Routledge
Taylor & Francis Group

The Development and Validation of Statistical Prediction Rules for Discriminating Between Genuine and Simulated Suicide Notes

Natalie J. Jones and Craig Bennell

The suicide note is a valuable source of information for assisting police forces in equivocal death investigations. The present study endeavored to develop statistical prediction rules to discriminate between genuine and simulated suicide notes. Discriminant function analysis was performed on a sample of 33 genuine and 33 simulated notes to identify variables that serve as best predictors of note authenticity. Receiver operating characteristic analysis was then applied to validate these models and establish decision thresholds. The optimal model yielded an accuracy score of .82, with average sentence length and expression of positive affect being particularly effective at discriminating between the notes. Theoretical implications are discussed as are the practical advantages of applying receiver operating characteristic analysis in the investigation of equivocal deaths.

INTRODUCTION

Although the empirical study of suicide notes spans over half a century (e.g., Gregory, 1999; Osgood & Walker, 1959; Shneidman & Farberow, 1957), the body of literature in the area remains fragmented, atheoretical, and fraught with methodological concerns. Attempting to place the existing research in a conceptual context, the present article draws upon the notion of cognitive energy to describe the psychological state of the suicidal person in relation to his/her final communication. In addition, statistical prediction rules (SPRs) are developed and validated in order to determine the most accurate predictors of suicide note authenticity. Although certain predictors have been identified in prior research (e.g., Gregory, 1999), no specific thresholds have been determined such as to indicate the degree to which these variables must be present in order to decide whether a suicide note is genuine or simulated. Thus, the present investigation is novel in its attempt to specify optimal

decision thresholds for the generated statistical models.

Theoretical Framework: The Cognitive State of the Suicidal Person

A basic and widely accepted tenet is that motivation affects language behavior, which in turn conveys a variety of psychological states (Osgood, 1960). Thus, it follows that the motivation of the suicidal person should be reflected in the structure and content of the produced suicide note. Content analysis of genuine versus fictitious suicide notes should also reveal the particular encoding characteristics of a suicidal individual that cannot be discerned by a non-suicidal counterpart attempting to simulate a final communication (Gregory, 1999).

It is argued that the author of a suicide note is motivated by a specific communicative purpose beyond that which is evident by the suicidal act itself (Gottschalk & Gleser, 1960). Certain researchers contend that this goal-driven behavior is accompanied by an elevated drive that, in turn, is associated with specific changes in linguistic expression (Cummings & Renshaw, 1979). The literature on suicidal risk factors appears to lend support to the theory of heightened motivation. Clinically, it has been widely reported that risk of suicide becomes elevated in individuals experiencing surges of energy in conjunction with persistent symptoms of depression (Alvarez, 1971; Meehl, 1973). In this state of heightened arousal, it is reasoned that one gains the cognitive clarity to materialize suicidal ideations (Schweizer, Dever, & Clary, 1988).

The Language of Suicide Notes

It is suggested that one may discern veritable suicide notes in their depiction of the author's unique psychological state, elements of which cannot be assimilated by a non-suicidal counterpart (Leenaars, 1988). While not an exhaustive review, the follow-ing is a general discussion of features most consistently highlighted as distinguishing indices of genuine suicide notes, with a particular focus on their relationship to the note writer's heightened motivational state and goal-driven behavior. One useful manner of conceptualizing these features is to categorize them dichotomously as either *structure* or *content* variables (Gregory, 1999). The former is a measure of language structure while the latter relates more directly to thematic aspects of the suicide note itself.

Structure Variables

Average Sentence Length. Osgood and Walker (1959) observed that the genuine suicide note is characterized by shorter, less diversified sentence fragments than the forged note as measured by *average sentence length*. In particular, it has been noted that under high drive states, the communicative focus is on the salient content of the message. Thus, the tendency to modify simple propositions through adjectives or adverbs diminishes (Gregory, 1999; Osgood & Walker, 1959). In addition, under high levels of arousal, the cognitive literature suggests that one's attention tends to constrict, focusing only on the most relevant details while disregarding peripheral information (Montgomery, 2000). This may further serve to explain the suicidal individual's succinct writing style.

Parts of Speech. Beyond sentence length, there is a notable dissimilarity in language behavior between genuine and forged suicide notes as reflected in their differential use of certain parts of speech (Edelman & Renshaw, 1982). Namely, there is a significantly greater *percentage of nouns* in the genuine communication, with a preponderance of references to persons and concrete objects (Arbeit & Blatt, 1973; McLister & Leenaars, 1988). The cognitive literature supports the idea that nouns are semantically richer than verbs in general, both of

which are encoded and stored differently from the earliest stages of language acquisition (Bird, Howard, & Franklin, 2000). The semantic richness and phonological properties of nouns facilitate encoding and retrieval relative to other parts of speech (for a complete review, see Black & Chiat, 2003). Furthermore, under elevated degrees of arousal, the recognition, retrieval, and ultimate use of nouns tends to remain intact while that of verbs may be subject to impairment (Hayiai-Thomas, Bishop, & Plunkett, 2004). Thus, it might be reasonable to assume that a suicidal individual under high drive would be more successful at processing and generating nouns relative to other parts of speech.

