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Human-computer relationships: Interactions and attitudes*

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An exploratory study of human-computer relationships is reported which utilizes gaming techniques. Attention is given to the conceptualization and measurement of human reactions and interactions; an attempt is made to investigate differentials between human-human and human-computer relationships.

Computer scientists and computer critics alike have become increasingly interested in various implications of "relationships" between people and computers. However, neither technical discussions of "man-machine systems" nor polemics against the "automated society" have significantly clarified the nature of "human-computer relationships" as sociological phenomena. Little systematic attention has been given to the conceptualization and measurement of human reactions and interactions toward computers. This paper will report an attempt to deal with these issues in an exploratory study of human-computer relationships.

Unless the term "human-computer relationships" is to be taken as little more than a metaphor, the nature of relationships between people and machines must be clearly specified. "Interpersonal relationships" can provide a useful conceptual reference point for analyses of "human-computer relationships." In an interpersonal sense, the concept "relationship" implies at least some notion of interaction between people. This observation directs attention to the possibilities of investigating interactional dimensions of human-computer relationships.

Interaction between humans and computers can be operationally approximated with time-sharing, conversational computer systems. A conversational computer can be programmed to present the appearance of "responsiveness" to human inputs in sequential dialogues. Although complex dialogues in natural languages can be programmed in the conversational mode, exploratory research on human-computer relationships might best begin with simpler and more structured interactional paradigms. Certain gaming techniques can be utilized for this purpose. In the present study, the familiar prisoner's dilemma (PD) game provided the vehicle for our exploratory research on the interactional implications of human-computer relationships. In an experimental setting, Ss were interfaced by Teletype to a PDP-8 conversational computer system. Although playing the PD game against a standardized program, Ss were led to believe that they played some games against a human opponent and other games against a computer opponent. We used human-human interaction for a comparative baseline for analysis of human-computer interaction.

A second problem of human-computer relationships considered in the present study involved attitudes toward computers. In interpersonal interaction, attitudes toward other persons emerge and are grounded in actual encounters with others. Such social attitudes represent a significant aspect of interpersonal relationships. The attitudinal component of human-computer relationships should also be studied in its relationship to actual human-computer encounters. A previous study of attitudes toward computers found the computer to be an abstract and ambiguous stimulus which "functions to a certain degree as a Rorschach blot or TAT card [Lee, 1970, p. 59]." Assuming that the respondents in Lee's study had very little direct contact or experience with a computer, it is little wonder that their attitudes in this area were vague and poorly articulated. We attempted to measure attitudes toward the computer in our study in the context of direct interactional experience with the attitude stimulus. At the conclusion of the PD gaming experiment, Ss were asked to fill out a number of scales and indices designed to tap their attitudinal reactions toward their computer opponent. In this way, we

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Table 1
Mean #1 (Cooperative) Choices by Condition and by Trial Blocks

	Opponent Sequence			
	Human-Computer		Computer-Human	
Opponent Strategy	1st 30	2nd 30	1st 30	2nd 30
10-10	12.25	6.25	9.50	9.50
50-50	13.50	9.50	7.25	3.50
10-90	6.25	14.00	6.50	11.75

Note–N = 4 in each condition.

attempted to operationalize attitudes toward the computer in a setting where these attitudes were experimentally relevant.

METHODOLOGY

A pool of male volunteer Ss was recruited from undergraduate sociology classes at the University of Minnesota during the 1972 Summer Session. When an S arrived as scheduled at the experimental laboratory, he was taken to an experimental room containing a Teletype terminal and given a copy of instructions for the gaming situation. Ss were led to believe that another S, who would be playing the game with him, was in a similar room elsewhere in the laboratory. Ss were told that they would first play four practice games. Following the practice games, two series of 30 PD games would be played. Half of the Ss were informed that they would play the first 30 games with the other human and the second 30 games with the computer itself. This order of opponents was reversed for the other half of the Ss. This counterbalanced manipulation of opponent sequence was introduced as a partial control for possible learning effects across blocks of trials in the gaming situation.

Ss were given a standard PD gaming matrix with the following payoffs:

		Player B	
		1	2
Player A	1	+5,+5	−10,+10
	2	+10,−10	−5,−5

All Ss were assigned the position of Player B throughout the experiment. Ss were told that each five points they won in the games would be worth 1 cent.

A telephone-coupled PDP-8 computer was programmed to administer the experiment, simulate the choices of the opponents, and collect data on the Ss' choices in the games. The simulated strategies of the opponents represented another manipulation in the experiment. For a third of the Ss (10-10 condition), both opponents were programmed to be extremely "uncooperative." In this opponent strategy condition, only 10% of the opponent choices in each series of 30 trials were #1 (the "cooperative" PD choice). A second third of the Ss were confronted by opponents in both series of trials which chose #1 on 50% of the trials (50-50 condition). The final third of the Ss played an uncooperative opponent for the first series of 30 trials (10% #1 choices) and an extremely cooperative opponent for the second series of trials (90% #1 choices). This was the 10-90 opponent strategy condition.

