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Résumé

Y a-t-il quelque chose qui nous échappe? La poursuite de recherches sur l'attrition

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L'attrition, ou la perte de participants au cours d'une étude, peut mettre en péril, de façon significative, l'intégrité d'une étude longitudinale et l'élaboration de théories issues de la recherche. Bien que l'attrition fasse récemment l'objet d'un intérêt renouvelé, ce phénomène est peu signalé et peu étudié, malgré le fait qu'il peut potentiellement gauchir les résultats d'une étude. La validité interne et externe, la fiabilité et la validité statistique subissent tous les effets de l'ampleur restreinte et, fort probablement, de la nature non aléatoire d'un échantillonnage. L'élaboration d'une théorie portant sur l'attrition permettra aux chercheurs d'élaborer des stratégies d'échantillonnage qui amélioreront la qualité des données obtenues dans les études longitudinales. L'auteure propose et décrit un modèle théorique écologique relativement à la participation dans le cadre de recherches.

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Are We Missing Anything? Pursuing Research on Attrition

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Attrition, or loss of participants over the course of a study, presents a significant threat to the integrity of a longitudinal research study and theory development resulting from the study. Although there has been a recent resurgence of interest in attrition, it is an underreported and understudied phenomenon despite its potential to introduce bias. Internal and external validity, reliability, and statistical validity are all impacted by a small sample and, most likely, a non-randomness in the study sample. Development of a theory of attrition will assist researchers in development of sampling strategies that will enhance the quality of their data in longitudinal designs. An ecological theoretical model of research participation is proposed and described.

Keywords: research participants, patient selection, research-participant relations, sample size

Nurses are increasingly being encouraged to consider longitudinal research designs as an effective way to study human experience over time (Russell & Gregory, 2000). Longitudinal research, whether quantitative or qualitative, provides an opportunity to study the nature and results of change as humans move through developmental and transitional experiences. The study of patterns and change over time is of particular relevance for nurses because of the diversity of nursing experience; this includes following the development of infants and children within families, exploring the trajectories of chronic illnesses, and identifying healthy mechanisms of ageing (Gottlieb & Feeley, 1999).

There are many advantages to choosing a longitudinal research design. These include the ability to describe patterns over time, establish the direction and magnitude of causal relationships, and describe and analyze dynamic change processes. Longitudinal designs are useful for a range of applications, including intervention, prevention, developmental, and evaluation studies. Longitudinal designs, by their very nature, also present significant challenges. They are complex and require significant commitment in terms of time, resources, and data management. Many researchers agree that participant attrition is one of the greatest disadvantages of longitudinal research. Even with the most sophisticated designs, participant attrition is considered to be a hindrance to research fidelity (Gross & Fogg, 2001; Mason, 1999).

We may stand to learn just as much from those who do not complete a study as from those who do. In this article I review the latest research on attrition, from the perspective of maintaining study integrity and consequently developing knowledge. I argue the position that attrition needs to receive more attention in research studies from theoretical, design, analytical, and reporting perspectives. I propose a theoretical model of attrition as a way of organizing considerations of barriers to research participation and strategies to maximize participation. Throughout, I will provide examples of longitudinal studies related to health, in particular intervention studies, to illustrate the points of discussion.

Definition, Prevalence, and Effects of Attrition in Longitudinal Studies

Within the literature, there are inconsistent definitions of attrition, resulting in a range of reported variability in attrition rates. Broadly, attrition can be defined as the failure of subjects to complete their participation in a study following enrolment (Given, Keilman, Collins, & Given, 1990). Participants may be considered non-completers if they do not complete the treatment protocol or if they miss any data-collection point during the study. Attrition is generally seen towards the end of a study, but sometimes it is seen throughout the study, with cumulative loss occurring with successive data-collection sweeps.