It is further reported that for the genuine author, the proportion of references to cognitive processes decreases as the complement of references to people, places, and things (Arbeit & Blatt, 1973; Gottschalk & Gleser, 1960). Plausibly due to their operational quality, *actions verbs* (e.g., bury, inform, etc.) are typically more prominent in genuine than in fabricated notes (Darbonne, 1969). However, fabricated notes contain significantly more *cognitive process verbs*, defined as verbs that convey mental processes rather than physical actions (e.g., think, regret, etc.). Gregory (1999) suggests that simulated notes, with their preponderance of cognitive process verbs, demonstrate evidence of problem solving. There is a failure on the part of the writer of a forged note to appreciate that the conflicts and doubts of the suicidal person have already been resolved. In fact, the suicidal person generally displays a rigidity of thought that propels a resignation to complete the suicidal act while preventing the recognition of viable alternatives (e.g., Lester, 2004).

Content Variables

Length of Communication. Compared to simulated notes, genuine communications are typically greater in length when measured as the expression of distinct thought units or *total number of words* (Black, 1993; Cummings & Renshaw, 1979; Edelman & Renshaw, 1982; Gregory, 1999; Shneidman & Farberow, 1957). These researchers have argued that the relatively greater length of the genuine communication is an index of the heightened cognitive state experienced by the suicidal individual. Gregory (1999) further reasons that the clear communicative purpose and high quantity of salient information upon which to draw when composing the note may also account for the relative increase in length.

Instructions. Relative to their simulated counterparts, genuine suicide notes include a higher frequency of instructions to survivors regarding insurance, requests to notify one's next of kin, and so forth (Black, 1993; Darbonne, 1969; Lester & Leenaars, 1988; Shneidman & Farberow, 1957). This finding coheres with the sense of decisiveness and finality assumed by the suicidal person. The final communication is highly purposeful and the author expends great energy in directing others to perform actions he/she will be unable to accomplish (Shneidman, 1980).

Affective State. Although counter-intuitive, genuine notes are characterized by a greater expression of positive affect than simulated notes, expressed in the form of affection, gratitude, or concern towards survivors (Leenaars, 1988). In addition, the genuine note is characterized by a higher frequency of endearment terms (e.g., love, dear, etc.) (Ogilvie, Stone, & Shneidman, 1966). With indices of positive affect often interspersed throughout the backdrop of despair inherent in the note, Leenaars (1988) argues that it is this emotional confusion that distinguishes the authentic from the simulated communication. Thus, although an individual may have achieved the cognitive resolution to engage in the suicidal

act, the associated emotional state may nonetheless be characterized as "ambivalent" (Leenaars & Balance, 1984).

Explanation Provided. Genuine note writers are less likely to provide an explanation for their ultimate action (Lester & Leenaars, 1988). Research in the domain of suicidology suggests that individuals typically exhibit "warning signs," conveying their intentions to family and friends, whether explicitly or implicitly, prior to a suicide attempt or completion (Correctional Service of Canada, 2001). Accordingly, the individual on the verge of suicide may perceive that his/her intentions have already been made apparent.

Locus of Control. It is widely reported that depressed individuals tend to exemplify an internal locus of control when explaining negative events, attributing failures to their own personal shortcomings (e.g., Joiner & Wagner, 1995; Seligman, 1975). Counter-intuitively, genuine suicide notes are generally characterized by an external locus of control, ascribing behavior and circumstances to products of fate, luck, or other external circumstances (Gregory, 1999). Gregory argues that by attributing misfortune to external events, genuine note writers render themselves devoid of responsibility for the intended suicide and in a sense, attempt to neutralize the ensuing act to both themselves and others. In contrast, the simulated note writer tends to convey an internal locus of control, mirroring the cognitive state of the typical depressed individual.

A Multivariate Approach to Predicting the Veracity of Suicide Notes

In addition to its absent theoretical framework (Leenaars, 1988), the literature on suicide notes has been criticized due to its failure to combine predictor variables into a comprehensive model (Gregory, 1999).

Accordingly, a few attempts have been made to employ multivariate approaches in the study of suicide notes (Edelman & Renshaw, 1982; Gregory, 1999). For example, Gregory (1999) applied a multidimensional scaling approach to elucidate the relationship between the aforementioned content and structure variables using the suicide notes featured in the Shneidman and Farberow (1957) sample (described in detail below). Results suggest that content variables as a group serve to best discriminate between genuine and simulated notes. In contrast to structure variables, Gregory reasons that indices of content are more reflective of an individual's internalized decision to die, a cognitive state that may not be appreciated by a non-suicidal counterpart. Despite such attempts at multivariate prediction, no appropriate thresholds have ever been specified to indicate the point at which a given piece of evidence is present in sufficient quantity to render a judgment of suicide note authenticity.

Advantages of Receiver Operating Characteristic (ROC) Analysis. Determining the authenticity of a suicide note involves the task of discriminating between two alternatives (i.e., genuine vs. simulated). Ultimately, the goal in such a task is twofold: 1) the identification of optimal discriminators in order to maximize decision-making *accuracy*, and 2) the specification of appropriate thresholds to quantify decision-making *utility* (Swets, Dawes, & Monahan, 2000). The former has been addressed in prior research (e.g., Edelman & Renshaw, 1982; Gregory, 1999). However, the suicide literature has largely ignored decision-making utility. A technique termed ROC analysis can be applied to examine these two aspects of decision-making (Swets, 1996).

