmography present the participant with several images of the same stimulus category, such as young males. Tests of statistical reliability indicate the extent to which participants respond in the same way to multiple instances of one stimulus category. The reliability of each stimulus category is statistically assessed, shedding light on the internal consistency of each assessment instrument.

Cronbach's alpha coefficients for visual reaction time and plethysmography were calculated for adult males and females, adolescent males and females, and young males and females. Table I shows that both visual reaction time and plethysmography produced highly reliable results. The alpha coefficients for plethysmography ranged from .66 to .97. (The lowest coefficient, .66, which is still strong, may be depressed by the broad range of ages included. Plethysmography measures included females 2–4 and 8–10, while visual reaction time measures included only females 8–10.) The

Table I. Reliability of the Plethysmography Maximum Difference Scores and Visual Reaction Time: Alpha Scores

Slide category	Plethysmography (N = 56)	Visual reaction time (N = 95)
Adult female	.85	.86
Adult male	.94	.88
Adolescent female	.92	.84
Adolescent male	.97	.89
Young female	.66	.90
Young male	.90	.87

alpha coefficients for visual reaction time were also strong, ranging from .86 to .90. These results demonstrate a high degree of reliability for both visual reaction time and plethysmography.

Validity

Validity refers to the extent to which an instrument measures what it is intended to measure: To what extent do visual reaction time and plethysmography measure interest in particular stimulus categories? Two sets of tests of the validity of these instruments are presented. The first analysis measured the correlation between each participant's self-reported sexual interest and his physiological response to each stimulus category. That is, was the participant's level of response to female children correlated with his self-reported sexual interest in female children? The second analysis was conducted to determine each methodology's ability to discriminate among types of sexual offenders. This second set of analyses is important because these analyses show the relative ability of the two instruments to categorize correctly participants with specific sexual behaviors.

Participants who completed visual reaction time, plethysmography, or both were categorized into two categories: those participants who had reported sexual behavior with children under age 18 (child molesters) and those who reported other inappropriate sexual behaviors such as rape, exhibitionism, and voyeurism (other offenders). Child molesters were coded according to the specific category of behavior, including behavior with female or male children (under 14 years old) or adolescent females or males (14–17 years old). This resulted in four groups of child molesters and one group of other offenders. In these analyses, the other offender group was used as a control group.

Validity: Bivariate Tests

It was hypothesized that child molesters who had engaged in a sexual behavior with a specific gender and age group of children would respond more strongly to the specific stimuli associated with that group. Table II presents the Pearson's product-moment correlation coefficients for the relationship between the specific stimulus categories and the corresponding behavior category for both visual reaction time and plethysmography. For example, the relationship between a measure of the response to adolescent males and the admission of sexual behavior with adolescent males was assessed.

Table II. Significant Correlations Between Category of Sexual Interests and Screening Instruments

Screening instrument	Category of sexual interest				
	Child female	Child male	Adolescent female	Adolescent male	Number of cases
Visual reaction time	Yes	Yes	No	Yes	157
Plethysmography	No	No	No	No	30
Plethysmography[a]	No	Yes	Yes	No	56
Self-reported arousal	No	Yes	No	Partial	157

[a]Subjects without variation were included in this second set of analyses.

Visual Reaction Time. The results show that stimulus-specific measures from visual reaction time correlate significantly with the corresponding category of sexual behavior in three of the four categories: female children, male children, and adolescent males. This result demonstrates an association at the simplest, bivariate level between the stimulus-specific measure and sexual behavior. (The discriminant analyses described below use a broader array of measures to assess the sexual behavior categories.)

Plethysmography. Participants without any variation ("flat-liners") were excluded from the initial analyses. These were defined, in different analyses, as participants who failed to reach 10, 20, and 30% of a full erection. The analyses presented in Table II use the 10% criterion, but no difference in the outcome of analyses resulted from changing this criterion. When participants without any variation were excluded from the analyses, stimulus-specific measures of plethysmography did not correlate with any of the four categories of visual stimuli. (For visual reaction time, a correlation coefficient was considered significant at $p \leq .05$. A correlation coefficient of $p \leq .10$ was considered significant for analyses involving plethysmography because of the smaller number of cases.) When participants without any variation were included in the analyses, stimulus-specific measures of plethysmography correlated with category of sexual stimuli in two categories: male children and adolescent females. According to the standard literature, such flat-liner cases should be excluded because they failed to respond significantly to any category, including adult categories. Inclusion of this group, however, improved the results of tests using plethysmography.