Reported attrition rates range from 5 to 70%. Although there is no absolute standard for acceptable attrition levels, bias is generally a concern if the rate exceeds 20% (Polit & Hungler, 1995). Boyle, Offord, Racine, and Catlin (1991) reviewed studies on childhood psychiatric disorders and found a general loss of 20 to 30% of participants from the first follow-up. In studies of adolescent substance use, losses of 20 to 55% are common. Furthermore, many studies do not even report on attrition. Goodman and Blum (1996) studied the organizational literature and found attrition rates ranging from 0 to 88%, with a median of 27% — and 44% of the studies did not mention attrition at all. Sifers, Puddy, Warren, and Roberts (2002) examined 260 research articles published in child psychology and child development journals and found that attrition rates were significantly underreported. The recent nursing research literature includes no similar studies. However, many nursing research journals follow the guidelines of the American Psychological Association, and since the fifth (and latest) edition of the APA's *Publication Manual* recommends the reporting of attrition information, we can expect to see increased reporting of attrition.

Reporting requirements for researchers have been developed and continue to be refined, particularly for those involved in large clinical

trials. For example, the CONSORT (Consolidated Standards of Reporting Trials) consensus statement on recommendations for improving reporting on the quality of randomized trials, developed by an international group of clinical trialists, statisticians, epidemiologists, and biomedical editors, includes attrition (called participant flow) as an item to report (Moher, Schultz, & Altman, 2001).

With the increasing complexity and costs of coordinating and conducting large longitudinal research studies, it is timely that participant attrition is the subject of renewed attention. Attrition has the potential to introduce significant bias into a study and represents a threat to internal, external, and statistical validity. Differential attrition may lead to selection bias, which is a threat to internal validity in comparative studies. External validity is also affected by sample bias, as completers may differ from noncompleters on various characteristics. Consequently, the sample may not be truly representative and extrapolation beyond the study may be impossible. Significant attrition may also result in a reduced sample size, leading to low statistical power.

Typical Management of Attrition

Farrington (1991) finds it ironic that more books and articles have been written about technical problems such as research design and statistical analysis than about practical problems such as attrition that may be more difficult to resolve and more consequential for the validity of conclusions. Researchers may see attrition as a practical rather than theoretical problem, and therefore accord it less prestige (Murphy, 1990).

Rather than anticipating and minimizing attrition, researchers have historically accepted it as part of the normal course of a longitudinal study and then focused on detecting and compensating for it. The method chosen to deal with attrition usually depends on the pattern of data that are missing (Kneipp & McIntosh, 2001). Additional statistical analyses are then incorporated into the study design to compensate for missing data and to increase confidence in the results.

The estimation of missing data has become a legitimate research subfield in and of itself. The increasing sophistication of statistical computer programs has advanced the management of missing data. Briefly, a few decades ago there were few methods available to manage missing data. The classic approach was to "get rid of" the data by doing listwise or pairwise deletions, or by just not using the data set (Patrician, 2002). Newer methods include single and multiple approaches to imputation. The most frequently used method in longitudinal studies is multiple imputation, which allows the researcher to use the existing data to impute values generated from the analysis of the data set. Multiple impu-

tation approximates the "real" value while preserving the uncertainty of the missing values (Patrician).

Statistical procedures for missing data continue to improve. Schafer and Graham (2002) suggest that newer methods such as multiple imputation, latent variable programs, and Full Information Maximum Likelihood are preferable to some of the older procedures. Most approaches to the handling of missing data are based on the assumption that data are missing at random. For data that are not missing at random, there is currently no reliable method of correction. However, Schafer and Graham report on upcoming statistical advances that will make it possible for researchers to deal with missing data that are not missing at random. Harris (1998) identifies a need for research to continue trying to develop appropriate analyses for non-random data; at present, a "study plagued by selective attrition cannot be rescued" (Hirdes & Brown, 1994, p. 349). Finally, an alternative to simply dealing with attrition is to plan for it. Graham, Taylor, and Cumsille (2001) propose that researchers consider building planned "missingness" directly into longitudinal studies. Researchers must still make every effort to maintain high participation rates and to minimize the effects of selective attrition.

The focus of the attrition research literature lies within the context of quantitative studies. Longitudinal qualitative research is considered a developing methodology and, other than retrospective biographical or life history methods, there are a limited number of published longitudinal qualitative research studies (Thomson & Holland, 2003). Despite the fact that this is an emerging method, attrition has already been identified as a key threat to the integrity of a study. Thomson, Plumridge, and Holland (2003) identify participant retention as the "most obvious imperative" of this method. Accordingly, they express concern that the method is developing without a relevant literature to inform and debate the epistemological and practical decisions made during development and conduct of the studies. Although the matter is beyond the scope of this article, there is a need for theoretical discussion of the appropriateness and application of the concept of attrition (as understood within quantitative methodologies) to the qualitative paradigm.