Any two-alternative decision task yields four possible outcomes based upon whether one's prediction of an event's occurrence corresponds to reality. In determining suicide note authenticity, correctly deciding that a note is simulated

would correspond to a *hit*, while determining that a given note is genuine when this is indeed the case would correspond to a *correct rejection*. Incorrectly classifying a genuine note as simulated is a *false alarm*, while failing to classify a simulated note as inauthentic is a *miss*. Accuracy can obviously be maximized by increasing the likelihood of making correct decisions and/or by decreasing the likelihood of making incorrect decisions.

Given the ambiguity inherent in behavioral evidence, a strict categorical criterion is typically not available in the determination of suicide note authenticity, such that the presence or absence of a given variable unequivocally signals the correct decision. Thus, an appropriate decision threshold must be established (Bennell, 2005). Given a continuum of evidence X (e.g., degree to which positive affect is expressed in a note), a decision threshold refers to a cut-off point along that continuum above which a given decision outcome emerges. The position of the threshold can be set anywhere along this continuum of evidence, the placement of which directly determines the probability of making correct and incorrect decisions (Swets, 1992).

Both the accuracy and utility of decision-making can be examined by plotting on a graph pH as a function of pFA at various decision thresholds.[1] When the plotted values are connected, the result is a ROC curve. The overall level of decision accuracy is given by the *area* falling *under* the *curve* (AUC) (Swets, 1988). AUCs typically range from .50 (chance level accuracy) to 1.00 (perfect accuracy). The AUC corresponds to the position of the entire curve rather than any single point along it and therefore, it provides a measure of accuracy that is independent of threshold placement (Bennell, 2005; Bennell & Jones, 2005).

Current Study

Drawing from variables noted to discriminate between genuine and simulated notes in previous research, the current study aims to develop multivariate statistical models that maximize decision accuracy. Moreover, optimal decision thresholds will be specified for the purpose of determining the appropriate amount of evidence required for a particular decision to be reached.

METHOD

Sample

The genuine and simulated suicide notes utilized in the current study were collected by Shneidman and Farberow (1957). These researchers were pivotal in their effort to introduce empirical controls to the study of suicide notes through a demographically matched sample of simulated note writers. With the cooperation of the Los Angeles County Coroner's Office in California, the authors randomly obtained 33 genuine suicide notes written between 1945 and 1953. Members of the control group ($n = 33$) were matched with authors of the genuine notes based on age and occupational level. These participants were instructed to produce a suicide note as they might were they hypothetically planning to take their own life.

Coding of Variables

In the context of the present study, a research assistant who was blind to note authenticity analyzed each of the 66 suicide notes for content and structure on the basis

---

[1]The probability of making a hit, pH $= a/(a + b)$, where $a =$ the frequency of hits and $b =$ the frequency of misses; the probability of making a false alarm, pFA $= c/(c + d)$, where $c =$ the frequency of false alarms and $d =$ the frequency of correct rejections.

of a coding dictionary provided by Gregory (1999) (see Appendix A). A sample of 20 notes was then randomly selected by the first author and blindly coded for the purpose of assessing inter-rater reliability. The achieved level of inter-rater reliability was high at .91, as measured through Cronbach's alpha. Any definitional ambiguities were resolved with the principle coder and subsequently clarified in the coding dictionary itself.

Analysis

Significance testing was initially performed between genuine and simulated notes for each predictor under consideration in the study using *t*-tests or chi-square tests as appropriate. Through a forced entry discriminant function analysis procedure, statistical prediction rules (SPRs) were developed including: 1) all structure variables (structure model), 2) all content variables (content model), and 3) all structure and content variables (inclusive model). Finally, a forward stepwise discriminant analysis procedure (inclusion criterion: $F \geq 3.84$) was applied to construct an SPR containing: 4) the optimal combination of structure and content variables (optimal model).

The SPRs were cross-validated using a leave-one-out procedure to ensure that levels of predictive accuracy were reasonably preserved when applied to independent cases. The leave-one-out procedure is systematic and exhaustive, testing the model and obtaining a diagnostic probability for each case when omitted from the analysis (Kearns & Ron, 1999). The cross-validated SPRs were then evaluated using ROC analysis to establish respective overall levels of predictive accuracy and to identify optimal decision thresholds (Swets, 1996). For each model, the decision threshold was specified at the level that maximized pH while minimizing pFA (Bennell, 2005).

RESULTS

Table 1 summarizes results generated from preliminary significance testing of each

TABLE 1. **Tests of Significance Between Genuine and Simulated Notes for Each Variable**

Variable	Genuine ($M \pm SD$ or frequency)	Simulated ($M \pm SD$ or frequency)	Test statistic
Structure variables			
Average sentence length	13.36 ± 6.22	16.87 ± 7.70	$t = 2.04^*$
Percentage of nouns	13.57 ± 7.39	11.89 ± 3.87	$t = 1.16$
Percentage of cognitive process verbs	19.19 ± 16.24	15.46 ± 13.23	$t = 1.02$
Percentage of verbs	18.93 ± 5.56	18.35 ± 4.72	$t = .46$
Content variables			
Positive affect	3.91 ± 4.10	1.85 ± 1.42	$t = 2.73^{**}$
Instructions	2.09 ± 1.89	1.06 ± 1.30	$t = 2.58^{**}$
Total number of words	105.48 ± 96.44	64.58 ± 56.25	$t = 2.11^*$
Locus of control	Internal = 15	Internal = 16	$\chi^2 = .16$
	External = 15	External = 13	
Explanation	Yes = 26	Yes = 27	$\chi^2 = .10$
	No = 7	No = 6	

$^*p < .05$, $^{**}p < .01$.

predictor in the study. In this initial set of tests, each variable was analyzed independently. As expected, in contrast to forged notes, genuine communications were significantly longer, yet composed of shorter sentence fragments. In addition, genuine notes communicated significantly more instructions to survivors and conveyed a greater expression of positive affect. Remaining variables did not serve as significant predictors of suicide note authenticity.