The experiment followed a 3 by 2 by 2 design, with repeated measures for learning effects by blocks of 30 trials nested within levels of opponent strategy and opponent sequence (see Table 1). Four Ss were randomly assigned to each of the six cells, yielding a total N = 24.

At the completion of the two series of PD game trials, Ss were given a postexperimental questionnaire. Open-ended questions dealt with Ss' impressions of their two opponents. Parallel series of Likert-type items asked Ss to rate their impressions of their human opponent and their computer opponent on several dimensions. As a further comparative measure of attitudes toward the two opponents, Ss rated each on a series of 27 semantic differential items. The questionnaire ended with several items on suspicions regarding the experiment. After completing the questionnaire, Ss were informed of the true nature and purpose of the experiment. They were sworn to secrecy and paid $2 for their participation.

Since our study was largely exploratory in purpose, no formal hypotheses were proposed. We did have a tentative expectation that Ss would tend to feel more threatened or defensive when playing against the computer than against the human. As indicated earlier, data on choices by Ss during the PD games allowed us to investigate interactional responses to the computer and the postexperimental questionnaire provided data on attitudinal responses by the Ss.

RESULTS

Choices

To provide an indication of Ss' interactional responses to the opponents, analyses were performed on the number of #1 choices played by S in each block of 30 game trials. Table 1 presents the means for cooperative responses by the Ss within conditions and trial blocks. Several trends appear in these data. Looking only at the opponent strategy conditions where the responses of the opponents were constant in both blocks of trials (10-10 and 50-50), a trend of decreasing cooperativeness for the Ss can be noted from the first block of 30 trials to the second block. Decreased cooperativeness over time is a typical finding in reiterated PD games (Shure & Meeker, 1968). This trend is reversed in responses to the differential strategies of opponents in the 10-90 opponent strategy condition. In this condition only, Ss become more cooperative in their own play as their second opponent increases in cooperativeness from the first opponent. There is a tendency in the 10-10 and 50-50 conditions for Ss to begin at a higher level of cooperativeness in the first block of trials when their opponent is human.

These data were analyzed by three-way ANOVA with repeated measures on one factor (Winer, 1971;

Table 2
Analysis of Variance Table for #1 (Cooperative) Choices by Condition and by Trial Blocks

Source	df	SS	MS	F
Between Ss				
A (Strategy)	2	12.54	6.27	
B (Sequence)	1	63.02	63.02	1.55
A by B	2	91.29	45.65	1.12
Error (Between)	18	729.62	40.53	
Within Ss				
C (Blocks)	1	.19	.19	
A by C	2	264.87	132.44	3.98*
B by C	1	4.69	4.69	
A by B by C	2	37.62	18.81	
Error (Within)	18	598.12	33.23	

$*p < .05$

Table 3
Mean Likert-Type Item Scores for Human and for Computer and Difference Scores Within Items

Item	Human	Computer	Diff
Degree to which winning was important to you (1 = ext important, 6 = ext unimportant)	2.958	2.792	.167
Extent to which your own choices were taken into account by opponent (1 = opponent based all decisions upon your choices, 5 = opponent ignored your choices)	2.917	3.583	−.667*
Degree of cooperativeness or uncooperativeness of opponent (1 = ext cooperative, 6 = ext uncooperative)	3.833	3.958	−.125
Degree of predictability or unpredictability of opponent (1 = ext predictable, 6 = ext unpredictable)	2.417	2.833	−.417
Personal feeling of comfort or discomfort when playing (1 = ext comfortable, 6 = ext uncomfortable	2.708	2.750	−.042
Degree of competitiveness or noncompetitiveness of your own playing strategy (1 = ext competitive, 6 = ext noncompetitive)	3.000	2.833	.167
Personal feelings of satisfaction or frustration when playing (1 = ext satisfied, 6 = ext frustrated)	3.250	3.333	−.083

*$p < .10$

p. 559-571). The results of this analysis are presented in Table 2. The only significant effect in the ANOVA is a Strategy by Blocks interaction. This reflects the difference between the 10-10 and 50-50 conditions vs the 10-90 condition in levels of cooperativeness across the first and second blocks of trials.

Likert-Type Items

The postexperimental questionnaire included 14 Likert-type items presented as 7 item pairs. Ss were asked to rate their reactions to each of their opponents in the gaming situation. In each pair of items, Ss rated their "human" opponent first and their "computer" opponent second. Table 3 presents the mean item scores for each of the item pairs and the difference in scores for each pair (human-computer) for all Ss (N = 24).

The mean scale ratings for both the human and the computer are consistently near the midpoint of the Likert scales. Ss apparently did not form extreme reactions to either opponent in the gaming situation. Differences between the mean scale scores for the two opponents are generally small. In only one case does the difference between mean scores reach borderline significance. Ss showed a tendency to feel that the human opponent was more responsive to the strategy of S than was the computer opponent. This finding suggests that Ss felt they were playing against a preprogrammed opponent when playing with the computer.