Variation in Attrition

Goodman and Blum (1996) suggest that attrition is affected by three types of variables: participant, researcher, and contextual. Participant variables, which usually include demographics, are often studied and reported. Some researchers, however, have found that emotional, psychosocial, and contextual factors are among the better predictors of attrition. For instance, non-completers may feel that their health has

improved and therefore they do not need follow-up. In a study of child health, Boyle et al. (1991) found that their largest sample loss occurred among children with psychiatric disorders living in adverse family situations. In her study of an adolescent parenting program in a neonatal intensive care unit, Letourneau (2001) noted that mothers who had partner difficulties and who visited their infants less frequently were more likely to miss follow-up visits.

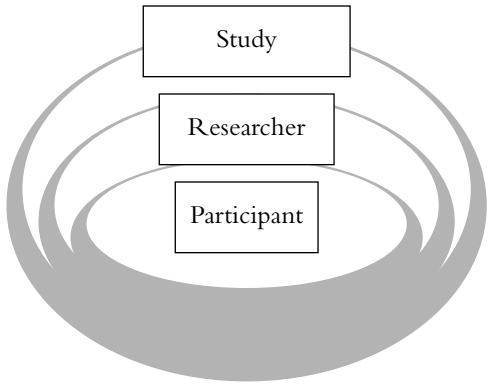
So far little direction has been provided for understanding why participants leave studies or clients leave treatment programs. Many studies of attrition are simply byproducts of studies designed to answer other research questions (Given, Given, & Coyle, 1985). Harris (1998) suggests that the study of attrition has shown an over-reliance on simple and atheoretical analyses, which highlights the absence of thoughtful, well-constructed, well-conceived theories of the underlying causes of attrition. She treats the study of attrition as a legitimate research sub-field. Flick (1988) presents an intriguing perspective on attrition. She suggests that rather than approaching it as a nuisance, researchers should treat it as a legitimate part of the phenomenon of interest and as an outcome variable.

The causes or correlates of attrition itself may be theoretically important and could be routinely built in as attributes that are measured and tested. In the quest to learn how factors, both singly and in combination, lead to attrition, a set of norms may evolve that will lead to the development of a theory of attrition that researchers can use in designing strategies to minimize attrition (Given et al., 1985). In the next section I will present a theoretical model generated from the literature on attrition. It reflects an initial step in the development of a theory of attrition.

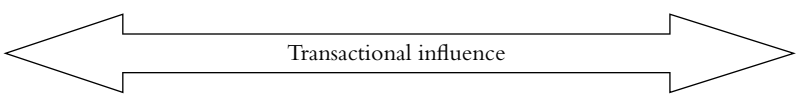
An Ecological Theory of Research Participation

Goodman and Blum's (1996) broad consideration of attrition, particularly because of the inclusion of context, invokes the notion of ecological developmental theory. Similarly, Given et al.'s (1985) call for the development of a conceptual model of attrition that addresses the interaction of multiple variables, including the interaction between intervener and participant, supports an ecological approach. Ecological perspectives stress the importance of interaction between individuals and their environment. An ecological perspective of research participation is proposed as a model within which to design and study multilevel retention strategies. This model consists of a series of nested layers that represent various influences on an individual's ability and desire to participate in a study (Figure 1). The factors within each layer are drawn from longitudinal studies of attrition. A large number of correlates of retention were iden-

Figure 1 ***An Ecological Theory of Attrition***



Participant	**Researcher**	**Study**	**Environment**
Motivation	Motivation	Complexity of design	Philosophical
Values	Personal meaning	Perspective on subject	Disciplinary
Beliefs	Values	Participation	Organizational
Personal meaning	Beliefs	Perceived importance	Practice
Specific population characteristics	Communication style		Political
	Respect for participants		Geographical
			Funding



PARTICIPANT-CENTRED

tified in these studies, including characteristics specific to the participants, the researchers, the individual studies, and the environment (philosophical, disciplinary, organizational practice, political, funding) in which the study took place (Harris, 1998).