Discriminant Function Analysis

A series of discriminant function analyses were performed using four structure and five content variables as predictors of group membership (i.e., genuine versus simulated). The first discriminant function analysis included structure variables alone. No significant association was found between this set of predictors and group membership. This function correctly classified only 50.0% of the cross-validated sample, thus reflecting chance level accuracy.

The second discriminant function analysis included content variables only. This function marked an improvement over that containing structure variables in isolation, with $\chi^2(5) = 10.80$, $p < .10$. This second SPR correctly classified 59.3% of cross-validated cases.

The third direct discriminant function analysis comprised all variables. This SPR yielded a highly reliable relationship between groups and predictors, with $\chi^2(9) = 21.52$, $p < .01$. Based on this inclusive model, correct classification for the cross-validated sample was 67.8%.

Finally, a discriminant function analysis was performed on all variables using a forward stepwise procedure to generate an optimal SPR. The resultant model also had significant discriminatory power in assigning group membership, with $\chi^2(2) = 14.26$, $p < .001$, correctly classifying 68.2% of cross-validated cases. For the optimal SPR, the expression of positive affect (content variable) and average sentence length (structure variable) emerged as optimal predictors, offering the best predictive accuracy of group designation.

ROC Analysis

Decision-making Accuracy. ROC curves were further employed to validate the variables included in each discriminant function analysis. ROC graphs and respective AUCs are represented in Figure 1, and summarized in Table 2. In sum, all models possess good levels of predictive accuracy save for the SPR composed of structure variables alone, which is characterized by low accuracy (Swets, 1988).

The structure and content models yielded AUCs of .69 and .74, respectively. The optimal model generated through the forward stepwise procedure emerged as a highly predictive SPR. Although comprised of only two variables (i.e., the expression of positive affect and average sentence length), this latter function yielded an AUC of .82. As expected, the AUC associated with the inclusive model is highest relative to the other models at .85.

A comparison of AUCs associated with each model through one-tailed z-tests reveals no significant differences between the structure and content models, or between the inclusive and optimal models. The inclusive model has significantly greater discrimination accuracy than both the structure ($z = 2.40$, $p < .001$) and content ($z = 1.86$, $p < .05$) models. Moreover, the AUC associated with the optimal model is significantly greater than that associated with the structure model ($z = 1.70$, $p < .05$). The trends observed in relative levels of discrimination accuracy yielded from ROC analysis generally concur with those emerging from discriminant function analysis, hence attesting to the validity of the devised models.
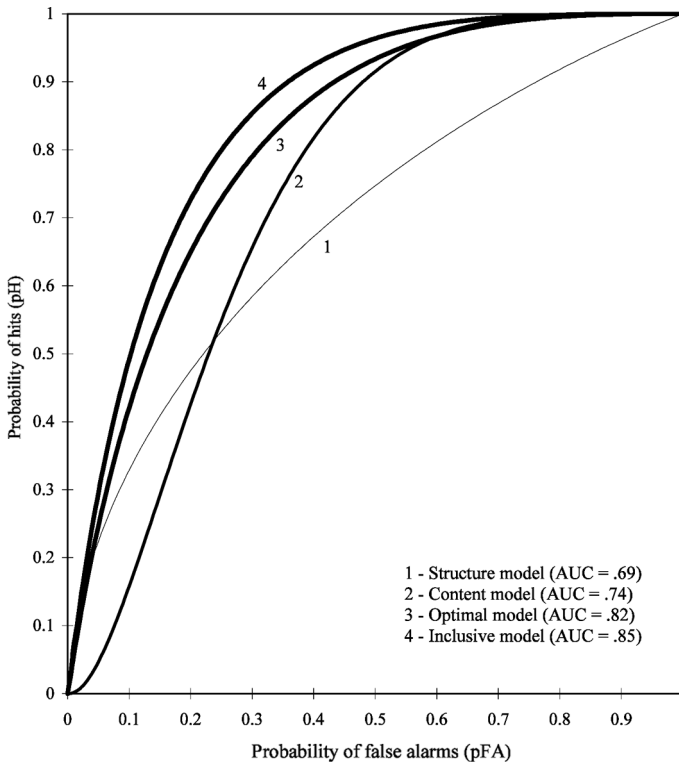
FIGURE 1. *ROC curves indicating discrimination accuracy levels for all SPRs.*

Decision-making Utility. Regardless of a model's accuracy, the utility of a prediction rule is dictated by the specification of decision thresholds. With respect to decision utility, one feasible option is to

set a threshold such as to maximize pH while minimizing pFA (Bennell, 2005). This cut-off can easily be obtained by drawing a perpendicular line from the upper left corner of the ROC graph to the positive diagonal and determining the coordinates (i.e., pH on the y-axis and pFA on the x-axis) that correspond to this line's point of contact with the ROC curve (Swets, Dawes, & Monahan., 2000). One can then work backward to determine the cut-off point (i.e., a specific p-value in this case) that resulted in these coordinates.