Semantic Differential Items

As a means for obtaining somewhat less structured attitudes toward the two opponents, Ss also completed two series of 27 semantic differential items on the postexperimental questionnaire. Ss rated the human opponent first on all 27 items and then rated the computer opponent on the same items. Five rating points were given along each bipolar scale. Table 4 presents the means for all Ss on each scale by opponent and the differences between opponents within items.

Several significant and near-significant differences between mean ratings of the two opponents emerge in these data. However, caution must be exercised in attributing substantive significance to a few statistically significant difference scores in a series of scores obtained from the same Ss. The computer opponent was perceived by Ss to be more depersonalizing and more powerful than was the human opponent. These

Table 4
Mean Semantic Differential Scores for Human and for Computer and Difference Scores Within Items

Item	Human	Computer	Diff
Simple-Complex	2.708	3.208	−.500
Depersonalizing-Personalizing	3.000	2.083	.917†
Insensitive-Sensitive	2.875	2.167	.708*
Organized-Disorganized	2.708	2.00	.708*
Hindering-Helping	2.667	2.750	−.083
Competitive-Cooperative	1.833	2.375	−.542
Skillful-Unskillful	3.292	2.500	.792*
Rational-Impulsive	2.625	2.125	.500
Cautious-Daring	2.458	2.792	−.333
Intelligent-Stupid	2.667	2.583	.083
Systematic-Random	2.292	2.208	.083
Reassuring-Frightening	2.708	2.625	.083
Flexible-Rigid	3.458	3.167	.292
Disgusting-Pleasing	3.042	3.167	−.125
Reliable-Unreliable	2.333	2.417	−.083
Weak-Powerful	2.833	3.375	−.542†
Threatening-Nonthreatening	3.250	3.250	.000
Compromising-Uncompromising	3.000	3.500	−.500
Interesting-Dull	3.042	2.375	.667*
Trustworthy-Untrustworthy	2.833	3.000	−.167
Effective-Ineffective	2.708	3.083	.375
Emotional-Unemotional	3.458	3.791	−.333
Humanizing-Dehumanizing	3.083	3.541	−.458
Unpredictable-Predictable	3.958	3.500	.458*
Aggressive-Submissive	2.750	2.792	−.042
Personal-Impersonal	3.167	3.667	−.500*

Note *Extreme rating on first adjective in each item pair is scored "1" and extreme rating on second adjective is scored "5."*
*$p < .10$, two-tailed t †$p < .05$, two-tailed t

differences are evocative of popular images of the computer in relation to humans. Six other differences between item scores for the two opponents attain borderline significance. As compared with the human opponent, the computer opponent tended to be perceived as more insensitive, organized, skillful, interesting, unpredictable, and impersonal. Several of these latter adjectives show some semantic relationship to the depersonalizing and powerful images of the computer which attained significance.

DISCUSSION

Our attempt to describe differentials between "human-human" relationships and "human-computer" relationships was not as encouraging as we had hoped. Our assessment of interactional implications of human-computer relationships in the PD game suggests one basic conclusion. Traditional determinants of gaming behavior, i.e., opponent strategy and learning effects, were more influential than was the nature of the opponent confronting the Ss. Close scrutiny of data on choices by Ss hints at lower cooperativeness toward the computer than toward the human, but these tendencies were far from definitive in the present study. Still, our methodology presents at least one empirical strategy for the examination of interaction in human-computer relationships. Future studies may better capitalize on this methodological approach than was possible in this exploratory effort.

Our questionnaire data on attitudes toward the two opponents also failed to reflect a great deal of discrimination between "human-human" relationships and "human-computer" relationships. The findings from the semantic differential items were more suggestive than those from the Likert-type items. Significant differences between human and computer in the semantic differential data were indicative of feelings of depersonalization in human-computer relationships and of perceptions of the power of the computer. These findings point toward promising areas for future empirical studies. Again, from a methodological standpoint, the use of interpersonal relationships as a baseline for understanding attitudes toward human-computer relationships seems a valuable strategy. Experience with human-computer interaction in the gaming situation also provided an immediate referent for attitudinal judgments.

Although the open-ended impressions of Ss toward their two opponents have not been formally analyzed here, data from these unstructured questions suggest some interesting directions for further research. Almost half of the Ss indicated in some way that it was more difficult to communicate or come to an agreement with the computer than with the human. These responses suggest the difficulty or impossibility of "taking-the-role-of-the-other" in human-computer interaction. Interpersonal interaction is premised on the possibility of role-taking, where parties to an interaction mutually anticipate the responses of others, attribute consensual meaning to those responses and arrive at a common definition of the situation (Shibutani, 1961). Confronted with interaction with the computer, which has no "social self" and cannot share a meaningful definition of the situation, our Ss seemed to perceive that a basic assumption of the possibility of role-taking had broken down. Further investigation of this central problem of symbolic interaction using methodologies similar to ours may shed light on interpersonal relationships as well as human-computer relationships.

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