In addition to the core layers, two key influences affect all levels of attrition. The first is transactional, reciprocal, and interactive — that is, each layer has a direct influence on the action of the system immediately adjacent to it and an indirect transactional influence, through that adjacent system, on the actions of all other systems (Drummond, 2004). The

second relates to the participant-centred approach to research, which is considered necessary. A theory of attrition that is relevant to the current research environment is one that recognizes and capitalizes on the increasing activism of people who are potential research participants (Gross & Fogg, 2001; Mitchell, 2001). Researchers are encouraged to move from a paternalistic relationship with participants to a relationship that is participant-centred (Gross & Fogg).

The ecological theory of research participation would give investigators the opportunity to address situation-specific barriers and develop strategies specific to the study and the population of interest in order to maximize participation. It would serve to guide the assessment of why participants do or do not remain in a study and what environmental or community factors might interact with the participant, researcher, or study to affect attrition.

In addition to considering recruitment and retention issues, which focus on timing and action, an ecological approach would incorporate meaning and interaction, which reflect the key influences of transaction and centring on the participant within the research relationship. Gross and Fogg (2001) suggest that the goal of such an approach is to reach the highest level of scientific inference while still acting in the best interests of the participants.

Two cautions are necessary with regard to this process of reframing attrition. First, the researcher must take care to maintain a balance between individualizing and contextualizing retention strategies and to ensure that retention strategies do not affect the dependent variable or the study outcome (Good & Schuler, 1997). Second, the potential exists for the misuse of attrition theories. For example, clinical trial recruiters may have determined, through research, which characteristics are associated with retention and completion and therefore sample for persons who possess those characteristics. Such characteristics (e.g., ability to adhere to a complex treatment protocol or a long-term assessment) may not be prevalent in vulnerable populations, which will result in the underrepresentation of these populations in the study.

Using the Ecological Theory to Design Strategies for Managing Attrition

In this section, strategies for managing attrition related to each core layer (Table 1) will be described. In addition to strategies specific to each layer, the transactional nature of the model requires examination of the interface between layers. For example, a complex treatment protocol may not be appropriate for a participant population with few life resources, particularly if delivered by researchers with time restrictions.

Table 1 *Strategies for Reducing Attrition*

Level of Ecological Model	Strategies
Participant	• Provide clear definition of sampling population — documentation on refusals with rationale, use of cohort tree for tracking • Form participant advisory group • Ensure that research-related activities are timely, convenient, and accessible • Provide material recognition that matches the characteristics and needs of the population
Researcher	• Provide favourable presentation of study — discuss its social usefulness • Establish meaningful networks with agencies that may be points of contact for potential participants • Plan for adequate preparation and supervision of data collectors — communications skills, development of study training/protocol manual, opportunity to practise data-collection prior to start of study • Develop participant bond with the study — assure participants regarding the credibility of the study; develop tools such as logo, theme, newsletter to create a project identity • Plan for continuity of participant contact with data collectors — clear expectations, pre-contact strategies, opportunities to ask questions, newsletter, prompt response to issues, sufficient time to respond to participants' needs • Collaborative effort between researchers and participants; assure participants regarding their ability to contribute to the study — remind them that they are the experts on the research topic, give feedback to validate their contributions • Express appreciation — thank you cards, recognition of birthdays, gifts or remuneration
Study	• Detail recruitment methods specific to characteristics of targeted population • Consider individualization of retention strategies within mandate of study • Develop informed-consent procedures that provide participants with realistic expectations of the study • Develop detailed tracking techniques and database • Respect the participant's time — flexibility in scheduling data collection, expressions of appreciation, provide babysitting and transportation • Ensure that measurement strategies are viable and are not onerous for participants • Ensure that hard-to-reach populations have an equal opportunity to participate in the study

Environment	• Assess environmental factors such as transportation and community perception of research • Strengthen outreach retention methods • Monitor external influences such as policy, politics, and media representation on issues related to population of interest and research question
Sources: Given et al. (1990); Good & Schuler (1997); Lauby et al. (1996); Mason (1999); Pruitt & Privette (2001); Vander Stoep (1999).	