The ratios of pH and pFA associated with these optimal thresholds are given in Table 3. An illustration of the "optimal" quality of these cut-offs becomes evident when considering a more extreme threshold placement. For example, in the context of the optimal model, if one were to

TABLE 2. Areas Under Each ROC Curve, with Associated Standard Errors, Probability Values, and Confidence Intervals

Variable group	AUC	Standard error	95% confidence interval
Structure	.69*	.07	.55–.82
Content	.74**	.07	.62–.87
Optimal model	.82***	.06	.71–.93
Inclusive model	.85***	.05	.74–.95

$*p < .05$, $**p < .01$, $***p < .001$.

TABLE 3. Ratios of Hits to False Alarms Resulting From Optimal Thresholds Associated With Each ROC Curve

Variable group	Probability (optimal threshold)	pH/pFA
Structure	.49	.64/.36 = 1.78
Content	.55	.66/.33 = 2.00
Optimal model	.51	.73/.27 = 2.70
Inclusive model	.57	.69/.30 = 2.30

hypothetically set a very lenient threshold at a probability level of .90, the corresponding pH would be 1.00 (i.e., one would correctly identify all forged notes), but the pFA would also increase to approximately .95 (i.e., one would erroneously identify genuine notes as forged in 95% of cases). On

the other hand, by setting a very strict threshold of .10, one would reduce the pFA to 0 (i.e., no genuine notes would be erroneously identified as simulated). However, the pH would also decrease to .03 (i.e., only 3% of simulated notes would be correctly identified).

While particular thresholds were specified as optimal for the purpose of this investigation, ROC analysis is advantageous as it permits thresholds to be tailored to the goals and constraints of individual situations. For example, in a forensic context where resources are typically scarce, an investigator may wish to adopt a fairly strict threshold by placing a limit on the probability of false alarms deemed acceptable. For illustrative purposes, consider the structure model and the optimal model depicted in Figure 2. Hypothetically,
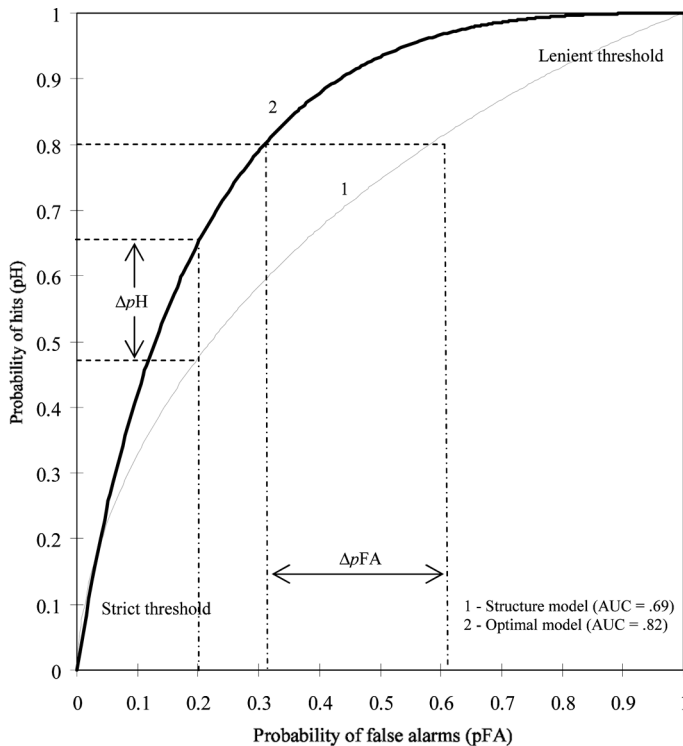

FIGURE 2. *Illustration of decision thresholds using two SPRs.*

assume that a police force has chosen to place a limit on the rate of false alarms at pFA = .20. For the ROC curve corresponding to the structure model, a hit probability of pH = .48 would be generated when using this threshold. In contrast, the same decision threshold applied to the optimal model would result in a hit rate of pH = .66. Thus, an investigator could potentially identify 18 additional simulated suicide notes for every 100 notes considered by applying the optimal SPR instead of the model based on structure variables alone. Similar comparisons may be considered for the other models developed in this study using these and alternative decision thresholds.

DISCUSSION

Several SPRs were developed and validated in this study to determine the variables and combinations thereof that offer the greatest degree of predictive accuracy in discriminating between genuine and simulated suicide notes. Although the difference between the AUCs of the structure and content models did not reach statistical significance, discriminant function analysis revealed that content variables as a whole were more effective in determining the authenticity of suicide notes than structure variables, the latter performing at a rate only slightly greater than chance. The highest level of predictive accuracy (AUC = .85) was achieved with the inclusive model, in which all nine variables were entered into the SPR.

Nonetheless, the optimal model based on the forward stepwise procedure demonstrated a comparable ability to discriminate between genuine and simulated notes, yielding an AUC of .82. Features that emerged as the most reliable discriminators were the expression of positive affect and average sentence length. Specifically, compared to genuine notes, simulated communications are significantly less likely to feature the expression of positive affect and are characterized by longer sentences. These findings are in accordance with previous research (e.g., Gregory, 1999; Leenaars & Balance, 1984; Osgood & Walker, 1959).