Self-Reported Interest. Finally, the correlations between participants' self-reported behavior and stimulus-specific interests were computed. The results demonstrated a significant relationship between self-reported behavior and responses to male children and adolescent males. Participants in

these two categories tended to report a higher level of interest to images of these two stimulus categories.

Do the single measures taken from the screening instruments agree with the clinical assessment of sexual interest by the therapist? (A participant was not assigned to a sexual interest category in these analyses unless he *admitted* that he had engaged in sexual behavior with a child in that category; a child female interest indicated that the participant had admitted to the therapist that he had touched a female child for sexual gratification. If the therapist believed that sufficient evidence existed to classify a participant as having an interest in children, but the participant denied engaging in child molestation behavior, he was classified as a "probable" and was omitted from analyses.) If so, this is an important finding because this type of statistical test uses only a single stimulus-specific measure from screening instruments that contain many more pieces of relevant information.

The stimulus-specific measures from visual reaction time significantly correlated with categorization of sexual interest in three of the four categories. The stimulus-specific measures from plethysmography significantly correlated in two of the four categories, when participants without any variation were included. Self-reported behavior also correlated with physiological responses in two of the four categories. Thus, according to this set of statistical tests, visual reaction time is consistent with clinical impressions in more categories of sexual interest.

Validity: Discriminant Analyses

The final analysis, presented in Table III, compared the validity of visual reaction time and plethysmography with all the information contained in each screening instrument. The sexual interest categories discussed above were again used in this set of analyses. However, the entire array of information contained in each screening instrument was utilized to predict categorization instead of using only the stimulus-specific measure. (This methodology is commonly used and is appropriate because, for example, a low level of response to adult females may also be relevant when predicting a person's interest in young boys.) The discriminant analyses used all of the stimulus categories as independent variables and treated stimulus-specific interest categories as the dependent variable. One discriminant analysis was computed for both visual reaction time and plethysmography. (Percentage correctly classified refers to the *percentage of all cases* who are *correctly predicted* to be in the category "has interest" or "does not have interest" by the analysis. Percentage true positives refers

Table III. Summary Results of Discriminant Analyses: Visual Reaction Time and Plethysmography

Dependent variable	*N* of cases	*N* with interest	Percentage correctly classified	Percentage true positives	Percentage false positives	Fisher's exact test
Female adolescent						.458
Visual reaction time	150	20	76.7	60.0	20.8	
Plethysmography	52	8	71.2	37.5	22.7	
Male adolescent						.586
Visual reaction time	148	10	91.2	60.0	6.5	
Plethysmography	52	6	88.5	50.0	6.5	
Female child						—
Visual reaction time	154	46	65.6	67.4	35.2	
Plethysmography	55	17	No variables entered the stepwise analysis			
Male child						.437
Visual reaction time	150	13	90.7	38.5	4.4	
Plethysmography	53	8	86.8	62.5	8.9	

Note. Independent variables represent type of model's proportion of all responses.

to the percentage of the cases with the interest who were predicted to have the interest by analysis. Percentage false positives refers to the percentage of the cases who do not have an interest who are predicted to have the interest by the analysis: the smaller this number, the "better" the results.)

A two-tailed Fisher's exact test was used to compare the percentages of correct classification between the plethysmography and the visual reaction time models. Fisher's exact test has the advantage of providing an exact probability value for a test of no association, as opposed to the chi-square test, which produces a probability value based on large sample properties and may not be as accurate in small sample sizes.

Female Adolescent Interest. Visual reaction time predicted the correct interest ("has interest" versus "does not have interest") in a slightly higher percentage of cases than did plethysmography and had a slightly lower rate of false positives. Visual reaction time correctly classified 60% of true positives, whereas plethysmography correctly classified approximately 38%. The Fisher's exact test comparing the percentages of correctly classified cases between plethysmography and visual reaction time had a probability value of $p = .458$, indicating that the difference was insignificant.

Male Adolescent Interest. Only a few percentage points separated visual reaction time and plethysmography in percentage correctly classified, and both screening instruments had few false positives. However, visual reaction time correctly classified more participants than did plethysmography. The Fisher's exact test comparing the percentages of correctly classified cases

between plethysmography and visual reaction time had a probability value of $p = .586$, indicating that the difference was insignificant.

Female Children Interest. Visual reaction time was better able to predict this interest; none of the variables from plethysmography were significant, and thus, none entered the equation. The Fisher's exact test could not be performed because there was no equation for plethysmography.