Strategies Related to the Participant

As previously described, retention strategies related to the participant tend to focus on demographics. Factors such as meaning, values, beliefs, and motivation have been identified as impacting recruitment and retention but are often overlooked. Given et al. (1985), in their study of attrition in an intervention program for hypertension, found that participants' beliefs and perceptions and the group to which they were assigned were better predictors of non-completion than demographic factors such as age, illness status, or socio-economic status. Perceptual variables such as individuals' understanding of their illness or participation in an intervention that provided contact and social support achieved more significance within logistical regression than demographic factors. Gross, Julion, and Fogg (2001), in their study of factors related to recruitment and retention in a prevention trial, found that goodness of fit between the personal goals of the participant and the goals of the study was highly correlated with continued participation in the study.

Retention and follow-up strategies may need to be tailored to characteristics of the population under study. An example of a research study that is not sensitive to participant characteristics is one in which the subjects are paid an honorarium but are expected to travel to a university laboratory with little regard to whether they have access to a vehicle or are mobile enough to travel. This is an important consideration for nursing research with populations who are physically, emotionally, or socially vulnerable. For example, Lauby et al. (1996) examined an intervention for HIV education at two clinic sites in Philadelphia. Although the demographics were similar at the two sites, the dropout rate was higher at the clinic situated in the more transient neighbourhood. The researchers determined that the most effective reminder strategy for this population was for outreach workers to look for the clients on the street. Similarly, Barnard, Magyary, Booth, and Eyres (1987), in a study with mothers and children at high social risk, offered tangible supports such as reimbursement, transportation, and babysitting costs in recognition of the mothers' participation in the study. Given et al. (1990), in their study

with family caregivers of elders with physical impairments, restricted their attrition rate to 4.5% by adopting several strategies: preparation of data collectors, participant bonding with the study, communication with the participants, continuity of participant contact with the data collectors, respect for participants' time, collaboration between the participant and the observer, and expressions of appreciation. These strategies focus not only on the participant, but also on the interface between participant and researcher.

Strategies Related to the Researcher

The needs of researchers have historically superseded those of participants (Gross & Fogg, 2001). Research is designed by and for scientists, and participants are expected to "respond like subjects." According to Chadwick (2001), research protocols have rarely been developed with any type of community input. However, elements of participatory action research are increasingly being incorporated into longitudinal studies. Strategies in which all participants are actively engaged in the research process are grounded in notions of participation and practicality (Brown, 2001). For example, the establishment of a participant advisory group provides an opportunity for participants and researchers to jointly design a study and protocol that are relevant and appropriate for the interests of both groups of stakeholders. As an indicator of the increased emphasis being placed on participatory approaches, the recent Blueprint for Health Research and Action (Canadian Institutes of Health Research, 2003) identifies public engagement as a key cross-institute theme for future research.

The concepts of privacy and confidentiality have acted not just as protective measures but also as barriers between participant and researcher. Some research, by virtue of its design, requires a formal separation between participant and researcher (Medical Research Council of Canada, 2003). Horsfall (1995) argues that this separation is reductive and ignores the power relations between participant and researcher. Researchers, then, need to focus on incorporating strategic elements into their retention plans, elements that foster engagement with the study, throughout its entire course and with all members of the research team. Olson and Toth (1999), in a study with mothers with addiction, found that some of the procedures they used to sustain the participation of the study population, such as bonding and follow-up, had the potential to engage chemically dependent women. This experience laid the groundwork for development of the Zero to Three program, a paraprofessional advocacy program that has had measurable success in helping high-risk drug-using mothers.

Depending on the population under study, philosophical or social differences between participants and researchers can create barriers to the development of a meaningful relationship. For example, First Nations peoples have expressed concern about researchers from other cultures coming into their communities to collect data that are not meaningful or useful for the people of the community, and then using the data to further their own agendas or careers (Smith, 1999). Boys et al. (2003) describe their use of former or current drug users as interviewers in research on drug and alcohol use as an example of how social researchers employ persons who share characteristics with the study population as a way to both increase data accuracy and develop and maintain rapport with the researcher and commitment to the study.

Finally, a number of practical factors related to retention impact the relationship between researcher and participant. Sullivan (2004) categorizes these factors as either logistical (such as lack of time or resources or an unstable research team) or personal (such as level of concern for participants or level of interest in the research question). These factors may be more important for studies that are of long duration.