Theoretical Implications

Generally, the results of the current study concur with the theoretical perspective proposed by the present authors. In particular, a genuine communication of suicidal intent is greater in overall length and is characterized by the provision of instructions, while lacking in ultimate justification for the intended act. These features suggest a need on the part of the suicidal person to convey salient information to survivors beyond the obvious reality of the ensuing act. In addition, the greater proportion of nouns and shorter sentence fragments typical of the genuine note support the theory that the suicidal individual is experiencing a high degree of cognitive arousal. Consequently, the individual's attention is funneled such that the focus of the communication is solely on relevant information, without the inclusion of superfluous detail through additional parts of speech.

As previously discussed with respect to affective expression, one of the two optimal discriminators, the ambivalent emotional state of the genuine note writer is likely to result in the expression of positive affect within the communication. The cognitive energy expended in writing the suicide note is not solely negative as one might expect. Rather, the individual has resolved to engage in the ensuing action and typically views the process of writing the note as a final opportunity to communicate with loved ones and potentially express affection towards survivors. The demonstration of positive emotion is particularly counter-intuitive to an

individual lacking an appreciation for the genuine suicidal state (Leenaars & Balance, 1984). As such, the capacity of this feature to distinguish between genuine and forged notes becomes more logical.

The shorter, more fragmented sentences of the genuinely suicidal individual (i.e., the second optimal discriminator) are consistent with the theory of heightened arousal and a consequent focus on only the most salient aspects of the communication. Compounding this effect is the simulated note writer's additional lack of appreciation for these "salient aspects of communication." As discussed, the typical purpose of the suicide note is to convey final instructions and factual information to survivors rather than to provide an existential account of the futility of one's life. The focus on a philosophical and abstract account in the forged note (versus a focus on the concrete) is arguably conducive to the elongation of sentences through the more frequent use of modifiers (e.g., adjectives, adverbs).

Practical Implications

Currently, many investigations of equivocal deaths rely on a technique termed equivocal death analysis (EDA). Limited empirical research has been conducted on the effectiveness of EDA, which is commonly criticized for its unreliability and speculative basis (Darkes, Otto, Poythress et al., 1993). The application of empirically validated SPRs may offer a viable alternative to police forces in the investigation of equivocal deaths.

Although the inclusive model outperformed all other SPRs, from a practical perspective, the optimal model is advantageous in its parsimony. Namely, it incorporates only two variables to achieve a degree of accuracy that is statistically equivalent to that associated with the inclusive SPR (i.e., AUCs of .82 and .85, respectively). Given limited investigative

resources, attention might simply be accorded to these most discriminating features rather than undertake an exhaustive analysis of a suicide note to code for variables that offer only a marginal improvement in predictive ability.

The results of this investigation clearly demonstrate that effective discrimination of genuine and forged suicide notes (or any other decision-making task) depends not only on the inherent discriminative power of a given variable or combination thereof, but additionally on the placement of decision thresholds. In a practical context, it is futile to recognize the discriminatory power of a specific piece of evidence without further establishing a threshold at which that evidence is deemed present in sufficient quantity to render a given decision (Bennell, 2005; Bennell & Jones, 2005). One of the primary advantages of the ROC approach to such discrimination tasks is that accuracy and utility may be considered simultaneously, without one dimension biasing the other (Bennell, 2005).

While the current authors explored the idea of setting optimal decision thresholds, it is important to emphasize that the way in which "optimal" was defined in this study is potentially inappropriate within certain applied settings. The definition of an optimal decision threshold is entirely dependent upon the particularities of the decision-making task at hand and surrounding contextual variables. What is considered optimal is dictated by one's desired balance between hits and false alarms for a given task, based not only on the respective consequences associated with these outcomes, but also on the probability that each alternative will occur. As a rule of thumb, Swets et al. (2000) suggest that ". . . a high prevalence of a problem or a large benefit associated with finding true cases generally argues for a lenient threshold. . ., [whereas] a low prevalence or a high cost of false alarms generally calls for a strict threshold"

(p. 84). Ultimately, specifying an optimal decision threshold is a complex undertaking with multiple considerations and will require police forces to conduct cost-benefit analyses tailored to the specific characteristics of a given situation (Bennell, 2005).

Limitations and Future Research

Generalizability of the Control Group. The simulated notes included in the Shneidman and Farberow (1957) corpus were written by individuals who, as a requisite to their participation in the study, were not only without a diagnosable mental disorder but generally of sound psychological state. It was also ensured that this group would not be overly susceptible to the trauma that could potentially result from forging a suicide note. Moreover, because the control group had little invested in the outcome of the study, participants were likely in a condition of low arousal. While the genuine author of a suicide note may indeed experience an elevated drive, it is plausible that in naturalistic settings, a simulated note writer might experience a similarly heightened degree of cognitive energy. For example, an individual who forges a suicide note to disguise a homicide is conceivably experiencing an elevated degree of arousal. As a result, the forged note encountered in "real-world" contexts may mimic certain aspects of the genuine note more closely than can be concluded by the present sample. Therefore, the control group under low drive included in the Shneidman and Farberow (1957) corpus may potentially lack generalizability.