Male Children Interest. Visual reaction time correctly classified a larger percentage of cases than did plethysmography and had a lower percentage of false positives. However, plethysmography correctly classified more true positives than did visual reaction time. The Fisher's exact test comparing the percentages of correctly classified cases between plethysmography and visual reaction time had a probability value of $p = .437$, indicating that the difference was insignificant.

In summary, these two screening instruments, visual reaction time and plethysmography, have the ability accurately to predict sexual interest categorization. The results showed that the two screening instruments are comparable for female adolescents, male adolescents, and male child categories. In these three analyses visual reaction time correctly classified a slightly higher percentage of cases but these differences were statistically insignificant. However, in the female child category, plethysmography failed to predict any cases correctly.

Both screening instruments had at least some stimulus-specific measures that correlated with corresponding categorizations. Both performed well in discriminant analyses used to predict specific categorizations. In sum, visual reaction time and plethysmography were similar in their ability to predict categorizations.

DISCUSSION

Both visual reaction time and plethysmography demonstrated good reliability. Measures of internal consistency were high for both. Whether sexual interest was measured by visual reaction time or plethysmography, consistent results were obtained within the six slide categories in this study. However, an exact replication of the two methodologies was not feasible for a number of reasons. First, the visual reaction time slides were chosen so as not to include depictions of nudes, which some find objectionable. However, plethysmography has traditionally used depictions of nudes, and therefore, nude slides were used in the plethysmography measurement. Second, the duration of stimulus presentation varied due to the differences in measurement techniques. For visual reaction time, the duration of the presentation of each stimulus slide was controlled by the participant. For

plethysmography, each slide was presented for a fixed duration of time. Third, the number of slides per category differed markedly between the two measurement techniques. Optimally, an adequate number of slides per category is included to guard against spurious reactions to particular slides. The longer duration of each slide presentation during plethysmography reduced the number of slides per category that could be comfortably viewed in a measurement session. However, within the restrictions of the methodological differences between the two measurement techniques, reliability was similar between visual reaction time and plethysmography.

The findings of this study lend strength to the validity of both measures. Relying on only the category of slides consistent with the category of interest, the correlation between visual reaction time and categorization was significant in three of four categories of sexual interest in children. The exception was that group of participants who had interests in adolescent females. Freund, McKnight, and Langevin (1972), using volumetric plethysmography, have demonstrated that normal males may have a significant sexual response to adolescent females. Failure to obtain correlations between those with and those without an interest in adolescent females is consistent with Freund and co-workers' finding.

The traditional wisdom that data should be used only if the participant reaches at least a certain maximal erection may not be correct. When participants without any plethysmographic variation were excluded, there were no significant correlations between plethysmography responses and categorization. However, when data for all the 56 offenders undergoing plethysmography were included, regardless of the extent of their erection responses, significant correlations were found in two of the four categories, indicating that significant data may be available in very low erection responses.

A further measure of the validity of the discriminant analyses of visual reaction time and plethysmography was their respective ability correctly to predict sexual interest categorization. The limitation of the analysis is that normal controls were not tested. Instead, all participants had some type of admitted inappropriate sexual behavior and were divided into two groups, those whose clinical interviews revealed that they had been involved in one of the four categories of child molestation or that they had been involved in some other type of inappropriate sexual behavior. Since some studies have found that many paraphilics have multiple deviant sexual interests (Abel, Becker, Cunningham-Rathner, Mittelman, & Rouleau, 1989; Abel & Osborn, 1992), it might be expected that some participants may have been misclassified because they concealed some of their inappropriate sexual behaviors. Although plethysmography did quite well in three of the four categories, in the category of female children, no model could be created.

These validity results cannot be used to calculate the sensitivity and specificity of the two methodologies, since normals were not compared with participants for child molesters. Results reported previously (Abel *et al.*, 1994), however, have demonstrated a high sensitivity and specificity of visual reaction time when comparing these two groups.

There are a number of limitations in this study. The number of participants per category for plethysmography studies was smaller than for visual reaction time. A second possible limitation was the absence of a normal control group. The purpose of the study, however, was not to determine the sensitivity and specificity of the two methodologies but, instead, to make a direct comparison of the two methodologies using the available population of male child molesters. In that regard, the absence of a control group is not a relevant factor.

Both methodologies are helpful in determining sexual interest. In view of these findings, visual reaction time appears to be an effective, noninvasive, and cost-efficient means of measuring sexual interest. The ability of clients to falsify their visual reaction time responses is currently being evaluated.

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