Strategies Related to the Study

Models used traditionally to structure study protocols have been drawn from agricultural research and do not translate well into human health and social contexts (Gross & Fogg, 2001). Many components of the research process, such as rigorous sampling, detailed measurement, and complex treatment, place an undue burden on participants. A retention strategy related to the study itself is to develop interventions and procedures that take the needs and resources of participants into account. In addition to the development of a detailed recruitment and retention protocol, Good and Schuler (1997) recommend individualization as a key strategy, particularly for clinical studies in which researchers have to deal with continuously changing patient conditions and environmental conditions. Individualization should be used cautiously and with consideration of its effect on the experimental nature of the study outcomes.

An interface between participants and the study is the determination of what constitutes a significant outcome. What is significant to the researcher may be markedly different from what is significant to the participant. For example, participants in a cancer therapy trial may feel that the study has been successful not only because the treatment has been effective for them but also because they have played a part in research that may help others. Gross and Fogg (2001) state that participants may be less interested in the fact that they achieved a measure of improvement on a testing score than in the fact that they achieved greater ability to function independently in their home.

It may be helpful to shift perspectives in study design: instead of blaming attrition on participant factors, design studies in such a way that participants are able to complete the protocols. A body of literature that may be useful in effecting this shift is the post-colonization and indigenous research literature. This work focuses on deconstruction of the privileged Western approach to knowledge development and promotes the development of methodologies that transform research into a pursuit that gives greater voice to participants (Smith, 1999). This approach is consistent with an ecological one in that it incorporates the influences of each layer and returns ownership of research knowledge to the participants.

Strategies Related to the Environment

Not all determinants of attrition are under the researcher's control, and contextual issues have not, traditionally, been routinely considered in retention planning. In the ecological model of research participation, contextual or environmental considerations include those related to philosophical, disciplinary, organizational, practice, political, geographical, and funding issues.

Geographic location plays a role in participation rates. Jacobsen (2004) examined the relationship, and its effects on attrition, between the location of the client's residence and the location of the treatment program. He describes the "treatment ecology" of a study as including neighbourhood quality, community resources, and travel burden. Cooley et al. (2003), in a US national study of quality of life among women with lung cancer, noted geographically unique recruitment and retention issues. For example, participating researchers in the southern part of the United States encountered specific challenges such as a distrust of research, competing health and family demands, and low literacy levels. Researchers reported the need to strengthen outreach retention strategies and to adapt them to the geographically different needs of the population.

Political and media-related factors also contribute to the level of interest in research participation. Tolomiczenko and Goering (2000) encountered a high level of distrust among stakeholder groups during the design and conduct of a study describing pathways into homelessness in Toronto. Recent political actions, including regional amalgamation, cutbacks to social funding, shifting of social housing responsibilities, and increased police attention, had made staff who work with the homeless population more protective of their clients. Paine, Stocks, Ramsay, Ryan, and MacLennan (2004) investigated the impact of the alarming media coverage of the Women's Health Initiative in the United States, which reported increased health risks for women receiving long-term hormone therapy (HT). In their own HT longitudinal study in Australia, Paine

et al. found that despite extensive study-related counselling many participants chose to stop their HT. Researchers need to not only monitor conditions within their own institutions and programs, but also be cognizant of external events that may play a role in participants' perceptions of the study.

Conclusion

Loss of participants is a constant in longitudinal studies. Despite the increasing availability of sophisticated statistical tools to manage missing data, there is still no substitute for a study design that ensures a high level of participation. If the phenomenon of attrition is built into the theoretical, conceptual, and methodological design, the potential for maintaining the integrity of the study will be increased. By promoting standard reporting for attrition, we will ultimately increase our confidence in the theories developed from longitudinal studies. Researchers might consider routinely reporting all attrition-relevant data (rates, description of inclusion and termination criteria, distribution of the cases that terminated early, and why) in outcome-related studies, to help the reader assess the validity of the study and to enhance the utility of future meta-analyses. Just as the issues of ethics, gender, and culture have become standards of reporting in recent years, routine reporting of attrition data will advance the rigour of nursing research (Sifers et al., 2002).

A participant-centred approach and an ecological model of research participation can potentially be a starting point for development of contemporary theories of attrition. Ultimately, "the consequences of not pursuing attrition research will be reflected in greater numbers of treatment failures, higher program costs, and continued impairment of research interpretation" (Harris, 1998, p. 9).

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