Arousal level notwithstanding, the simulated note writer may nonetheless hold false stereotypes regarding suicide notes given that this individual has not experienced the cognitive state of the truly suicidal person. Moreover, it might be predicted that elements of the suicide note that are most subject to false stereotype would retain their discriminatory power regardless

of one's degree of arousal. Content variables arguably reflect these stereotypes more directly (e.g., expression of positive affect), potentially explaining their overall greater discriminatory power. On the other hand, structure variables are possibly more affected by a general elevation in arousal, irrespective of the quality of one's particular cognitive state (e.g., use of nouns). Given that structure variables have relatively poor discriminative power when using a control group under low arousal, one might expect that the predictive ability of these variables would decline further in naturalistic settings where forged notes are composed by individuals under high drive. It is critical for future research to address these issues by identifying and controlling for potential confounds such as quantity and quality of cognitive arousal (e.g., one could potentially obtain a sample of notes from individuals who may have experienced suicide ideations but did not carry out the act itself). In addition, it is important to elucidate the respective effects of arousal levels on both content and structure variables.

The Sample. An obvious limitation pertinent to this and other relatively recent investigations relying on the Shneidman and Farberow (1957) corpus of suicide notes (e.g., Gregory, 1999; Leenaars & Balance, 1984) relates specifically to the age of the communications. Both genuine and simulated notes in this corpus were written between 40 and 50 years ago. While the general variables considered in the analysis of the genuine note may still hold and aptly characterize the cognitive state of the suicidal person, it is unclear to what degree these predictor variables would retain their ability to discriminate between authentic and forged notes written in the present time. Namely, it is uncertain to what extent the stereotypes held in relation to suicide half a century ago are still applicable today. This concern underscores the great need to

acquire a more recent corpus of notes for research purposes.

Are Note Leavers a Unique Subset of Suicide Victims? As a general issue of concern in the suicide literature, debate exists over whether the characteristics of suicide victims who choose to leave a note are generalizable to those who do not leave a final communication. Numbers vary depending upon the source, but up to 30% of individuals reportedly pen notes prior to taking their own lives (Arbeit & Blatt, 1973; Darbonne, 1969). While Gleser and Gottschalk (1960) proposed that the psychopathology characterizing the note-leaver differs from the state of those who do not leave a note, the preponderance of evidence indicates that such is likely not the case. Beyond the drive to convey final words to survivors, research reveals no significant demographic differences between note leavers and non-leavers (Arbeit & Blatt, 1973; Kleiner, Lavell, & Tuckman, 1959; Shneidman & Farberow, 1957). While this issue may have theoretical bearing on general issues in the field of suicidology, one might question the very relevance of this concern in a practical, forensic context. In the investigation of equivocal deaths, one is likely interested in comparing the communication of a genuine note writer to that of a non-suicidal counterpart (e.g., a homicide offender)—not to a genuinely suicidal person who failed to leave a note. Therefore, future researchers may want to carefully consider the control group, perhaps by obtaining of a corpus of forged notes authored in naturalistic settings for the purpose of concealing a crime.

CONCLUSION

The aim of the present investigation was to develop and validate statistical prediction rules (SPRs) while specifying decision thresholds to assist in the discrimination of genuine and simulated suicide notes. As postulated, features of final communications related to content held, as a whole, more predictive accuracy than structure variables. However, the most reliable predictors emerging from the optimal SPR were the expression of positive affect and average sentence length. When considering these two variables alone, an AUC of .82 was yielded from ROC analysis. However, the identification of optimal predictors of suicide note authenticity is futile without determining the degree to which these must be present to render an accurate decision. The ROC approach affords the flexibility to tailor decision thresholds according to the specifications and constraints of individual situations, which will be of tremendous practical benefit to police forces in their investigation of equivocal deaths.

AUTHOR NOTE

Natalie J. Jones and Craig Bennell, Department of Psychology, Carleton University, Ottawa, Ontario, Canada.

Correspondence regarding this article should be addressed to Natalie J. Jones, Department of Psychology, Carleton University, 1125 Colonel By Drive, Ottawa, Ontario, Canada, K1S 5B6. E-mail: njones2@connect.carleton.ca

REFERENCES

Alvarez, A. (1971). *The savage God: A study of suicide.* New York: Norton.

Arbeit, S. A. & Blatt, S. J. (1973). Differentiation of simulated and genuine suicide notes. *Psychological Reports, 33,* 283–297.

Bennell, C. (2005). Improving police decision making: General principles and practical applications

of receiver operating characteristic analysis. *Applied Cognitive Psychology*, *19*, 1157–1175.

Bennell, C. & Jones, N. J. (2005). Between a ROC and a hard place: A method for linking serial crimes using an offender's modus operandi. *Journal of Investigative Psychology and Offender Profiling*, *2*, 23–41.

Bird, H., Howard, D., & Franklin, S. (2000). Why is a verb like an inanimate object? Grammatical category and semantic category deficits. *Brain and Language*, *72*, 246–309.

Black, M. & Chiat, S. (2003). Noun-verb dissociations: A multi-faceted phenomenon. *Journal of Neurolinguistics*, *16*, 231–250.

Black, S. T. (1993). Comparing genuine and simulated suicide notes: A new perspective. *Journal of Consulting and Clinical Psychology*, *61*, 699–702.

Correctional Service of Canada. (2001, March). *Inmate suicide awareness and prevention program: Facilitator's manual*. Ottawa, ON, Canada. Correctional Service of Canada National Headquarters.

Cummings, H. W. & Renshaw, S. L. (1979). SLCA-III: A metatheoretical approach to the study of language. *Human Communication Research*, *5*, 291–300.

Darbonne, A. R. (1969). Study of psychological content in the communications of suicidal individuals. *Journal of Consulting and Clinical Psychology*, *33*, 590–596.

Darkes, J., Otto, R. K., Poythress, N., et al., (1993). APA's expert panel in the congressional review of the USS Iowa incident. *American Psychologist*, *48*, 8–15.

Edelman, A. M. & Renshaw, S. L. (1982). Genuine versus simulated suicide notes: An issue revisited through discourse analysis. *Suicide and Life-Threatening Behavior*, *12*, 103–113.

Gottschalk, L. A. & Gleser, G. C. (1960). An analysis of the verbal content of suicide notes. *British Journal of Medical Psychology*, *33*, 195–204.

Gregory, A. (1999). The decision to die: The psychology of the suicide note. In D. Canter & L. Alison (Eds.), *Interviewing and deception* (pp. 127–156). Aldershot, UK: Ashgate.

Hayiai-Thomas, M. E., Bishop, V. M., & Plunkett, K. (2004). Simulating SLI: General cognitive processing can produce a specific linguistic profile. *Journal of Speech, Language, and Hearing Research*, *47*, 1–27.

Joiner, T. E. & Wagner, K. D. (1995). Attribution style and depression in children and adolescents: A meta-analytic review. *Clinical Psychology Review*, *15*, 777–798.

Kearns, M. & Ron, D. (1999). Algorithmic stability and sanity-check bounds for leave-one-out cross-validation. *Neural Computation*, *11*, 1427–1453.

Kleiner, R. J., Lavell, M., & Tuckman, J. (1959). Emotional content of suicide notes. *American Journal of Psychiatry*, *116*, 59–63.

Leenaars, A. A. (1988). *Suicide notes: Predictive clues and patterns*. New York: Human Sciences Press.

Leenaars, A. A. & Balance, W. D. G. (1984). A logical empirical approach to study of suicide notes. *Canadian Journal of Behavioral Science*, *16*, 249–256.

Lester, D. (2004). *Thinking about suicide: Perspectives on suicide*. Hauppauge, NY: Nova.

Lester, D. & Leenaars, A. A. (1988). The moral justification of suicide in suicide notes. *Psychological Reports*, *63*, 106.

McLister, B. & Leenaars, A. A. (1988). An empirical investigation of the latent content of suicide notes. *Psychological Reports*, *63*, 238.

Meehl, P. (1973). Why I do not attend case conferences. In P. E. Meehl (Ed.), *Psychodiagnosis: Selected papers* (pp. 225–302). Minneapolis, MN: University of Minnesota Press.

Montgomery, J. W. (2000). Relation of working memory to offline and online time sentence processing in children with specific language impairments. *Applied Psycholinguistics*, *32*, 117–148.

Ogilvie, D. M., Stone, P. J., & Shneidman, E. S. (1966). Some characteristics of genuine vs. simulated suicide notes. In D. C. Dunphy, D. M. Ogilvie, M. S. Smith, & P. J. Stone (Eds.), *The general inquirer: A computer approach to content analysis* (pp. 527–535). Cambridge, MA: MIT Press.

Osgood, C. E. (1960). The cross-cultural generality of visual-verbal synesthetic tendencies. *Behavioral Science*, *5*, 146–169.

Osgood, C. E. & Walker, E. G. (1959). Motivation and language behavior: A content analysis of suicide notes. *Journal of Abnormal Psychology*, *59*, 58–67.

Schweizer, E., Dever, A., & Clary, C. (1988). Suicide upon recovery from depression: A clinical note. *Journal of Nervous & Mental Disease*, *176*, 633–636.

Seligman, M. E. (1975). *Helplessness*. San Francisco: Freeman.

Shneidman, E. S. (1980). *Voices of death*. New York: Harper & Row.

Shneidman, E. S. & Farberow, N. L. (1957). *Clues to suicide*. New York: McGraw-Hill.

Swets, J. A. (1988). Measuring the accuracy of diagnostic systems. *Science*, *240*, 1285–1293.

Swets, J. A. (1992). The science of choosing the right decision threshold in high-stakes diagnostics. *American Psychologist, 47*, 522–532.

Swets, J. A. (1996). *Signal detection theory and ROC analysis in psychology and diagnostics: Collected papers.* Mahwah, NJ: Lawrence Erlbaum.

Swets, J. A., Dawes, R. M., & Monahan, J. (2000, October). Better decisions through science. *Scientific American*, 82–87.

APPENDIX A

Suicide Note Coding Dictionary

Structure variables:.
1. Percentage of nouns: % of nouns present in the note (i.e., people, places, things).
2. Percentage of verbs: % of verbs present in the note (e.g., actions, words).
3. Average sentence length: average number of words per sentence.
4. Percentage of cognitive process verbs: active verbs that indicate cognitive/ mental processes rather than physical actions (e.g., feel, want, forgive, regret, thought, etc.).

Content variables:
1. Total number of words: total number of words in the note.
2. Positive affect: presence (i.e., frequency) of words such as love, loving(ly), dear(ly), dearest, darling, beloved, bless, indicating the expression of positive emotion.
3. Instructions: presence (i.e., frequency) of instructions to survivors, such as requests for particular burial arrangements, final wishes for family or friends, or the designation of the receiver of items in a will.
4. Explanation: indication of potential reason or explanation for ensuing suicide.
5. Locus of control: indication of whether the person had an internal (believes that his/her behavior/circumstances are guided by personal decision and efforts) or external (believes that his/her behavior/circumstances are guided by fate, luck or other external circumstances) locus of control.